PHYTOAVAILABILITY, DYNAMICS AND PARTITIONING OF SOME HEAVY METALS IN VEGETABLE FARMSOILS IN ILORIN METROPOLIS.

BY

BEN-UWABOR, PATIENCE OLAYINKA

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BEING A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D.) IN PLANT BIOLOGY (PLANT DIVERSITY AND ENVIRONMENTAL MANAGEMENT) IN THE DEPARTMENT OF PLANT BIOLOGY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF ILORIN.

SUPERVISED BY: PROF P.O. FATOBA

CERTIFICATION

I certify that the findings reported in this thesis were conducted under the supervision of Prof. P. O. Fatoba, Department of Plant Biology, University of Ilorin. The thesis has been read and accepted as meeting the requirement of the Department of Plant Biology.

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Prof. P.O. Fatoba

Supervisor

………………………………………………………………………………………………….

Dr. AbdulRahaman

Head of Department.

Examined this…………………………..day of ……………………………………….2018

External Examiner………………………………………………………………………

DEDICATION

This research work is dedicated to the Almighty God and the vegetarians in Ilorin metropolis.

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ABSTRACT

Vegetables are food materials that provide vitamins, minerals and fibres. These plants are raised during dry season (irrigated) and rainy season (rain fed). Anthropogenic activities involved in the raising of vegetables have been of great concern. There is little or no available information on the safety and qualities of irrigated vegetables. The objectives of this study were to: (i) determine

the total heavy metal (HM) load in some farm soils and water; (ii) determine the phytoavailable heavy metals in soil; (iii) determine the heavy metal fractionation; (iv) determine available heavy metals in the vegetables; (v) investigate the heavy metal transfer and pathway in the vegetables; and (vi) evaluate the effects of the agronomic activity on the nutritional value of vegetable accessions.

The HM contents of the soil and water were determined using Atomic Absorption Spectrophotometer. Five vegetable accessions: *Amaranthus hybridus* (NG/AA/03/11/010, NG/AO/11/08/039 and NGBO125) and *Corchorous olitorius* (NG/OA/Jun/09/002, NG/OA/04/010) obtained from National Centre for Genetic Resources and BioTechnology, Ibadan were planted in different soils and irrigated with water collected from the different sites. The HM and the proximate analysis of vegetables were carried out. Data generated were subjected to Analysis of Variance and the means separated by Duncan Multiple Range Test set at 5% level of significance.

The findings of the study were that the:

i. range of heavy metal content of soils (mg/kg) and water (mg/l) respectively, were: 0.21-4.67 and 0.00-2.75 (Cd); 1.40–4.79 and 2.41-30.08 (Cu); 1.29-11.67 and 5.25-82.00 (Pb) in soils (mg/kg) and 0.00-0.07 and 0.00-0.07 (Cd); 0.00-0.34 and 0.52-1.68 (Cu); 0.04-0.63 and 0.21-0.54 (Pb) for dry and rainy season respectively;

ii. phytoavailable HM range in soils (mg/kg) were: 0.11-0.67 and 0.00-0.13 (Cd), 0.17-3.86 and 1.80-9.25 (Cu) and 0.50-5.83 and 0.276.25 (Pb) for dry and rainy, respectively;

iii. range of soils HM fractionation were: 0.00-1.67 and 0.00-1.17 (Cd); 0.21-6.67 and 0.00-11.67 (Cu) and 0.00-7.33 and 0.00-18.33 (Pb).

iv. available HM in the accessions were: 0.00-1.67 and 0.00-1.17 (Cd); 0.17-6.97; 0.00-23.00 (Cu); 0.00-6.67 and 0.00-18.33 (Pb) for dry and rainy season, respectively. However, most accessions accumulated Cd and Pb above the European Union (EU) and WHO/FAO standards for vegetables;

v. five vegetable accessions were good accumulators of Cd, Cu and Pb with bioaccumulation coefficient of accessions greater than 0.5; and

vi. accessions had 6.18-10.14% (H_2O); 1.21-5.56% (ash), 3.19-5.38% (crude fat and oil); 6.26-21.55% (crude protein); 1.07-2.58% (crude fibre) and 62.71-76.83% (crude protein) and 6.53-9.44% (H_2O); 1.06-7.14% (ash); 2.84-5.83% (crude fat and oil); 7.02-23.50% (crude protein); 0.93-4.60% (crude fibre); 58.19-75.18% (carbohydrate) in dry and rainy season, respectively. However, the soils and water used made Cd, Cu and Pb more significantly ($p<0.05$) available to the vegetables.

The study concluded that soil and water used for raising vegetables are sources of HM pollution which can lead to health hazard. Farmers should therefore, be advised and encouraged to use treated wastewater for irrigation.

CHAPTER ONE

INTRODUCTION

1.1: Background of study

Soil is very important natural resource which sustain the agricultural activities and civilization of mankind (Brady and Weil,1999). They are the major reservoirs of heavy metals which are released as a result of human activities like domestic waste disposal, agricultural practices, products of mining, vehicular exhaust emission, solid discharge and industrial discharges and effluents, gas flaring, insecticides and pesticides, municipal wastes and practices of fertilizer application, spillage of petrochemical and combustion of coal, fossil burning, combustion of coal e.t.c (Afzal shaliet, 2013). These heavy metals are not biodegradable and their concentrations vary from soil to soil (Hazard, 2012). Examples are mercury, nickel, zinc, copper, chromium, lead, iron, cadmium and arsenic. Accumulation of heavy metals in the soil over a period of time may lead to excessive uptake of these elements by plants (Garcia and Millan, 1995). Bioaccumulation of metals in tissues and leaves of edible vegetable plants had been reported to pose serious health risks (Ferré-Huguet, 2008).

Ying *et al*. (2013) reported that, the presence of high levels of metals in plants' tissues has toxic effect on animals especially when consumed. Metals like zinc and copper are trace metals because they are needed in minute quantities in animal and human, and are essential for plant and animal growth and development, but at a high concentrations can lead to toxicity in plants and animals (Boularbah, 2006). High doses of copper are associated with liver and kidney damage, anaemia as well as irritation of the intestine and stomach (Gray,1999), whereas, high doses of zinc in the soil inhibit the breakdown of organic matter by influencing the activities of microorganisms and earthworm in the soil (Ma and Rao, 1997) which in turn could result to feeble plant growth and yield depression (Ying *et al*.,, 2013). Toxic metals such as mercury, cadmium, lead and arsenic are not essential for either plant, human and animal growth but constitutes health risk especially when they go into the food chain (Benson and Ebong, 2005). Consumption of leafy vegetables, fruits and other food items is a main route of toxic heavy metals exposure to human and other animals (Boularbah, 2006).

High level and longtime exposure to Lead have been reported to be associated with renal damage, death, gastrointestinal tract and central nervous system disorder (Erwin and Ivo,1992). Arsenic toxicity has been associated with skin damage, circulatory system disorder and high risk of cancer while mercury, a toxic and non-degradable metal is associated with brain, lungs and kidney damage whereas bioaccumulation of cadmium in the kidneys has been reported to cause permanent damage to the kidney (Singh *et al.*, 2010). It has been reported by Iwegbue *et al.* (2006) that, metals have excellent ability to be absorbed and assimilated by plants through root and foliar systems through filtration, adsorption and cation exchange or stabilization. Different plants species have different abilities to absorb and transport metals at different environmental and soil conditions which enhance phytoremediation of soil (Zhuang *et al*., 2009). The solubility and the kinetics of simple ions adjacent to roots have been reported by Rodriguez *et al*.(2002) to determine greatly the phyto availability of heavy metals in the soil. The negative effect of heavy metals in water and soil from the careless disposal of industrial, domestic and agricultural wastewater without treatment in compliance with the safe and standard disposal regulatory limit on agricultural lands, into rivers, stream and lakes as reported by Burmamu *et al* .(2014), are sources of pollution and are of great concern.

As a result of the severe consequences brought by the heavy metal pollution in soil, Hong *et al.*(2014), reported the urgency and necessity to prevent and remedy the contamination. The migration, distribution, dynamics, phyto availabilty, transformation behavior and rules of heavy metals in soil must be well studied in order to make an accurate assessment of contamination level at each site (Hong *et al*., 2014). Heavy metals once in soil, are persistent because of their immobile nature, while other metals would be more mobile, therefore have the ability to transfer through soil infiltration down to ground water to plant – root uptake and subsequent transfer into the food chain, to cause biochemical defects in body organs like liver, kidney, spleen and lungs is highly likely to occur (Jacob, 2010).

Heavy metal contamination assessment in agricultural soil is of major importance because of the potential to accumulate in soil for a long period of time (Iwegbue *et al*., 2006). High concentration of metal ions in soil environment may be of a high risk to the quality of soils, plants, natural waters and human health and the excessive accumulation of heavy metals in agricultural soils may result not only in soil contamination but also affect the food quality and public health safety issues (Jan *et al.*, 2010). Evidence of heavy metal contamination or pollution of agricultural soils and uptake of the heavy metals in vegetables and fruits in Romania and Brazil were reported by Lacatusu (2008) and Guerra *et al.* (2012). They further added that the toxic effects of some heavy metals in vegetables like Cu and Pb focus on several human body organs such as liver, kidneys, spleen and lungs causing a variety of biochemical defects. Owing to the high significant effects and consequences of heavy metals to the environment, plants and animals, it is essential to monitor heavy metal contamination or pollution levels of irrigated vegetable farm soils in Ilorin metropolis in order to reduce the possible transfer of these metals into irrigated crops. Agriculture in Ilorin metropolis is dominated by small–scale farmers who produce about 80% of the total food requirement (Fayinka, 2004).

Adequate production of vegetables like okro, tomatoes, green vegetable, leafy vegetable, melon, lettuces, carrot, cabbage e.t.c which are consumed in many parts of the country are the main practice of these small scale-farmers which had contributed positively to the agricultural sector and also play an important dietary role in all parts of Africa (Sharma *et al.*,2008b). Migration of people from one area to another will lead to an increase in population of such areas. To sustain the migration process, people will require food and vegetables but the rain-dependent rural system of agriculture cannot continuously provide requisite food and vegetables all year round (Muchuweti *et al.*, 2006). The above constraints coupled with the serious need to ensure food sufficiency and extra income by low-income peri and urban peasants, agricultural activities in the area has become a necessity, such agricultural practice is usually carried out on vacant land, uncompleted buildings and strips of land along major and minor rivers which can either be wet, dry season or all season farming (Baird, 2002). Soils in peri urban and urban areas such as Ilorin are usually contaminated with different types of pollutants from different activities of men and products of industries which include domestic wastes, pesticides, products of mines, oil spillages from mechanic’s workshops, generating sets, petrol stations, vehicular emission, domestic wastes, industrial emission, etc. all which contain heavy metals (Lokeshappa, *et al.*, 2012).

The development of human activities and industrialization in peri urban and urban areas has led to an increased accumulation of these heavy metals in the soil, water and air (Sakagami *et al*., 1982). Plants are grown on these same contaminated soils which may result into the transfer and accumulation of these pollutants into the plants. Heavy metal contamination of foods and vegetables cannot be underestimated as these foodstuffs are important components of human diet (Sobukola *et al.*,2010). Vegetables are rich sources of vitamins, minerals, and fibers, and also have beneficial anti oxidative effects (Sharma *et al*.,2008 a). However, intake of heavy metal-contaminated vegetables may pose a risk to the human health as heavy metal contamination of the food items is one of the most important aspects of food quality assurance (Intawongse and Dean, 2006). Heavy metal contamination of vegetables has been a concern and an important aspect of food safety and quality assurance (Sharma *et al*., 2006). There is a growing concern about the possibility of soil contamination resulting in the uptake by vegetables and the introduction of the elements in vital food chains affecting food safety indirectly (Jawad,2010).

The knowledge of the buildup of metals in the soils of cultivated areas is important to recognize potential ecological problems (Singh *et al.*, 2012). Absorption and accumulation of heavy metals in vegetables and fruits can cause a serious depletion of some essential nutrients in the body causing a decrease of immunological defenses and disabilities associated with malnutrition and a high prevalence of upper gastrointestinal cancer (Oluwatosin *et al*., 2010). Oliver (1997) reported that soil and vegetables contaminated with Pb and Cd in Copsa Mica and Baia Mare, Romania, significantly contributed to decreased human life expectancy (9-10 years) within the affected areas. Cd and Pb are the most toxic elements for man as reported by Volpe *et al.* (2009). Other elements such as Mn, Zn and Fe, although essential for human but at concentrations higher than those recommended may cause metabolic disorders (Ying *et al.*, 2013). Moreover, an increasing awareness in terms of the importance of vegetables to human diet suggests the monitoring of heavy metals in food crops which should be carried out frequently (Ferré-Huguet *et al*., 2008).

Little knowledge is available on the dynamics of heavy metal, bioavailabilty and the associated health risks for consumers in Ilorin metropolis (Okunola *et al*., 2007).

1.2 PROBLEM STATEMENT

Soils in Ilorin metropolis are contaminated with different pollutants from anthropogenic activities and from products of industrialization; yet, these same soils are used for agricultural purposes. These pollutants get transferred into plants through soil, water and air which enter into animal and mans' body system via food chain (Intawongse and Dean, 2006). Industrial developments and anthropogenic activities of men have contributed to the high levels of heavy metals contamination in the developing countries, such as Egypt (Radwan and Salama, 2006), China (Wong, 2003) and India (Sharma, 2008a and b).

The global concentration of population is increasing due to migration from rural areas to peri urban areas like Ilorin metropolis. To sustain the processes, people will require food and vegetables. The rain-dependent rural system of agriculture cannot continuously provide the required food and vegetables all year round which prompted the need for irrigation farming system in order to support the supply of vegetables in the area (Obadan, 2002). The development of human activities and industrialization in Ilorin metropolis, had led to an increased accumulation of heavy metals in the soil, water and air (Kabata-Pendias, 2011).

Soils, water and air in the developing areas have been confirmed by many researchers to be contaminated with different types of pollutant, of which heavy metals are a major category of these pollutants which enter the plants through the soil, water or air (Adriano, 2001; Tijani *et al.*, 2004 and Hong *et al.*,2014). Anhwangbe *et al.*(2007) reported that agricultural practices like fertilizer application, anthropogenic activities of man and treatment with pesticides increase the concentrations of heavy metals in the soils, and have become a serious problem because they could enter into food chains and cause harm to human and animal health. Absorption and accumulation of heavy metals in vegetables and fruits can cause a serious depletion of some essential nutrients in the body causing a decrease in immunological defenses, disabilities associated with malnutrition and a high prevalence of upper gastrointestinal cancer (Chabiri *et al.*, 2009).

1.3: JUSTIFICATION

Previous projects had been carried out to asertain different levels of the heavy metals in soils and water samples but this project specifically targets heavy metals in selected vegetables grown and irrigated with water sources from different Farmlands in Ilorin metropolis of Kwara State, Nigeria.

1.4: AIM

The study was aimed at investigating the availability and uptake of heavy metals by vegetables raised through the irrigation with river water in Ilorin Metropolis.

1.5: RESEARCH OBJECTIVES

The objectives of this study were to÷

i) determine the total heavy metal load in some farm soils in Ilorin metropolis;

ii) evaluate the phytoavailable metals in soil;

iii) assess heavy metal partitioning in soils (fractionation);

iv) determine the bioavailability of heavy metal in the vegetables;

v) assess the transfer and pathway of metals in vegetables (dynamics); and

vi) evaluate the effects of the pollution on the nutritional value of the vegetables

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CHAPTER TWO

LITERATURE REVIEW

Soil is a natural, complex and variable living medium which is a mixture of minerals, organic matter, gases, liquids, and many organisms that together support plant life (Oliver, 1997). It is a habitat that serves as a platform for human activities, a reservoir of water storage, supply and purification, a recycling system for nutrients and organic wastes, as an engineering medium, a habitat for soil organisms, a regulator of water quality, a modifier of atmospheric composition, and a medium for plant growth landscape and heritage and acts as a provider of raw materials (Rayment and Higginson, 1992). Soils support varities of inorganic and organic chemical reactions which dependent on some particular soil chemical properties like the soil acididty, organic matter and pH (Obrador *et al.,* 2007).

Soil contamination is caused by the presence of human-made chemicals or other alterations in the natural soil environment. It occurs when humans introduce harmful objects, chemicals substances, directly or indirectly into the soil, air or water (Lokeshwari and Chandrappa, 2006). Contamination of soils are usually caused by industrial activity, agricultural chemicals, improper disposal of wastes and lots more. The most common chemicals involved are petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (such as naphthalene and benzo (a) pyrene), solvents, pesticides, lead, and sources of industrialization and intensity of chemical usage which all generate heavy metals (Raymond and Okieimen, 2011). Natural sources of pollution or contamination include, dead plants, carcasses of animals and rotten fruits and vegetables which add to the fertility of the soil. However, waste products are full of chemicals that are not originally found in nature which lead to soil contamination (Xiong, 1998).

The concern over soil contamination are primarily from health risks from direct contact with the contaminated soil, vapours from the contaminants, and from secondary contamination of water supplies within and under the soil (Oliver,1997). Soil contamination affects plant growth as the ecological balance of any system gets affected due to the widespread contamination of the soil rendering most plants unable to adapt when the chemistry of the soil changes so radically in a short period of time (Carl, 2012). It slowly diminishes the soil fertility, making land unsuitable for agricultural purposes and decreasing crop yield (Qadir *et al*., 2000). The contaminated soils produce fruits and vegetables which lack quality nutrients and may contain some poisonous substances which may cause serious health problems in people consuming them (Rapheal *et al*., 2011). Crops and plants grown on contaminated soil absorb much of the pollutants which are passed on to man in the food chain. (Ferré-Huguet *et al*., 2008). Long term exposure to polluted soil can affect the genetic make-up of the body, causing congenital illnesses and chronic health problems that cannot be cured, infact, it can sicken the livestock to a considerable extent and cause food poisoning over a long period of time easily (Agarwal *et al*.,2010). Soil contamination can even lead to widespread famines if the plants are unable to grow in it.

Heavy metals abound in the environment, as a result of both natural and anthropogenic activities, and humans are exposed to them through various pathways, especially food chain (Herawati *et al*., 2010). Cd and Pb are the most toxic elements for man (Ying *et al.,* 2013). In terms of environmental concentration, Pb is the heavy metal closest to the level in which toxic signs manifest than any other substance (Iwegbue *et al*.,2013). Other elements such as Cr, Co and Ni, although essential for men, at concentrations higher than those recommended, may cause metabolic disorders (Fabbri *et al*., 2001).

Heavy metal is any metallic chemical element that has a relatively high density, toxic or poisonous at low concentrations and occurs naturally in the environment, but anthropogenic contributions raise natural concentrations (Kabata-Pendias, 2001). They can also be referred to as atoms of elements found naturally in disturbed and unpolluted soils whose small amounts are required by plants to remain healthy (Hawkes, 1997). They are a member of an ill-defined subset of elements that exhibit metallic properties, which would mainly include the transition metals, some metalloids, lanthanides, and actinides (Awofolu, 2005). They include transition metals with higher atomic weight metals of group 111 to V of the periodic table, such as mercury, lead, cadmium, aluminum, cobalt, copper, selenium, chromium iron, lead, manganese, molybdenum, silver, antimony, arsenic and these metals are the cause of environmental pollution (heavy-metal pollution) from a number of sources, including lead in petrol, industrial effluents, and leaching of metal ions from the soil into lakes and rivers by acid rain (Hong *et al*., 2014).

Many different definitions of heavy metals have been proposed, some based on density, some on atomic number or atomic weight, and some on chemical properties or toxicity. Heavy metals such as zinc, copper, and nickel are necessary in trace amounts, but toxic in elevated amounts, while others, like cadmium, lead and arsenic are toxic at any level (Wilson and Pyatt, 2007). They are difficult to metabolize and so can easily build up in organisms by a process called bioaccumulation (De Miguel *et al*., 1998). They cannot be degraded or destroyed (Carl, 2012). They enter human bodies via food, contaminated water (e.g. from lead pipes), high ambient air concentrations near emission sources, or intake via the food chain, Inhalation and dermal uptake are both exposure routes, but ingestion is the most common source (Finster *et al*., 2003). They are dangerous because they bioaccumulate in the body of an organism, that is, they increase in the biological organism over time, compared to their concentrations in the environment. They are very harmful because of their non-biodegradable nature, long biological half-lives, accumulated when taken up and stored faster than they are broken down (metabolized) or excreted and their potential to accumulate in different body parts (Micó *et al.*, 2006).

Some heavy metals are toxic while some do not have significant toxic properties, like iron, copper, zinc and cobalt which are essential to maintain the metabolism of the human body, essential micronutrients for animals, plants and many micro-organisms but at higher concentrations can lead to poisoning (Micó *et al.*, 2006). Most of the heavy metals are extremely toxic because of their solubility in water and even at low concentrations have damaging effects on man and animals because there is no good mechanism for their elimination from the body (Opaluwa *et al*., 2012). Heavy metals also get accumulated in agricultural soils through wastewater irrigation which not only result in soil contamination, but also affect food quality and safety (Iwegbue *et al*.,2013). All heavy metals demonstrate toxic effects on living organisms by interfering with the metabolic activities of the body. Heavy metals can enter a water supply by industrial or from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater (Arora, *et al.*, 2008). The most common heavy metals found at contaminated sites is usually in the order of Pb, Cr, As, Zn, Cd, Cu and Hg (Levy, 1992). These metals reduce crop production due to the risk of bioaccumulation, biomagnifications in the food chain and the risk of superficial and ground water contamination (Hong *et al*., 2014).

The knowledge of the basic chemistry of environmental and associated health effects of these heavy metals is necessary to understand their speciation, bioavailability and remedial options as the pattern of transport of heavy metals in soil depends significantly on the chemical form (Burmamu *et al.*,2014). Heavy metal are absorbed by the initial fast reactions which are redistributed to different chemical forms with carrying bioavailability, mobility and toxicity (Lokeshwari and Chandrappa, 2006). Biological immobilization, mineral precipitation, absorption, desorption, dissolution, aqueous compellation and ion exchange are processes reported to control the reaction of heavy metals in soil (Jacob, 2010).

The soil nutrient transformation, microbial activities and microbial population in the ecosystem have been reported to be reduced in a cadmium contaminated soil (Raymond and Okieimen, 2011). It is further reported that, Cd shows a severe effect in seedling length and dry weight, causes structural changes in the chloroplast and also reduces photosynthetic activities in plant (Verkleji, 1993). High concentration of Cd in the soil is reported to be associated with parent materials which are majorly manmade like burning of fossil fuel, industrial waste such as effluent from iron steel processing, sewage sludge and application of fertilizer (Oliver, 1997). Nigeria as a country is experiencing different forms of environmental pollution which are discharged from various sources which tend to litter the environment. Awofolu (2005) reported that toxic heavy metals constitute pollutants of concern in the environment, and one of such metals is lead which can be obtained from petrol, paint, building materials, industrial emissions which are distributed through different pathways : air; dust; and soil (Samaila *et al.*, 2011).

World Bank report showed that 80% of children in the urban areas whose ages are between 3 and 5years have been suspected to have Pb in their blood (Burmamu *et al*., 2014). Nervous system and brain damage are traceable effects of Pb in human system (WHO. 2013). Copper is one of the essential micro nutrients necessary for plant and animal growth. In human, it helps in the production of blood hemoglobin while it is required in the production of seed, water regulation and disease resistance in plant (Kudirat and Funmilayo, 2011) but when it exceeds a particular concentration in the plant or animal' bodies it constitutes a health risk (Guerra *et al.*,2012). It is the third most widely used metal in the world and the sources of copper contamination include drinking water from the pipe, from additives for algal growth control e.t.c.

(Dinelli and Lombini, 1996). Although, Cu as a micronutrient essential for growth, its increased level in the body will lead to health risks such as kidney damage, stomach and intestinal irritation, liver damage and anaemia (Tchounwou *et al*., 2004). Cu interaction with the environment is complex and research shows that most copper introduced into the environment rapidly becomes stable and results in a form that does not pose risk in the environment (Ghosh, 2012).

One of the most common and widely studied contaminants is Lead because of its spectrum of use: production of lead-based paints, automobiles, oil refineries, lead-acid battery production, and antiknock in petrol~~s~~. Metals occur naturally in the environment but due to industrial revolution via technological advancement, metals' concentrations in the environment are becoming increasingly high. Urban areas, that is, cities, with automobile activities like mechanic workshops, major road systems, vehicular emissions, mining industries, agricultural activities e.t.c. are areas of elevated metals concentration which contaminate the environment by discharging the pollutants from the various activities into the environment (Yusuf and Osibanjo, 2006).

Cu surplus had been associated with liver damage, Zn may produce adverse nutrient interactions with Cu. Zn also reduces immune function and the levels of high density lipoproteins Other metals like Pb and Cd are toxic even at low concentration. Pb has been reported to induce renal tumours, reduces cognitive development, and increase blood pressure and cardiovascular diseases in adults while Cd was reported to induce kidney dysfunctions, osteomalacia and reproductive deficiencies (Lokeshappa *et al*., 2011). Waste water irrigation, solid waste disposal, sludge applications, vehicular exhaust and industrial activities are all major sources of soil contaminated with heavy metals (Iwegbue *et al*., 2013). An increased metal uptake by food crops, vegetables and fruits grown on such contaminated soils is often observed in wide world and has posed a lot of concern in recent time due to heavy metals build up in large quantities enough to cause potential health risks to the consumers (Ghosh, 2012). In order to assess the health risks, it is necessary to identify the potential of a source which introduces risk agents into the environment, to estimate the amount of risk agents that come into contact with the human-environment boundaries, so as to be able to quantify the health consequences of the exposure (Iwegbue, 2013). The soil and plant contaminated with heavy metals have been proved in various studies, especially in North and Central part of Romania, and less in the South west part, and had been reported that plants accumulate heavy metals in different parts of their bodies (Lokeshwari and Chandrappa, 2006). Some accumulate heavy metals in their harvestable parts like in the shoots or roots in low concentration (excluders), some accumulate in a low to high soil contamination (accumulators), some accumulate heavy metal causing an external response from the internal heavy metal accumulated (indicators) and some in a very abnormal high proportion (hyperaccumulators) (Greger, 1999). Heavy metal accumulation are also characterized by a shoot-to-root heavy metal ratio (bioaccumualation coefficient (BAC) $\geq$ 1 are hyperaccumulators, BAC$\geq$0.5 are accumulators, BAC$\leq$0.5 are excluders (Li *et al*., 2008).

One of the identified greatest challenges facing the production of food through irrigation today is the contamination or pollution of water, air and soil which are all factors that support plant growth (Hong, 2014). The indiscriminate disposal of industrial, domestic and agricultural wastewater without treatment to comply with the safe and standard disposal regulatory limit on agricultural lands, into rivers, stream and lakes are the obvious pollution type that are of serious concern due to the negative effect of heavy metals in water and soil into the environment and also a medium on which agricultural crops are produced and the possibility of these crops to take up these metals (Ghosh *et al*., 2012). Heavy metals once in soil becomes persistent because of their immobile nature, while some would be in mobile state, therefore the potential of transfer of these metals through soil infiltration down to ground water to plant – root uptake and finally into the food chain, to cause biochemical defects in body organs like liver, kidney, spleen and lungs is likely to occur (Singh *et al*., 2010).

Heavy metal contamination levels in agricultural soil are of major significance because of the potential to accumulate in soil for a long period of time (Iwegbue, 2013). High concentration of metal ions in soil environment is of a significant risk to the quality of soils, plants, natural waters and human health (Wu and Zhang, 2010). Excessive accumulation of heavy metals in agricultural soils may result not only in soil contamination but also consequences for food quality and public health safety issues (Okunola, 2007). Evidence of heavy metal contamination or pollution of agricultural soils and uptake of the heavy metals in vegetables and fruits in Romania and Brazil were reported by Guerra. (2012) and Lacatusu (2008).

They further added that the toxic effects of some heavy metals in vegetables like Cu and Pb focus on several human body organs such as liver, kidneys, spleen and lungs causing a variety of biochemical defects (Burmamu *et al.,* 2014). The environmental burden with heavy metals are that they are non-degradable and most of them have toxic effect on living organisms when they exceed a certain concentration level either in water, soil or food substances (Hong, 2014). Metals in the environment are a global concern in recent time because the globe is said to be experiencing a silent epidemic of environmental poisoning from the amounts of metals released into the biosphere (Yilmaz and Zengin, 2004). Soil is a natural and very important component of rural and urban environments, but this natural resource is often contaminated by different activities of men (Burmamu, 2014). Urban soils contamination may come from various human activities, such as industrial and energy production, construction, vehicular exhaust, waste disposal, as well as coal and fuel combustion (Ying et al.,2013). These activities release heavy metals into the air and the metals get deposited into the soil. Sakagami (2013) reported that there was a close relationship between heavy metal concentrations in soils and those in the dust falls. Other contaminants include products of mining, manufacturing, and the use of synthetic products (e.g. pesticides, paints, batteries, industrial waste, and land application of industrial or domestic sludge).

Soils are dynamic media with various physico-chemical and environmental forces in them that influence metal conduction from the root to the shoot of a plant. These factors include: moisture, electrical conductivity, cation exchange capacity, organic matter, available phosphorus, nitrogen-nitrate content etc (Wang *et al.*, 2004). Mining, manufacturing, and the use of synthetic products like pesticides, paints, batteries, industrial waste, and land application of industrial or domestic sludge can also result in heavy metal contamination of urban and agricultural soils (Ogoko, 2014). Potentially contaminated soils may occur at old landfill sites particularly those in industrial areas, at old orchards that use insecticides containing arsenic as an active ingredient, fields that had past applications of waste water or municipal sludge, areas in or around mining waste piles and tailings, industrial areas where chemicals may have been dumped on the ground, or in areas downwind from industrial sites (Arora, *et al.*, 2008).

Vehicle exhaust particles, tyre wear particles, weathered street surface particles, brake lining wear particles, industrial emission (power plants, coal combustion, metallurgical industry, auto repair shop, chemical plant, etc.), domestic emission, weathering of building and pavement surface, atmospheric deposits etc were also reported by Brady and Weil (1999) as soil contaminants which occur in different forms and are associated with a range of different components which determine their phytoavailability, reactivity and transfer to plants. Not all the heavy metals in the soil are readily available to plant (phytoavailable) but may become available under some environmental influence like change in pH, redox potential, cation exchange capacity, organic matter content and, moisture content of the soil (Yadawe, 2011).

Potentially harmful metal contents in soils may come not only from the bedrock itself, but also from anthropogenic sources like solid or liquid waste deposits, domestic waste, agricultural inputs, and fallout of industrial and urban emissions (Wilson and Pyatt, 2007) which may result not only in soil contamination, but also have consequences on food quality and safety. It is therefore essential to monitor food quality, given that plant uptake is one of the main pathways through which heavy metals enter the food chain (Antonious and Kochhar, 2009). Ying *et al.* (2013) reported that monitoring of heavy metals in soils and food crops should be carried out frequentlybecause of the increasing awareness in terms of the importance of vegetables and fruits to human diet. Therefore, this study was taegetted at investigating the concentrations of Cd, Cu and Pb in some irrigated vegetables grown in Ilorin metropolis farmsoils. Plants are important natural components of ecosystems as they transfer elements from abiotic into biotic environments (Tack *et al.*, 2006). The primary sources of elements from the environment to plants are: air, water and the soil (Hamilton, 1995). They are exposed to many adverse environmental conditions like biotic and a biotic stress. Despite others stresses, heavy metal stress is of great importance which has a notable adverse effects on crop productivity and growth. Heavy metals trigger different responses in plants, ranging from biochemical responses to crop yield, therefore, distribution and availability of heavy metals to plants is important when assessing the environmental quality of an area (Meers and Samson, 2007). Not all the heavy metals in soil are readily available to the plants, therefore, the readily soluble fraction of the heavy metals in soil that are disposed to plants uptake are referred as phytoavailable heavy metals (McLaughlin, 1999). The phytoavailability of these heavy metals in soil, measures the dynamics or mobility of their distribution which determines the level of contamination in plants and the degree of health risks as they are consumed via food chain (Alloway, 1995; Davis *et al*., 1992; Katabata-Pendias, 2004). It has been established that the total concentrations of metals in soil does not provide information about its phytoavailability (Hajeb, *et al*., 2014). The chemical form in which metals are presented in soil, as well as the physical and chemical characteristics of the environment, determine their phytoavailability, mobility, and reactivity for absorption. Phytoavailability is a complex function of many factors including total concentration and speciation of metals, mineralogy, pH, redox potential, temperature, total organic content and suspended particulate content, volume of water, water velocity, and duration of water availability, especially in arid and semi-arid environments. The accurate estimation of metal phytoavailability in soils and solid wastes is important in risk assessments (Yadawe, 2011). Risks associated with polluted soils are contamination of the food chain which are closely related to the phytoavailability of toxic elements, that is, ability to enter the different compartments of the food chain and primarily the availability to plants which in turn are controlled by the metal ion speciation in the soil (Alloway, 1995; Davis *et al*., 1992 and Katabata-Pendias, 1993).

The risks of heavy metal transfer into the food chain are dependent on the mobility of their metal species and availability in the soil (Zhuang *et al*., 2009). Plants respond only to the fraction that is readily available to them. The phytooavailability of elements to plants is controlled by many factors associated with soil and climatic conditions, plant genotype and agronomic management, including: active and passive transfer processes, sequestration and speciation, redox states, the type of plant root system and the response of plants to elements in relation to seasonal cycles (Kabata and Pendias, 2004). Water-soluble metal ions can be easily mobilized and may be considered as highly phytoavailable. Studies had also reported wind transport and removal from the atmosphere by rainfall as factors to consider in heavy metal phytoavailability in soil and many of these factors vary seasonally and temporally, and mostly are interrelated (Singh *et al.*, 2012). Changing one factor may affect several others and poorly understood biological factors seem to strongly influence bioaccumulation of metals and severely inhibit prediction of metal bioavailability (Richard *et al*., 2000).

Detailed legal directives precisely define the permissible content as standard or acceptable level of elements in plants for consumption (Singh *et al*., 2012). In Poland, the critical contents of heavy metals were assessed by The Institute of Plant Protection in Poznan, Poland, regulating the agricultural applicability of plants used as food (Cd 0.2, Zn 50, Pb, 1.0, Ni 10, As 0.20 mg/kg) and feed (Cd 0.5, Zn 100, Pb, 10, Ni 25, As 0.20 mg/kg) (Pilc, 1994). (Singh *et al*., 2012) (Zhuang *et al*., 2009).

The nature of heavy metals, its association with other soluble species and the soil ability to release the metal from the solid phase to replenish the one removed from soil solution by the plants depend on the soil properties (Huang and Gobran, 2005, Krishnamurti., 2007 and Krishnamurti and Naidu, 2002)tents of organic matter, carbonates, oxides, structure and profile (Huang and Gobran, 2005, Krishnamurti., 2007 and Krishnamurti and Naidu, 2002). The transport of dissolved elements in soils depends primarily on their concentration gradient and the mass flow of water (Qadir *et al*., 2000). Mobility and plant uptake of elements move through the solution phase which depends not only on its activity in the solution, but also on the relationship existing between solution ions and solid phase ions (Lokeshappa *et al*., 2012).

Plants take up essential and non essential elements from soils in response to concentration gradients inducted by the selective uptake of ions by roots, or by diffusion of elements in the soil and micronutrients, oxidation-reduction potential, activity of microorganisms, bioavailability of plants and animals in soil, quantity and type of clay minerals, the content of the oxides of iron, aluminum and manganese, and the redox potential which determines the soil's ability to retain and immobilize metals (Mwegoha and Kihampa, 2010). Heavy metal phytoavailability is regulated by physical, chemical, biological processes and interactions between them and the mechanical composition of soil content in plant tissues. Increasing the amount of organic matter in the soil, helps to minimize the absorption of heavy metals by plants and the accumulation of heavy metals by plants and the transfer coefficient is a function of both soil and plant properties (Vogeler, 2009). Plants have proven to be particularly effective for both bioremediation of metal contaminated sites and for studying the uptake, transport and toxicity of metals (Volpe *et al*., 2009).

The transport and cell wall diffusion theory of plant root uptake of heavy metals is similar to processes governing other minerals in solution due to availability at the root surfaces being limited by diffusion of the cations, the interception of growing roots, and mass transport of solute flowing toward the root and driven by evapotranspiration (Sauerbeck, 1991). In the case of rapid root uptake, a depletion zone of the heavy metal may form near the root uptake sites, unless evapotranspiration and root growth rate overwhelm the diffusion process (Ferner, 2001). A variety of factors influence the rate of uptake by plant roots, these include: solubility of the chemical species, hydrogen ion concentration (pH), high concentrations of soil nutrients, like calcium, the precise species or valency of the heavy metal cation, mycorrhiza which is the result of a symbiotic relationship between plant roots and a fungus due to the presence of certain peptides, organic acids and polyphosphate grains in the mycelium of the organism and lots more (Obrador *et al*., 2007). Heavy metals are easily accumulated in the edible parts of leafy vegetables, as compared to grain or fruit crops (Mapanda *et al*., 2005). Vegetables take up heavy metals and accumulate them in their edible and inedible parts in quantities high enough to cause clinical problems both to animals and human beings (Lawal and Audu, 2011).

It has been reported that uptake of metals by plants grown in pots is greater than those raised on the same soil, without pot, this is because, the root of the container grown plant is grown solely in the contaminated soil while that in the field of the same soil may reach down to less contaminated soil (Benson and Ebong, 2005). A number of serious health problems can develop as a result of excessive uptake of dietary heavy metals (Raymond and Okieimen, 2011). There is a significant amount of filtering or rejection of unwanted heavy metals due to the architecture of the root tissues (Singh *et al.*, 2010). Once the heavy metal ion has penetrated the outer root membrane, it is forced to navigate the crossing of the Casparian strip, a waxy impregnated layer of the endodermis that forces all solutes diffusing across the root epidermis to enter before entering the xylem, which serves as a veritable freeway of solute transport driven by evapotranspiration which is a highly specialized filter mechanism to limit the inflow of harmful chemicals (Tome., 2003).

Efflux mechanisms also operate at the plant root surfaces to expel heavy metals from the plant which is governed by ionic diffusion, these elimination processes are very important in regulating the cellular concentrations of essential metals such as zinc (Kabata and Pendias, 1999). As in the case of root tissue, leaves also have a reverse process of efflux, where some stomata have shown this to be a mechanism for eliminating ionic mercury, by its conversion to gaseous form in the stomata and effluxing the resultant gas through the cuticle (Nuhu, 2000). The phenomenon is important when acid rain is deposited on leaf surfaces, there can be significant cation exchange with a result of expulsion of considerable amounts of heavy metals onto leaf surfaces, and eventual washing of the leaves by the precipitation due to high hydroid concentrations (Burmamu, 2014).

Vegetables

They are very important part of humans diet and sources of main nutrients like protein, vitamins, minerals and fibers (Edeoga *et al*., 2006). Vegetables consumption as food is reported to be the most rapid and simple means of providing nutrients such as vitamins, minerals, and fibers, protein and also have beneficial anti oxidative effects (Prabu, 2009). Examples of vegetables are amaranths, jute mallow, lettuce, cabbage, pumpkin, spinach, cucumber, bitter leaf.

Vegetables and heavy metals

The quality and safety of these vegetables are highly affected by heavy metal contaminations which is of great and global concern to many researchers because of the safety issues and potential health risks they pose when ingested either directly or indirectly (Burmamu *et al.*, 2014). Phyto availability of metal, that is, metal uptake and accumulation in vegetables are controlled by factors such as soil properties, species of plant and the efficiency of different plants in absorbing metals which is evaluated by either plant uptake or soil to plant transfer factors of the metals (Intawongse and Dean, 2006). The uptake of heavy metals in vegetables is likely to be higher due to the accumulation of these toxic metals in human body which has created growing and global concern in the recent days because of the inherent health risk (Wuana, 2013). Yusuf and Osibanjo (2006) reported that the major sources of these toxic metals are anthropogenic activities such as the domestic waste disposal, vehicular emission, exhaust discharge, addition of manure, sewage sludge, fertilizers, pesticides e.t.c. There are many literatures in respect of the occurrence of heavy metal accumulations in vegetables and these include: Anhwange *et al*. (2007), Cobb *et al*. (2000); Ebong *et al.* (2007); Farooq *et al*.(2008); Jawad *et al*. (2010); Lawal and Audu. (2011); Lokeshwari. (2006) and Sobukola *et al. (*2010). Another source of heavy metal contamination to vegetables is through irrigation.

Irrigation is the artificial application of water to the land or soil other than the natural rainfall (Galavi et al.,2010).It is used for protecting plants against frost, suppressing weed growth in grain fields, preventing soil consolidation, assist in the growing, maintenance and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall (Séguin *et al*., 2004). Sources of Irrigation water includes groundwater e.g springs or wells, surface water e.g lakes, rivers or reservoirs or non-conventional sources like, slugdes, treated wastewater, drainages, desalinated water, (Ferré-Huguet *et al.*, 2008). Owing to the high significant effects and consequences of these heavy metals to the environment, plants and animals, it is essential to monitor heavy metal contamination or pollution levels of irrigated vegetable farm soils in order to reduce the possible transfer of these metals into irrigated crops (Chary and. Raj, 2008). Heavy metal contamination of foods and vegetables cannot be neglected, as these food stuffs are important components of human diet that are rich sources of vitamins, minerals, and fibres, and also have beneficial anti oxidative effects (Sharma, *et al*., 2008a). However, intake of heavy metal-contaminated vegetables may pose a risk to the human health as heavy metal contamination of food items is one of the most important aspects of food quality assurance (Ramesh and Murthy, 2012); Opaluwa and Umar, 2010 and Radwan, 2006).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1: Study areas

The study area was Ilorin metropolis, the capital city of Kwara State. Ilorin was founded by the Yoruba, one of the three largest ethnic groups in Nigeria, in 1450 and it is in the Middle Belt of Nigeria which is part of the Southern Guinea Savannah zone with daily temperature as high as 37^0C (Oregun, 2001). It is located on Latitude $8^0 26'$ and Longitude $4^0 30'$and covers about 100 km^2(Onwalu and Ahaneku, 2006). It has a population of 814,192 and located at 290m above the sea level (Oyegun, 2001). Ilorin climate is characterized by rainy and dry seasons, the rainy season is between March and November with two peaks between March and July: and between August and late September while the dry season starts from November and ends in March, with the peak of dry season between November and January: and onset of dry season between January and late March (Onwalu and Ahaneku, 2006).The total rainfall ranges from 800mm to 1,200mm in the Northwest and 1,000 mm to 1,500mm in the Southeast of Ilorin (Oyegun, 2001).

Agriculture is one of the main source of the economy and the crop produced in Ilorin metropolis include: vegetables, beans, maize, cotton, yam and palm produce which could be produced during the rainy season or the dry season. The dry season farming is normally practised along the River bank using municipal effluent wastewater and river water to grow edible vegetables by farmers. Mineral resources in the state are gold, limestone, marble, clay, kaolin, quartz and granite rocks. Some industries in the town include Dangote Flour Mill, Lubcon Lubricant Company, Kam Industries Nigeria Ltd, Tuyil Pharmacy Nig. Ltd., Padson Industries Nig. Ltd., Resinoplast Plastic Industry, Phamatech Nigeria Limited. Others are Paper Manufacturing Industry, Agricultural Products Company (Onwalu and Ahaneku, 2006).

3.2: Sampling areas

Twelve different sites were chosen in the four Local Governments of Ilorin metropolis as sampling areas and the Botanical garden

served as the Control site for the collection of soil and water samples to raise the vegetable accessions (Table 1). The sampling areas were the vegetable farmlands in Ilorin metropolis and the Botanical garden was considered as the Control site because it had minimal level of pollution (Fig 1), that is, it was not close to any dumpsite, contaminated water body, and the land has not been cultivated with the use of fertilizers, pesticides and any other chemical that would have contaminated the soil.

3.3 Experimental design

Randomized Complete Block Design (RCBD) was used for the experimental design in this study. This was done by a 2x3x5x13 factorial design with 20cm distance in between the plots to prevent interference during irrigation (Fig. 2).

3.4. Sample collection:

a. Soil

Thirty one kilograms (31 kg) of top soil sample (0 – 15m) was collected with soil auger from each of the thirteen study areas. The soil samples were separately collected into different clean well labelled polyetheylene bags and brought into the Unilorin Botanical garden for experimental use. A replicate of the soil samples was taken to the laboratory for heavy metal content and other physicochemical analyses.

b. Water

Thirty (30) litres of water samples were collected from each of the irrigation sources (stream) at 5 different points at 500m apart. These water samples were collected into a clean pre-washed well labelled plastic containers and 30 drops of 1% HNO_3 was immediately added to keep the metals in solution according to the method of Chilchem (2003). The collected water samples were transported to the Botanical garden for plant irrigation. In addition, a replicate of the water samples was taken to the laboratory for further analytical work.

Table1: Sampling areas

S/N	Site (Farm)	Source of water for irrigation	LGA
1	Otte	Renge /Otte, Alalubosa stream	Asa
2	Budo- Abio	Budo-Abio stream	Asa
3	Budo- Egba	Asa stream, Budo-Egba	Asa
4	Mubo road	Asa Dam, Mubo stream	Ilorin East
5	Oyun	Oyun stream, Oyun	Ilorin East
6	Oja- gboro	Asa Dam, Oja-gboro stream	Ilorin East
7	Ola-olu	Agba stream, Ola-olu	Ilorin South
8	Eroomo	Yaalu stream, Offa Garrage	Ilorin South
9	Oke – Odo	Ogan stream, Off Unilorin Road	Ilorin South
10	Coca-Cola	Asa stream, Coca-cola Road	Ilorin East
11	Isale Aluko	Isale Aluko stream, Isale Aluko	Ilorin West
12	Odo-ore	Asa stream, Odo-ore Egbejila	Ilorin West
13	Botanical Garden (Control site)	Oyun river	Ilorin south

Note: LGA means “Local Government

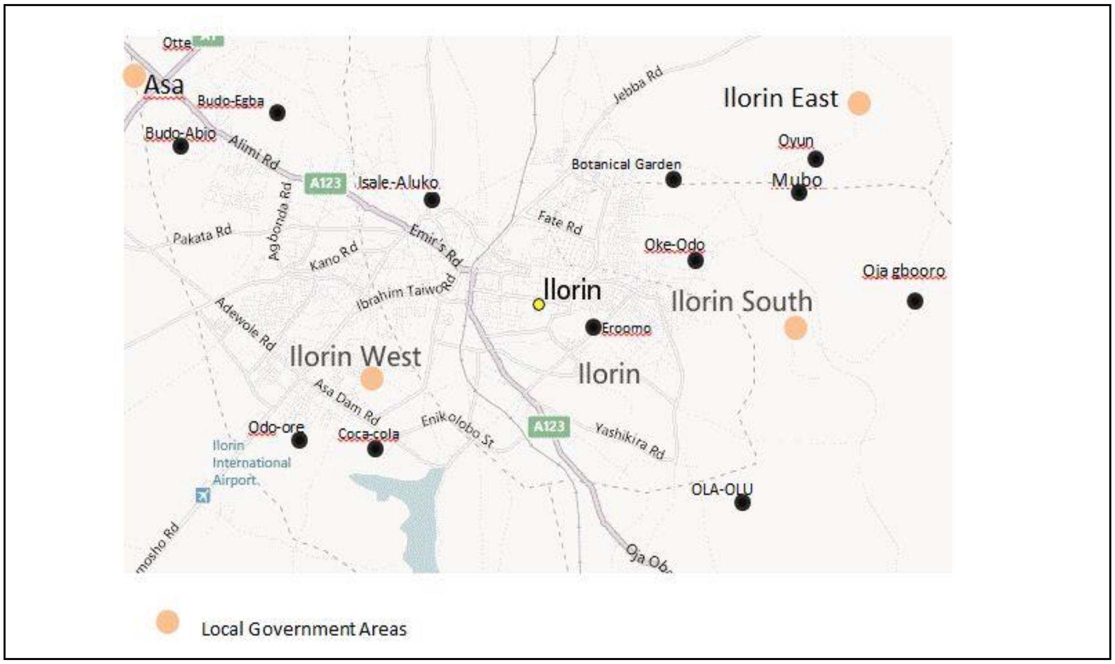

Fig.1: Map of Ilorin Metropolis

Fig 2: Exerimental design.

c. Seed collection and treatment:

Five different accessions each of *Amaranthus hybridus* and *Corchorus olitorius* were collected from the National Centre for Genetics Resources and Biotechnology (NACGRAB), Ibadan, for planting. The accessions were *Amaranthus hybridus*: NG/AA/03/11/010, NG/AA/MAY/09/027, NG/AO/11/08/039, NGBO125 and NGB01283: *Corchorus olitorius:* NG/OA/Jun/09/002, NG/04/02/11/007, NG/OA/04/010, NG/SA/07/207 and NGBO124. The collected vegetable accessions were kept in the refrigerator until planting was done. At the point of planting, each accession was tied in a clean, separate white handkerchief and was dabbed in a hot water (65-70^0) for about 5 minutes in order to break the dormancy of the seeds as instructed by the NACGRAB officers. The seeds were separately spread on clean tray after dabbing in hot water to air-dry, after which 5 grains were sown per pot.

3.5: Experimental layout:

The planting was carried out on a 120m x 150 m plot of land. 30 pots on a row per site for 13 sites totaling 390 experimental pots with a distance of 20 cm between each pot to prevent interference during irrigation in the Screened house located in University of Ilorin Botanical Garden.

3.6 Pot preparation

Ten kilograms of soil from each site was weighed into clean polyethylene bag perforated at the base. Five seeds of each accession were sown in each pot. Each treatment was replicated.

3.7: Planting periods :

i. Peak of dry season (first dry season)- November 30th, 2015 to January 16th, 2016

ii. Peak of rainy season (first rainy season) –July 30th, 2016 to September 15th, 2016

iii. Onset of dry season (second dry season) January 3rd 2017 and February 19th, 2017

iv. Onset of rainy season(second rainy season) May 3rd 2017 to June 19th, 2017.

3.8: Plant raising

Five dabbed vegetable species were planted in each pot. Irrigation of the plants was done by adding 75 ml of the water samples collected from each source of irrigation every day twice, that is, in the morning and evening. A tray was placed under each pot to collect the drained water (leachate) from the plant which was fed back into the growing plant. The number of each plant per pot was reduced (thinned) to prevent overcrowding and competition. Growth parameters of the plants: plant height, leaf length and leaf width were measured with a metre rule until the vegetables were matured and harvested after 6 weeks. The weights were differenly taken using a weighing balance.

3.9: Growth parameters

a:Plant height: Two plants in each pot were randomly tagged for growth performance measurement. A meter rule was used to measure the plant height from the ground level of each base to the highest point of the plant. The measurements were added up and divided by the number of measurements taken to get the mean plant height (Wood and Roper, 2000).

b: Leaf length: Two leaves from the randomly sampled tagged plants were chosen for measuring the leaf length. Measurement was done with a metre rule measuring from the bottom of the leaf (leaf base) to the tip of the leaf. The measurements were added up and divided by the number of measurements taken to get the mean leaf length (Wood and Roper, 2000).

c: Leaf width: Two leaves from the randomly sampled tagged plants were chosen for measure of the leaf width. Measurement was done with a metre rule measuring from the largest surface of the leaf. Measurement was done with a metre rule measuring from one edge to the other of the largest leaf surface. The measurements were added up and divided by the number of measurements taken to get the mean leaf width (Wood and Roper, 2000) .

d: Numbers of leaf: Two vegetable plants were tagged and the numbers of leaf in the tagged plants were counted including the new leaf tips and sprouts (Wood and Roper, 2000).

e: Weight of plant: Each of the two tagged plants was removed from each pot after six weeks (at harvest). Soil from the roots was rinsed off with a gentle stream of water. The plants rinsed were dried with a paper towel. These were caught into root and shoot using a sharp knife . Each was placed on a measuring scale where the weight was taken. The weights were added up and divided by number of weights taken to get the mean plant weight (Wood and Roper, 2000) .

3.10: Laboratory analyses

a.Soil analysis

i. Pre-treatment of samples

Prior to the analysis, each collected sample (soil and water) was prepared or pre-treated before being analysed using the method of Shobukola *et al*. (2007). Composite soil sample (500g) from each study site was sieved through a 2 mm sieve in order to eliminate stones and other extraneous materials from the soil. The sieved soils were separately spread over a polyethylene sheet and air-dried at room temperature for one week. Samples were separately ground to a fine powder in a tungsten-carbide swing mill for 3 mins and sieved through a <1 μm sieve. After which further chemical and heavy metal analyses were conducted.

3.11: Physico-chemical of the soil samples

a: Determination of percentage moisture.

Moisture content was determined by the method of Brady and Weil (1999). One hundred grams (100 g) of each soil sample was weighed into a crucible. The content was placed in the oven and dried at 80^0 C until the weight was constant, after when the moisture content was calculated using the formula below. The experiment was done in thrice and the mean value calculated thus:

$$\%\ \mathrm{Moisture} = \frac{\mathrm{a-b}}{\mathrm{a}} \times 100$$

Where $\mathrm{a} = \mathrm{Weight\ of\ wet\ sample(Ww)}$

$\mathrm{b} = \mathrm{Weight\ of\ dry\ soil\ sample\ (Wd)}$

b: Determination of bulk density.

The method of Cresswell and Hamilton (2002) was used. The empty density bottle was weighed (without lids). Each soil sample was placed in the pre-weighed density bottle (without lids) and was placed on the pre-calibrated Camry EK3650/EK3651 weighing balance. The experiment was repeated thrice to minimize error and the mean value was calculated thus:

$$\text{Bulk Density } (\mathrm{g/cm^3}) = \mathrm{M_d/V}$$

M_d = Mass of dry soil

V = soil volume (cm^3) which is the capacity of the weighing can used to measure soil sample.

c: Determination of acidity and alkalinity (pH)

This was determined using the method of Oyinloye (2007). Ten grams (10 g) of each of the air-dried soil sample was weighed into 50 ml beaker and 100 ml of distilled water was then added. The soil solution was allowed to stand for 30minutes and was stirred occasionally with a glass rod. A pre-calibrated pH 7310 no 1 LAB glass electrode pH metal in buffer 4, 7, 9 was inserted to determine the pH of the soil sample in water, this was repeated thrice and the average reading was calculated.

d: Determination of total acid value.

The method of Shailesh *et al*. (1997) was used for the determination of total acid value in soil. Five grams (5 g) of air- dried soil sample from each study site was weighed in triplicates into different sample containers, 50 ml of 1N KCl was added to each sample and allowed to stand for 30 minutes. This was then filtered using Whatman filter paper no 4 and 25 ml of the each extract was prepared into 100 ml conical flask with 2 drops of 1% phenolphthalein indicator added to each sample. The mixture was titrated against 0.01 N NaOH and colour change from colourless to red indicated end point.

$$\textbf{Total acid value (Total acidity)} = \frac{\textbf{Titre Value} \times \textbf{normality of NaOH x Volume of extract}}{\textbf{Weight of sample}}$$

e: Determination of organic matter.

The soil organic matter content of the soil was determined using Ignition method by Reddy (2002). The mass of an empty, clean and dry porcelain dish was determined and recorded. The mass of the dish and entire oven-dried soil sample from the moisture content experiment in the porcelain (MPDS) was also determined and recorded. The dish was placed in the muffle furnace and the temperature was gradually increased to 440^0C. This was left in the furnace overnight. The porcelain dish was carefully removed using the tongs and was allowed to cool to room temperature and the mass of the dish containing the ash (burned soil) was determined and recorded. The dish was emptied, cleaned and the mass of dry soil was determined.

$$M_D = M_{PDS} - M_P$$

M_{PDS} is the mass of porcelain and dry soil.

M_P is the mass of porcelain only.

The mass of the burnt/ ashed soil: $M_A = M_{PA} - M_P$

M_A (mass of ashed soil)

M_{PA} (mass of porcelain and ashed soil)

Organic matter Content: $M_O = M_D - M_A$

Percentage Organic matter (content): % OM = $\frac{MA}{MD}$x 100

f: Determination of total available nitrogen content

Determination of Total Nitrogen was carried out using Macro Kjeldahl (1965) method. This method is of two steps, and these are: digestion step; and Distillation step

i: Digestion step: Air dried and ground soil sample (1 g) was weighed into a Kjeldahl flask. A Kjeldahl tablet was dropped into the flask, 10 g of K_2SO_4 , 0.5 g $CuSO_4$ and 25 ml Conc.H_2SO_4 were added and heated until the clear mixture changed to green colour which indicated digestion. This was allowed to cool and was made up to the mark of the 250 ml with distilled water.

ii: Distillation step: Five (5) ml of the extract from the content in the 250 ml was pipetted into the Kjeldahl apparatus and 5ml of 5% NaOH was added to the content in the apparatus. The liberated ammonium was distilled into 5 ml of Boric acid, 2 drops of Broom cresol green methyl red indicator was added in the titration flask and 50 ml distillate was collected. The ammonium (NH_4) in the distillate was then titrated against 0.01N HCl until the colour changed from green to blue which confirmed the end-point.

Calculation:

$$\text{Total Nitrogen} = \text{Nitrogen Titre Value} \times \text{Normality of HCl} \times \text{Equivalent of Nitrogen} \times \frac{\text{total volume of extract}}{\text{volume of extract}} \times \frac{100}{1}$$

Normality of HCl = 0.01 g/mol

Equivalent of Nitrogen = 0.014

Total volume of extract= 250ml

Volume of extract = 5ml

Weight of sample = 1g

g: Determination of available phosphorous

The method of Dickman and Bray. (1999) was used to determine the available phosphate in the soil. Five grams (5g) of each soil sample was weighed into the sample bottle, 35ml of an extracting solution containing 1N of ammonium fluoride and 0.5 ml of hydrogen chloride, were added to each sample. The content was shaken for 5 minutes and was filtered using Whatman no 42 filter paper. 5 mls of the extract was pipetted into 50 ml volumentric flask.. The content was made up to mark of the 50 ml standard volumetric flask with distilled water. This was allowed to stand for 30 mins.

The absorbance was then read at 600nm wavelength using Flame Absorption Spectrophotometer spectronic 20. Blank sample was also run with the same procedure to cross check background error.

$$\text{Available Phosporus} = \frac{\text{Reading in ppm} \times \text{volume of extract}}{\text{Weight of sample}}$$

h: Determination of the exchangeable cations (Ca, Mg, Na and K)

The method of Jackson (1958) was adopted. Ammonium acetate extract buffered at pH 7 with effective cations calculated using Juo *et al*.(1976) formula. Five grams (5 g) air-dried and pre-sieved soil sample from each site was weighed in triplicate into sample bottles and 50 ml of 1N NH_4OAc was added. The content was left for 1 hour after which it was filtered with Whatman No 4 filter paper.

i: Determination of calcium (Ca^{2+}) and magnesium (Mg^{2+})

Five millitre (5) mls of each of the extracts was pipetted into a 100 conical flask and 5 mls of each of the concentrated ammonium solution, 5 drops of 10% Hydroxylamine Hydrogen Chloride and 2 drops of 5% Potassium Cyanide were added. This was titrated against 0.02 N EDTA (Ethylene Disodium Tetra Acetate) using Erio-chrome **B**lack T indicator which changed the colour from red to blue.

Calculation:

$$\text{Ca} + \text{Mg} = \text{Titre value} \times \text{Normality of EDTA} \times \text{vol of extract} \times \frac{100}{\text{vol of sample}} \frac{\text{mol}}{\text{g}}$$

ii: Calcium (Ca^{2+}) only

Five millitres (5 ml) of the extract was pipetted into 100 ml conical flask, 5 ml of 40 % NaOH was added and 2 drops of Calcon indicator was added leading to colour change from red to colourless.

$$\text{Ca} = \text{Titre value} \times \text{Normality of EDTA} \times \text{vol.}\,(\text{NH4OA}) \times \frac{\text{capacity of conical flask.}}{\text{vol. of extract}} \frac{\text{mol}}{\text{g}}$$

Normality of EDTA = 0.02

Volume of extract = 5ml

Weight of sample = 5g

Mg^{2+} was determined from the calculated value of Mg^{2+} + Ca^{2+} - value of Ca^{2+} alone

iii: Sodium (Na^+), and potassium K^+ determination

The ammonium acetate (NH_4O_A) extract was analyzed using Flame Photometer. The standards of sodium and potassium were prepared with concentrations in part per million (ppm), with Na^+ in 10 ppm and K^+ in 20ppm

$$K = \frac{20\text{ppm}}{10} \times R$$

Na^+ was calculated from the estimated value of Na^+ +K^+ - the calculated value of K^+

Mg^{2+}, Ca^{2+}, Na^+ and K^+ are all exchangeable cations

Cation Exchange Capacity (CEC) = Exchangeable Cations + Total Acid Value

i: Determination of electrical conductivity.

The method of Rayment and Higginson. (1992) was used for the analysis. Ten grams of air-dried soil sample from each site was weighed into a 100ml conical flask and 25 ml of distilled water was added. This was stirred for 10 minutes with a stirring rod and left to stand for 30 minutes after which it was again stirred for 2 minutes. This was finally left to stand for 15 minutes before the pre-calibrated EC 214 HANNA electrical conductivity meter was inserted and the reading was recorded in microSiemens which was converted to decisiemens per square (dsm^{-1}).

3.12: Heavy metal analysis in soil samples:

3.12.1. Total heavy metal in soil

a. Soil samples pre-treatment.

Soil samples were separately oven dried at 60 °C for almost a week. After drying, samples were ground to a size <63 µm in an agate mortar then stored in plastic vials for further analysis.

b: Digestion of soil samples

This analysis was carried out to determine the total concentration of each heavy metal in each soil sample using the modified methods of Zheljazkov and Nielson (1996) and Jiang *et al*. (2011). One gram (1g) of each composite soil sample was weighed into a 250 ml digestion tube and 3 mls of concentrated HNO_3, 2 mls of concentrated HCl and 1 ml $HClO_4$ were added in sequence. Each sample was heated on the hot plate until the brownish fume was expelled and a clear solution was obtained; which indicated complete digestion. The walls of the tube were washed down with 1ml distilled water and the tube was swirled throughout the digestion process to keep the wall clean and prevent the loss of the sample. This was allowed to cool, after which the solution was filtered using Whatman No. 42 filter paper. This was then transferred into a 25 ml volumetric flask and made up to the mark by adding distilled water. Quality control was assured by running the procedure thrice to check error and the use of blanks to check for background contamination of the reagents used. A certified reference material (CRM: IAEA-SL-1-lake sediment) was digested along with the samples and the recovery percentage of the CRM was between 72%-97%. (International Atomic Energy Agency, Vienna, Austria). With Certified values of Cd and Cu, Pb was 0.26, 30 and 37.7 mg/kg respectively.

c: Atomic absorption spectrophotometry

The determination of the heavy metals in the soil samples was performed with PerkinElmer Analyst 200 Atomic Absorption Spectrophotometer equipped with a deuterium background corrector at the University of Ibadan Central Laboratory. An atomizer with an air/acetylene burner was used for determining all the investigated elements. All instrumental settings were those recommended in the manufacturer's manual book. Suitable internal chemical standards (Merck Chemicals, Germany) were used to calibrate the instrument and standard curve for each metal was plotted by preparing four different concentrations of each metal from each metal stock (Ahiamadjie *et al*., 2011**)**.

3.12.2: Phytoavailable heavy metal analysis

The single extraction procedure of Tessier *et al*.(1979) and Song *et al*.(2008) were used to determine the readily available metals in the soil samples. One gram (1 g) of each of the air- dried pre-sieved composite top soil sample was extracted at room temperature with 8 ml of magnesium chloride solution (0.5 M $MgCl_2$) by continuous agitation at pH 7 for 20mins. Extracted solution and the blank ($MgCl_2$) were filtered by using Whatman No 42 filter paper and made up to 25ml .Phytoavailable contents of Pb, Cd and Cu were analyzed using PerkinElmer 200 Analyst Spectrophotometer (AAS).

3.12.3: Heavy metal partitioning in soil (fractionation).

The heavy metal partitioning in soil was analyzed using the method of Brunori (2004), Joksic (2005) and Mossop and Davidson (2003). Sequential Extraction Procedure was used to determine the dynamics of the different forms of heavy metals in the soil. Fraction 1—Soluble and Exchangeable Fraction. Each of the dried soil (1.5 g) and 20 ml of NH_4NO_3 were added to a 50 ml centrifuge tube and shaken for one hour. The mixture was then centrifuged, the supernatant liquid was decanted and poured into a 50 ml glass vessel. The remaining soil was washed twice with 10 ml distilled water, and the supernatant was removed and added to the first extract. The extract was diluted with distilled water to 50 ml while the residual soil was used for the next extraction.

Fraction 2—Bound to Carbonates. The residue of Fraction 1 was extracted with 16 ml of 1 M sodium acetate/acetic acid buffer at pH 5 for 5 hours at room temperature. The extracted metal solution was decanted. The remaining soil was washed twice with 10 ml distilled water, and the supernatant was removed and added to the extract. The extract was diluted with distilled water to 50 ml and analyses of Pb, Cd, Cu and Zn speciation as above were done while the residual soil was used for the next extraction.

Fraction 3—Bound to Oxides. The residue from fraction 2 was extracted under mild reducing conditions. Hydroxyl amine hydrochloride ($NH_2OH \cdot HCl$) 13.9 g was dissolved in 500 ml of distilled water to prepare 0.4 M $NH_2OH \cdot HCl$. The residue was extracted with 20 ml of 0.4 M $NH_2OH \cdot HCl$ in 25% (v/v) acetic acid with agitation at 96°C in a water bath for 6 hours. The extracted metal solution was decanted from the residual soil. The remaining soil was washed twice with 10 ml distilled water, and the supernatant was removed and added to the extract. The extract was diluted with distilled water to 50 ml and analyses of Pb, Cd, Cu and Zn were done as above while the residual soil was used for the next extraction.

Fraction 4—Bound to Organics. The residue from fraction 3 was oxidized as follows: Three millilitres of 0.02 M HNO_3 and 5 ml of 30% (v/v) hydrogen peroxide, which was adjusted to pH 2, were added to the residue from fraction 3. The mixture was heated to 85°C in a water bath for 2 hours with occasional agitation and was allowed to cool. Another 3 mls of 30% hydrogen peroxide, adjusted to pH 2 with HNO_3, was added. The mixture was heated again at 85°C for 3 hours with occasional agitation and allowed to cool. Moreover, five millilitres of 3.2 M ammonium acetate in 20% (v/v) nitric acid was added, this was followed by the final addition of 20 ml de-ionizedwater. The extracted metal solution was decanted from the residual soil. The remaining soil was washed twice with 10 ml distilled water, and the supernatant was removed and added to the extract. The extract was diluted with distilled water to 50 ml and analyses of Cd, Cu and Pb were carried out as above while the residual soil was used for the next extraction.

Fraction 5—Residual or Inert Fraction. Residue from Fraction 4 was oven dried at 105°C. Digestion was then carried out with a mixture of 5 ml conc. HNO_3 (HNO_3, 70% w/w), 10 ml of hydrofluoric acid (HF, 40% w/w) and 10 ml of perchloric acid ($HClO_4$, 60% w/w) in Teflon beakers. The soil mixture was then filtered through a filter paper to remove any undissolved material and diluted to 25ml with distilled water. Each sample was stored in polyethylene bottle and taken for speciation metal analysis. The procedure was validated, the instrument was calibrated and was programmed to carry out metal detection by displaying three absorbance readings and the average was taken. Blanks were also prepared for correction of background and other sources of error. The results of the sequential extraction was checked by summing up the different concentrations of fractions for each element and compared with the results obtained from the total digestion.

3.13: Pollution index of the soils. This was estimated using the method of Deng *et al*. (2012). This parameter evaluated the degree of pollution in soil .

$$P_y = \frac{C}{S_j}$$

Where p_y is the pollution index of the heavy metal j in the i -th functional area soil. Cj is the measured contamination value of metal$j$ in the i -th functional area soil, and S_i is the background contamination value of heavy metal.

Interpretation:

Py ≤ 1 (No pollution), Py ≥ 1≤ 2 (Low pollution), Py ≥ 2 ≤ 3 (Moderate pollution),

Py≤ 3≥ 5 (Strong pollution) and Py ≥ 5(Very strong pollution) (Yang *et al.,* 2011, 2014)

3.14: The potential ecological risk index (RI): This was evaluated in this study by calculating the contribution to potential ecological harm of each single heavy metal and the potential RI of multiple heavy metals. This shows the sensitivity or response of the study area to soil heavy metal contamination and also presents potential ecological risks of the soil to the heavy metals. To quantify the potential risks from soil metal contamination, the potential ecological risk index (RI) was calculated thus:

$$RI = \text{£}_{i-1} \frac{(T_i C_i)}{B_i}$$

where RI is the monomial potential ecological risk factor of heavy metal in soil, Ti is the toxicity factor of a particular heavy metal which is the toxicity coefficient of specific single heavy metal based on the results of (Hakanson,1980; Xu, 2008). Ci is the practical concentration of a particular metal in soil, and Bi is the background value for heavy metal, the background value of the University of Ilorin Botanical garden is the reference values in this work. Based on related published research, the toxicity coefficients of Cd, Cu and Pb, in this study were 5, 5 and 5 respectively.

Interpretation:

RI≤ 150 : low potential ecological risk

Ri ≥ 150≤300 : moderate potential ecological risk

Ri ≥300≤600 : considerable potential ecological risk

Ri ≥600 : very high potential ecological risk

Hakanson. (1980)

3.15: Water analysis.

3.15.1: Physico-chemical analyses of water samples

a: Determination of pH

The pH of each water sample was determined using the method of Oyinloye (2007). About 100 ml of each water sample was pipetted into a 250 ml beaker. The glass electrode pH meter was inserted to measure the pH of the water samples. The pH of each water sample was measured using a pre-calibrated pH meter with model specification 7310 1 no LAB using buffer 4, 7 and 9 standards. The experiment was replicated for comparison and to minimize error.

b: Determination of electrical conductivity

The method of Oyinloye (2007) was used to determine the electrical conductivity of each water sample after calibrating the EC 214 HANNA electrical conductivity bridge with 0.05NKCl**.** The cell was thoroughly rinsed with three portions of the water sample. The temperature was adjusted to about 25 ºC after which the electrical conductivity of each of the water sample was taken on the meter bridge in microSiemes per cm

c: Determination of chloride ion content

The titrimetric method of Skoog (1996) with Silver nitrate ($AgNO_3$) was used. About 20 mls of each of the water sample was pipetted into a 100 mls volumetric flask and made up to the mark with distilled water. Each diluted water sample, 10 mls was pipetted into a conical flask. 50 mls distilled water and 1 ml of chromate indicator was added. Each solution was then titrated against 0.1$moll^{-1}$ $AgNO_3$ solution until a light red colour was formed which indicated end-point. The titration was done thrice to minimize error.

$$Cl^- = \frac{\text{Mean Titre} \times \text{Molarity of AgNO3}}{\text{Volume of water Sample}} \times 1000$$

d: Determination of turbidity.

The method of Ulhrich and Bragg (2003) was used. A pre-calibrated HACH 2100N turbidity meter was used to determine the turbidity of the water samples. Each water sample was put into the HACH 2100N Turbidity meter sample cell. This was filled to the horizontal mark of the cell. The wall of the cell was wiped with a soft tissue after when it was placed in the pre-calibrated HACH 2100N Turbidity meter such that the vertical mark in the sample cell coincided with the mark in the turbidity meter. The sample cell was covered and the turbidity of each water sample was read when the reading on the meter was stable in NTU. The experiment was repeated in thrice to minimize error and the mean value was calculated.

e: Determination of total acid value.

This was measured by titrimeric method of Shailesh *et al*. (1997). 50 mls of each water sample was pipetted into a 100 ml conical flask, 2 mls of 1 N NaOH and 3 drops of carcon indicator were added. This was titrated against 0.1N EDTA solution until the colour changed from pink to purple.

$$\text{Total Acid Value (Total Acidity)} = \frac{\text{Titre Value} \times \text{ normality of NaOH x} \ \ \text{Volume of NaOH}}{\text{volume of sample}}$$

f: Determination of total hardness (Calcium ion plus Magnesium ion)

Determination of total hardness in water was carried out by the titrimetric method of Harris . (1995). About 50 milliliters of each water sample was pipetted into a 250 ml conical flask, 10 ml concentrated Ammonia, 3 drops of Sodium cyanide and 3 drops of Eriochrome Black T indicator were all added, diluted to 100ml with de-ionized water and was titrated against standardized 0.01N EDTA solution (4ml of buffer solution at pH 10) until the colour changed from wine red colour to light blue which indicated the end-point. The titration was done thrice to minimize error.

Calculation:

$$\text{H in} \left(\frac{\text{mg}}{\text{l}}\right) = \frac{\text{Titre value (Volume of EDTA used} \times \text{Molarity of EDTA} \times 1000}{\text{Volume of water used}}$$

i: Determination of Ca^{2+} (aq) ions in the water samples

About 50 mls of each water sample was pipetted into a conical flask and 30 drops of 50% w/v NaOH solution was added. The solution was swirled and was allowed to stand for 5 minutes to completely precipitate the magnesium ions as $Mg(OH)_2$. A pinch of hydroxynaphthol blue was added and was titrated with 0.01 Ml^{-1} EDTA until it changed to sky blue which signified the end-point. The titration was repeated to obtain two concordant results and the mean values calculated.

$$\text{Calcium ions:} = \frac{\textbf{Titre value}\times\textbf{molarity of EDTA}\times\textbf{1000}}{\textbf{Volume of water sample}}$$

ii: Determination of magnesium ions

Determination of Magnesium was calculated from the value obtained from Total Hardness (Ca+ Mg) minus the value obtained from Calcium

3.15.2: Heavy metal analyses in water.

The method of Agbenin (1995) was used to digest the water samples. About 50 ml of each of the water samples was put into 100 ml beaker and 10 ml Nitric acid and 10ml of Perchloric acid (70%) were added. Each beaker was placed on the hot plate and the content was heated until the brown fume of nitric acid escaped, the heating continued until the volume of the content was reduced to 10 ml volume. Each digested sample was cooled at room temperature, filtered through Whatman No 24 filter paper and the volume was made up to 100 ml with distilled water then the digests were kept for heavy metal analysis using PerkinElmer Analyst Spectrophotometer

3.16: Vegetables analyses.

3.16.1: Determination of heavy metal content in vegetable accessions.

a.Sample treatment

Each part of the vegetable accession was analyzed for Cd, Cu and Pb content using the wet-digestion method of Ghosh *et al*. (2012) and Atomic Absorption Spectrometer (Kalavrouzioti, 2012). Vegetable parts (shoots and roots) of all the accessions were analyzed for the selected metals. Each part of the accession was thoroughly washed with distiiled water to remove the extraneous materials and samples were cut into sizeable pieces using knife and they were sun dried.

They were later placed in an oven set at 50 ^oC for 2 days for complete dryness. The dried samples were then ground using blender (Model 33750), into fine powdery form. Each of the samples was stored in well labelled plastic containers for other analyses (Jawad *et al.*, 2010 and Lawal *et al* ., 2011) .

b: Digestion of the plant: Each of the ground samples (0.25 g) was weighed into a 50 ml beaker followed by the addition of 10 8 mls, 6 M HCl in triplicate (Ebong *et al*., 2008; Redojevic *et al*., 1999). The beaker containing the samples was covered and heated for about 15 mins followed by the addition of one milliliter conc. HNO_3. The digestion was performed at 95 ^oC until about 4 ml of the solution was left in the beaker. One milliliter 6 M HCl was added, swirled and ten milliliters of distilled water was added. The beaker was heated again on the steam bath to ensure complete dissolution. After cooling, the solutions were filtered using a Whatman No. 42 filter paper into a 50 ml volumetric flask and made up to a mark with distilled water for instrumental analysis (Ebong *et al*., 2008; Redojevic *et al*., 1999). The Cd , Cu and Pb levels were determined by Atomic Absorption Spectrometry using A Analyst 200 Perkin Erlymer. Certified reference material IAEA 359 (cabbage) was digested and percentage recoveries for the heavy metals were calculated to validate the procedure.

c: Instrumental analysis (AAS)

The Cd, Cu and Pb levels were determined with Atomic Absorption Spectrometer using A Analyst 200 Perkin Erlymer Spectrophotometer. Standard solutions of 0. 1.5, 3.0, 4.5 and 6.0 ppm were prepared for each metal to be determined. Deionized water was used as blank in standardizing the instrument. Calibration curve was constructed by plotting absorbance versus concentration. By interpolation, the concentrations of each heavy metals in digested sample were determined (Lawal *et al*., 2011).

3.17: Model: Characterizing quantitatively the transfer of an element from soil to plant, the soil–plant, the following models were used

a. Biological accumulation coefficient (BAC) was calculated as a ratio of heavy metal in shoots to that in soil as described by Li *et al*.(2008).

$$BAC = \frac{C_{shoot}}{C_{root}}.$$

Interpretation; BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal: BAC ≥1 implies good hyperaccumulator of metal Li *et al*.(2008).

b. Transfer factor (TF) expresses the ratio of contaminant concentration in plant parts to concentration in dry soil used .

$$TF = \frac{C_p (mg\ kg^{-1})}{C_t\ (mg\ kg^{-1})},$$

Where, C_p is the root metal content and C_t is the heavy metal content in the soil (Chojnacka, 2005; Prabu, 2009). It is an indicator of metal mobility in soil (Kalavrouzioti, 2012).

Interpretation;

TF >1.0 – Good hyperacumulator/ phytostabilizer and High metal transfer (Garba, 2012; Mendez and Maier, 2008

TF<0.5 – Low metal transfer rate (Klokeet al., 1984)

3.18: Proximate composition analyses (Nutritional content (%)) of the vegetable accessions.

The recommended methods of the Association of Official Analytical Chemists (AOAC, 1999) were used for the determination of moisture, ash, crude fat and oil , crude fibre, crude protein and carbohydrate content in the different vegetable accessions.

Fresh edible leafy vegetables were harvested and thoroughly washed with distiiled water to remove the extraneous substances and used for the the proximate analysis of the vegetable accessions . The samples were then cut into sizeable pieces using knife and dried. They were later placed in an oven at temperature of 50 ^{o}C for 2 days for complete dryness. The dried samples were then ground using blender (Model 33750), into fine powdery form. Each of the samples was stored in well labelled plastic containers for other analyses.

a: Determination of moisture content.

This was carried out by using the method of AOAC (1999). Fresh vegetable accession was air dried and ground to fine powder. This was mixed to obtain a homogenous sample of large surface area. The weight of the crucibles with the lids was taken with a weighing balance and recorded. In each of the crucibles, 2.0 g of the ground sample was placed in it, it was then dried in an oven at 100° C for 17 hours . The samples were removed from the oven and the lids were replaced. The samples were then transferred to desiccators containing CaO as desiccant at room temperature (28±1^{o}C) and was weighed. The process was continued until a constant weight was obtained and the average weight was calculated.

The percentage moisture content was calculated as follows:

$$\% \text{ moisture} = \frac{t - U}{s} \times 100$$

where,

s = Weight of sample for analysis. t = Weight of sample + crucible before drying.

U = Weight of sample + crucible after drying

t-U = Loss of weight or moisture content

b: Determination of ash content

The ash content of the vegetables was determined by incineration. (Association of Official Analytical Chemist AOAC,1999). Porcelain crucibles with lids were ignited for 5 mins in a muffle furnace at 550°C, this was cooled in desiccators and weighed. Two grams of each sample was separately weighed into appropriately labelled crucible and weighed again. This process was replicated twice. Each crucible and content was ignited in the muffle furnace at 550°C for 18 hours to light grey ash. They were removed and placed immediately in desiccators to cool and were later weighed . The difference in weight or loss in weight of the crucible and sample before ashing gave the organic matter content of each sample, while the difference between the weight of the crucibles alone and crucible and ash gave the weight of the ash of each sample.

$$\text{Percentage of Ash in the vegetable sample} = 100 \left(\frac{X-Y}{Z}\right)$$

where,

X = Weight of crucible and content after drying

Y = Weight of empty crucible

X-Y = Weight of ash. Z = Weight of sample

c: Determination of crude fat and oil:

The procedure of AOAC (1999) was employed. This method was based on the principle that non-polar components of samples are easily extracted into organic solvent. Three grams (3 g) of each of the moist-free samples was placed into fat free thimbles. These were then weighed, plugged with glass wool and introduced into Soxhlet Extractors containing 160 ml petroleum ether (b.p 60-80°C). Receiver flask was clean dried, weighed and fitted to the extractors. The extraction unit was assembled and cold water was allowed to circulate, while the temperature of the water bath was maintained at 60 °C. Extraction was carried out for 8 hrs. At the end of this time, the thimble containing the sample was removed and placed in an oven at 70°C for 3 h and dried to constant weight. The weight of the dish and the content was then obtained using a standard analytical balance.

The percentage crude fat was obtained as the difference in weight before and after the exhaustive extraction.

Hence the percentage fat was therefore calculated as

$$\% \text{ Fat} = \frac{(x - y)}{z} \times 100$$

where, X = Weight of thimble and oil

Y = Weight of empty thimble

Z = Weight of sample

d. Determination of crude fiber (on dry basis)

The crude fiber was determined according to the procedure of AOAC (1999). Four grams of each moisture-free sample was weighed into a 250 ml beaker and 50 mls of 4% H_2SO_4 was added, followed by the addition of 250 mls distilled water. This was then heated to boiling point and kept boiling for 30 minutes on a Bunsen burner flame, with constant stirring using a rubber-tipped glass rod to remove all particles from sides of beaker. The volume was kept constant by the addition of hot distilled water. After 30 minutes of boiling, the content was poured into a Butchner funnel fitted with an ashless Whatman No. 4 filter paper connected to a vacuum pump. The beaker was washed several times with hot distilled water and was then transferred quantitatively with a jet of hot water. Washing continued on the funnel until the filtrate–was acid-free as it was indicated by litmus paper. The acid-free residue was transferred quantitatively from the filter paper into the same beaker removing the last traces with 5% NaOH solution and hot water to a volume of 200 ml.

The mixture was boiled for 30 minutes with constant stirring as earlier described, keeping the volume constant with hot water. The mixture was then filtered and washed as earlier described until it is alkaline free using filter paper. The resultant residue was then washed with two portions of 2 ml 95% alcohol and was transferred to a pre-weighed porcelain crucible. The content of the crucible was then dried in an oven maintained at 110°C to a constant weight after cooling in a desiccators. Crucible content was ignited in a muffle furnace at 550°C for 8 hrs, cooled and weighed. A triplicate determination was carried out on each sample. The percentage crude fibre was therefore calculated as:

$$\%\ \text{Crude fibre} = \frac{y - a}{x} \times 100$$

x = Weight of sample (g). y = Weight of insoluble matter (g). a = Weight of Ash (g)

e: Determination of % crude protein Kjeldahl (1983) method was adopted for the determination of percentage Nitrogen. Powdered vegetable sample (2g) was digested in a Kjeldahl digestion flask by boiling with 20ml of concentrated H_2SO_4 with a Kjeldahl digestion tablet (catalyst) until the mixture was clear. The digest was filtered into a 250 mls volumetric flask and the solution was made up to mark with distilled water and was distilled with 50 mls of 45% of sodium hydroxide, which converted the ammonium salt to ammonia. About 150mls of the distillate was collected in a conical flask containing 100 mls 0.1N HCl and methyl red indicator. The ammonia that distilled into the receiving conical flask reacted with the acid and the excess acid in the flask was estimated back by titration against 2.0M NaOH with colour change from red to yellow (end point). % Nitrogen was calculated as follows:

$$\% \text{ Nitrogen} = \frac{(\text{ml standard acid x N of acid}) - (\text{ml blank x N of base})] - (\text{ml std base x N of base})}{\text{Weight of sample in grams}}$$

Where N=normality

Total nitrogen was determined by calculating proteins from nitrogen using the Kjeldahl micro method (AOAC, 1999) and conversion of nitrogen to proteins by the multiplying it with the factor 6.25.

% Crude protein was determined by multiplying the % Nitrogen with the factor 6.25

$$\% \text{ Crude protein} = \% \text{ Nitrogen} \times 6.25$$

f: Estimation of total carbohydrate

Total Carbohydrate was estimated with the use of the method of Onwuka. (2005). The total carbohydrate content of the samples were obtained by subtracting the sum of percentage crude protein, crude fat, Moisture, Fibre and ash from 100.

% Carbohydrate = 100 - (sum of percentage crude protein + crude fat + Moisture + Fibre + ash) .

3.19 Data analysis : All determinations were done in triplicates. Representative results and the data were reported in $mgkg^{-1}$. Statistical validation of result was done using SPSS version 21.0 to evaluate the data generated. Analysis of Variance (ANOVA), Duncan's Multiple Range Test (DMRT) and Posthoc test were used. A one-way ANOVA was used to determine whether significant differences existed between the sampling sites and between the plants species. (Romijn, 2014**).** Descriptive statistics were used for the interpretation of data.

The relationship between the plant – metal, soil characteristics, bioavailable metals (pH, organic matter) with heavy metals concentrations, proximate composition were estimated using Pearson's Correlation Coefficients.

CHAPTER 4

RESULTS

4.1. Physico-chemical properties of Soil samples

Table 2 shows the physicochemical properties of the soil samples used for planting the vegetable accessions in the first dry season (2015). The range of the moisture content in the soil was between 10.13±0.04% and 18.95±0.02 % (Table 2). Lowest moisture content was observed in the soil of Coca cola while the highest was recorded in soil of Olaolu with mean moisture content of 10.13±0.04% and 18.95 ±0.02% respectively. The moisture content of the soil of the Control was higher than soils of Okeodo, Coca cola and Isale Aluko but lower than the moisture content of soils of Otte, Budo Egba, Budo Abio, Mubo, Oyun, Ojagboro,Olaolu, Eroomo and Odoore. No significant differences were observed in the moisture content of soils of Odoore and the Control site (Table 2). The pH values of the soil samples ranged between 6.62±0.04 and 7.18±0.03 (Table 2). This shows that the soils were from slightly acidic to slightly alkaline. The highest pH value was recorded in Mubo soil while the lowest was recorded in Budo Egba soil. Soil of the Control was found to be statistically the same with the pH values of soils of Ojagboro, Olaolu and Odoore sites. The pH values of soils of Otte and Isale Aluko were statistically the same at $p< 0.05$. Soils of Oyun and Coca cola were statistically the same at $p< 0.05$. No significant differences were recorded in the pH values of soils of Ojagboro, Olaolu, Odorre and Control sites (Table 2). Soils of Budo Egba and Eroomo were found to be statistically the same at $p< 0.05$ (Table 2).

The range of the bulk densities of soils between sites was between 1.82 ± 0.01 g/cm^3 and 2.69 ± 0.03 g/cm^3. The highest bulk density value was recorded in Control soil while the lowest was recorded in Oyun soil. Soils of Ojagboro and Olaolu were statistically the same at $p\leq 0.05$ (Table 2). Soil of Odoore was also found to have the same bulk density value with the Control site statistically at 2.69±0.01 g/cm^3 and 2.69±0.03 g/cm^3 respectively. The mean total acid values ranged between 0.08±0.03 mgKOH./g and 0.53± 0.01 mgKOH/g which were recorded in soils of Coca cola and Eroomo (Table 2). The mean total acid value of soil of the Control site was greater than the mean total acid values of soils at most of the sites except soils for Budo Egba, Olaolu and Eroomo (Table 2). Soils of Odoore and the Control site were statistically the same in the mean total acid value at $p \leq 0.05$. In soils of Otte, Ojagboro, Okeodo and Isale Aluko, there were no significant differences in the mean total acid values.

Soils of Budo Egba and Olaolu recorded no significant differences in the mean total acid values. Soil of Coca cola was found to have the lowest mean total acid value while the highest was recorded in soil of Eroomo (Table 2). The mean organic matter content of soils ranged between 2.05 ± 0.02% and 3.50 ± 0.05%. Soil of Mubo has the highest value of organic matter content (3.50 ± 0.05 %) while Coca cola had the lowest organic matter (2.05 ± 0.02 %). Soil of the Control site recorded a relatively high value of mean organic matter content than the other sites. Soils of Eroomo and the Control site recorded the same mean organic matter content statistically (Table 2). Soils of Coca cola and Odoore had no significant differences in the mean organic matter content, so also were soils of Budo Abio and Olaolu, and Eroomo and the Control site (Table 2). The mean Cation Exchange Capacity (CEC) ranged between 3.68 ± 0.02 Cmolc/kg and 8.63 ± 0.03 Cmolc/kg. Highest mean Cation Exchange Capacity (CEC) was recorded in soil of Odoore while the lowest was found in soil of Isale Aluko. Soil of the Control site recorded a higher CEC values than soils of Olaolu and Isale Aluko but lower in CEC values than soils of the other sites (Table 2). Soils of Otte and Okeodo were significantly the same in their CEC (Table 2). Soils of Mubo, Eroomo and Coca cola were statistically the same in the values of CEC (Table 2). There were significant difference in CEC of the soils in the order of $12 \geq 2 \geq 5 \geq 6 \geq 3 \geq 13 \geq 7 \geq 11$.

The range of the available phosphorous in soils between sites was 0.79±0.01 mg/l and 5.85±0.05 mg/l which was found in soils of Odoore and Otte respectively. Soil of the Control site had a relatively higher value of available phosphorous than soils of the other sites except Otte, Budo Egba and Ojagboro with higher values (Table 2). In soils of Budo Abio, Oyun, Eroomo and Isale Aluko, the available phosphorous were statistically the same. Soils of Budo Egba, Ojagboro and Control site were significantly different in their available phosphorous content in the order of $2 \geq 6 \geq 13$ (Table 2). Soils of Coca cola and Odoore recorded a significantly low available phosphorous compared to soils of the other sites. The range of mean Nitrogen content in soil was 0.69 ±0.01% and 1.06 ±0.01%. Soil of Budo Egba recorded the lowest value of Nitrogen while soil of the Control site recorded the highest percentage of soil Nitrogen.

Table 3 shows the physicochemical properties of soil used to raise the vegetable accessions in the second dry season (2016). The range of the moisture content of the soils was between 10.86±0.07%

and 19.63±0.04 % with the lowest moisture content observed in Odoore and the highest in Olaolu. The moisture content of the Control was lower than the other sites except Okeodo, Cocacola and Odoore. Moisure content of Okeodo and Cocacola were significantly the same at $p \leq 0.05$. The moisture content of the two dry seasons, 2015 and 2016 were statisticallt the same. There were significant differences in the moisture content between the sites (Table 3). The pH of the soil ranged between 6.61±0.01 and 7.20±0.01 with the lowest recorded in Eroomo and the highest in Mubo. The pH of the Control site was lower than the other sites except Budo Egba and Eroomo. The pH of the Control site and Odoore were statistically the same, so also were those of Budo Egba and Eroomo, Budo Abio and Eroomo, Otte and Isale Aluko at $p \leq 0.01$. The soil pH range of the second dry season was more or less the same with the first dry season (Table 2 and 3). It further showed that the soil pH in the second dry season was also slightly acidic to slightly alkaline (Table 3).

The range of bulk density of the soil was between 1.96±0.02 g/cm^3 and 2.75±0.01 g/cm^3 with the lowest bulk density in Oyun and the highest in Odoore. The bulk density of the soil of the Control site was higher than soil of the other sites except the soil of Odoore (Table 3). The soil of the Control site had the same bulk density value with Odoore statistically. No significant differences in the bulk densities of soils of Oyun and Olaolu and the soils of Eroomo and Okeodo were found. The bulk densities of soils were more or less in the soil for 2015 and 2016 (Tables 2 and 3). The range of the Total acid value of the soil was between 0.16±0.01 mgKoH/g and 0.56±0.01 mgKoH/g with the lowest in Cocacola and the highest in Eroomo. The total acid value of the Control site was higher than all the other sites except those of Budo Egba, Olaolu and Eroomo (Table 3). The total acid values of Otte, Budo Abio and Isale Aluko were significantly the same at $p \leq 0.05$. There were no significant differences in the total acid value of soil of the Control site, Odoore and Okeodo at $p \leq 0.05$, so also were the Mubo and Ojagboro, Oyun and Cocacola (Table 3). The organic matter of the soil ranged between 2.11±0.07 % and 3.33±0.13 % with the lowest recorded in soil of Cocacola and the highest in Mubo. The Control site had higher organic matter content than the other sites except for Budo Abio, Mubo, Oyun, Ojagboro and Okeodo (Table 3). Otte and Odoore were statistically the same in the organic matter content, so also were Budo Egba and Okeodo, Olaolu and Erooom at $p \leq 0.05$. The total acid value of Mubo soil was statistically the same as that of Eroomo.

The cation exchange capacity (CEC) of the soil ranged between 3.59±0.09 Cmolc/kg and 8.63±0.09 Cmolc/kg with the lowest recorded in Isale Aluko and the highest in Odoore. The cation exchange capacity of the Control site was lower than other sites except for Olaolu and Isale Aluko (Table 3). Available phosphorous in soils used for second dry season planting (2016) ranged between 0.83±0.08 mg/l and 5.90±0.03 mg/l with the lowest recorded in Odoore and the highest in Otte. The Control soil recorded higher available phosphate than the other sites except for Otte, Budo Egba, Oyun and Ojagboro. Available phosphorous of the soil of Budo Abio and Mubo, Olaolu and Cocacola, and Eroomo and Isale Aluko were statistically the same at $p \leq 0.01$. The nitrogen content in the soil ranged between 0.60±0.01% and 1.06±0.06 % with the lowest recorded for Ojagboro and the highest for Budo Egba. There were very slight significant differences in the soil nitrogen of first season (2015) and second dry season (2016). (Tables 2 and 3). The Nitrogen content of the Control site was lower than all the other sites except for Ojagboro. Nitrogen content for Otte and Budo Egba were statistically the same, so also were Budo Abio, Oyun and Eroomo, Mubo, Okeodo and Odoore at $p \leq 0.05$ (Table 3).

Table 4 shows the physico-chemical properties of soil samples used to raise vegetable during the first rainy season (2016). The range of moisture of soils used for the first rainy season (2016) ranged between 13.65±1.35% and 17.79± 1.93%. Highest percentage moisture was recorded for soil of Odoore while the lowest was recorded for soil of Ojagboro. pH of soils used to raise plants during the first rainy season ranged between 6.59± 0.05 and 6.97±0.11 suggesting that the soils were slighty acidic. The pH of soil of the Control site was higher than the pH of soils of the other sites except for the Eroomo (Table 4). pH for soil of Budo Egba recorded the highest while the lowest was recorded for soil of Eroomo. Soils of all the sites except for Eroomo, Okeodo and Coca cola were statistically the same showing no significant differences in the pH values. The range of bulk density for soils used to raise plants during the first rainy season was between 2.19±0.08 g/cm^3 and 2.47±0.16 g/cm^3 (2016). Highest value of bulk density was recorded for soil of Budo Egba while the lowest was recorded for soil of Isale Aluko. The range of the total acid value for soils was 0.33± 0.14 mgKOH/g and 0.56±0.04 mgKOH/g. The highest value was recorded for the soil of Okeodo while the lowest was recorded for soil of Budo Egba. The range of the organic matter for the soil samples used for planting in the first rainy (2016) was between 2.28 ±0.22% and

3.01±0.20% . Organic matter for soil of the Control site was higher than soils of the other sites except for the soil of Otte (Table 4). Highest organic matter for the soil samples used for planting for the first rainy (2016) was obtained for the soil of Otte while the lowest was recorded for soil of Eroomo. The range of the available phosphorous for soil samples was between 1.65 ±0.79 mg/l and 3.15± 0.97 mg/l. Soil of the Control site recorded lower available phosphorous than soils of the other sites except for Eroomo, Okeodo, Coca cola and Isale Aluko that had lower available phosphorous than the Control soil.Highest available phosphorous for soil was obtained of Oyun (3.15 mg/ l) while the lowest was recorded for soil of Eroomo (1.65 mg/ l) (Table 4). The range of the Cation Exchange Capacity (CEC) for soils used to plant during the first rainy season (2016) was 4.61 ± 0.71 Cmolc/kg and 6.09 ± 1.11 Cmolc/kg. Soil of the Control site recorded lower value of CEC than the soils of other sites except for soils of Eroomo and Isale Aluko. The highest CEC value was recorded for Oyun soil and the lowest for Eroomo soil. Soil of Okeodo had the same CEC value statistically with soil of the Control site (5.31±0.19 Cmolc/kg). Only the soil of Eroomo recorded lower value of CEC than the Control site (Table 4). Total Nitrogen of soils ranged between 0.74± 0.09% and 0.96± 0.08%. The highest total Nitrogen was recorded for Odoore and the lowest for the soil of Ojagboro (Table 4). Total nitrogen for the Control soil was lower than the other soils except for the soil of Odoore. The total nitrogen content of all the soils were statistically the same except for the soils of Eroomo, Isale Aluko, Odoore and the Control site for 2016. The physicochemical properties of Soil used to raise the vegetable accessions for the second rainy season (2017) (Table 5).

The moisture content of soils ranged between 15.64±0.02% and 22.72±0.02 %, this showed higher moisture contents than for the soils of the first rainy season (2016). The lowest was recorded for Ojagboro while the highest was recorded for Odoore. The moisture content for the Control site was higher than other sites except for Oyun, Olaolu and Odoore. The moisture content of Oyun and Eroomo soils were statistically the same (Table 5). The pH of the soil samples ranged between 7.11±0.02 and 9.33±0.02 suggesting that the soils were alkaline and were higher than the soil pH for the first rainy season (2016).

Table 2: Physico-chemical properties of soil samples used to raise vegetable accessions in the first dry season (2015).

Site	Moisture (%)	pH	Bulk density (g/cm^3)	TotalAcid value (mgKoH/g)	Org. Matter(%)	CEC (Cmolc/kg)	Available Phosphate (mg/l)	Nitrogen Content (%)
Otte	14.96±0.04^{e}	6.93±0.1^{c}	2.21±0.01^{g}	0.35±0.01^{f}	2.23±0.01^{i}	6.51±0.09^{bc}	5.85±0.05^{a}	1.04±0.01^{b}
Budoegba	12.85±0.03^{f}	6.62±0.04^{h}	2.12±0.01^{h}	0.45±0.01^{bc}	3.07±0.02^{c}	5.56±0.01^{e}	4.25±0.04^{b}	1.06±0.01^{a}
BudoAbio	11.74±0.02^{h}	6.88±0.01^{d}	2.47±0.01^{d}	0.31±0.01^{g}	2.47±0.05^{g}	5.04±0.03^{h}	2.15±0.02^{g}	0.96±0.01^{d}
Mubo area	15.57±0.02^{d}	7.18±0.03^{a}	2.10±0.01^{i}	0.18±0.01^{h}	3.50±0.05^{a}	5.93±0.04^{cd}	2.46±0.01^{e}	0.89±0.01^{f}
Oyun area	17.73±0.03^{c}	7.05±0.04^{b}	1.82±0.01^{k}	0.11±0.06^{i}	3.20±0 .02^{b}	5.43±0.02^{f}	2.17±0.02^{g}	0.95±0.01^{d}
Ojagboro	18.47±0.03^{b}	6.81±0.01^{f}	1.96±0.01^{j}	0.38±0.02^{ef}	2.77±0.02^{e}	5.21±0.03^{g}	3.81±0.02^{c}	0.77±0.01^{i}
Ola-Olu area	18.95±0.02^{a}	6.69±0.01^{f}	1.96±0.01^{j}	0.47±0.01^{b}	2.46±0.03^{g}	4.05±0.01^{j}	2.07±0.01^{h}	0.92±0.01^{e}
Eroomo	10.87±0.01^{i}	6.63±0.04^{hg}	2.59±0.01^{b}	0.53±0.01^{a}	2.53±0.02^{f}	5.89±0.01^{d}	2.17±0.01^{g}	1.01±0.01^{d}
Okeodo	10.45±0.03^{k}	6.85±0.01^{e}	2.56±0.01^{c}	0.36±0.02^{ef}	2..97±0.04^{d}	6.55±0.01^{b}	2.33±0.03^{f}	0.81±0.01^{h}
CocaCola	10.13±0.04^{l}	7.08±0.04^{b}	2.41±0.01^{e}	0.08±0.03^{i}	2.05±0.02^{j}	5.84±0.06^{d}	0.93±0.02^{i}	0.91±0.01^{e}
IsaleAluko	10.38±0.02^{g}	6.94±0.01^{c}	2.31±0.01^{f}	0.35±0.01^{ef}	2.36±0.02^{h}	3.68±0.02^{k}	2.19±0.01^{g}	1.02±0.01^{c}
Odoore	10.58±0.02^{j}	6.68±0.01^{f}	2.69±0.01^{a}	0.43±0.01^{cd}	2.09±0.01^{j}	8.63±0.03^{a}	0.79±0.01^{j}	0.86±0.02^{g}
Bot.garden(Control site)	10.57±0.02^{j}	6.67±0.01^{fg}	2.69±0.02^{a}	0.41±0.01^{ed}	2.56±0.03^{f}	4.83±0.03^{i}	3.72±0.02^{d}	0.69±0.01^{j}

Mean value with same alphabet along the column are statistically the same at $p \leq 0.05$. Values represent mean ± SD

Table 3: The Physicochemical properties of soil used to raise the vegetable accessions in the second dry season (2016).

Site	Moisture content (%)	pH	Bulk Density g/cm^3	Total Acid Value (mgKoH/g)	ORG.MAT (%)	CEC (Cmolc/kg	Available Phosphorous (mg/l)	Nitrogen C0ntent (%)
Otte	15.31±0.04^{e}	6.93±0.03^{c}	2.29±0.04^{ef}	0.37±0.01^{e}	2.15±0.13^{j}	6.57±0.05^{b}	5.90±0.03^{a}	1.06±0.06^{a}
Budo Egba	13.49± 0.03^{g}	6.62±0.01^{h}	2.22±0.03^{f}	0.48±0.01^{c}	2.81±0.27^{c}	5.54±0.10^{f}	4.32±0.04^{b}	1.07±0.6^{a}
Budo Abio	14.38±0.03^{f}	6.89±0.01^{d}	2.53±0.04^{c}	0.35±0.01^{ef}	2.22±0.21^{h}	5.06±0.15^{i}	2.20±0.03^{gh}	1.02±0.08^{b}
Mubo	16.84±0.06^{d}	7.20±0.01^{a}	2.15±0.01^{g}	0.20±0.01^{g}	3.33±0.13^{a}	5.83±0.08^{d}	3.17±1.14^{e}	0.97±0.01^{c}
Oyun	19.17±0.03^{b}	7.02±0.02^{b}	1.96±0.02^{i}	0.17±0.02^{h}	3.06±0.10^{b}	5.41±0.19^{g}	2.21±0.01^{gh}	1.02±0.02^{b}
Ojagboro	18.66±0.03^{c}	6.82±0.01^{e}	2.05±0.01^{h}	0.21±0.01^{g}	2.62±0.12^{d}	5.33±0.39^{h}	3.89±0.03^{c}	0.60±0.01^{h}
Olaolu	19.63±0.04^{a}	6.73±0.02^{f}	1.99±0.03^{i}	0.52±0.02^{b}	2.36±0.08^{fg}	4.04±0.04^{k}	2.10±0.05^{i}	0.93±0.06^{cd}
Eroomo	12.10±0.04^{i}	6.61±0.01^{h}	2.63±0.02^{b}	0.56±0.01^{a}	2.33±0.13^{fg}	5.84±0.08^{d}	2.24±0.15^{g}	1.03±0.08^{b}
Okeodo	11.04±0.03^{k}	6.85±0.03^{d}	2.61±0.02^{b}	0.41±0.01^{d}	2.85±0.14^{c}	6.40±0.02^{c}	2.41±0.02^{f}	0.96±0.10^{c}
Cocacola	11.10±0.04^{k}	7.04±0.03^{b}	2.41±0.01^{d}	0.16±0.01^{h}	2.11±0.07^{jk}	5.72±0.12^{e}	1.10±0.06^{i}	1.04±0.07^{ab}
Isale Aluko	13.08±0.06^{h}	6.95±0.01^{c}	2.27±0.01^{f}	0.36±0.01^{ef}	2.39±0.03^{f}	3.59±0.09^{l}	2.25±0.01^{g}	0.89±0.11^{e}
Odoore	10.86±0.07^{l}	6.68±0.03^{g}	2.75±0.01^{a}	0.43±0.01^{d}	2.19±0.04^{i}	8.63±0.09^{a}	0.83±0.08 ^{j}	0.96±0.03^{c}
Botanical Garden(Control site)	11.41±0.02^{j}	6.67±0.02^{g}	2.73±0.01^{a}	0.42±0.02^{d}	2.47±0.10^{e}	4.80±0.11^{j}	3.79±0.11^{d}	0.71±0.10^{78}

Mean value with same alphabet along the column are significantly the same at $p \leq 0.05$. Values represent mean ± SD.

The pH of the Control site was lower than all other sites except for Otte, Budo Egba, Ojagboro, Cocacola and Isale Aluko. Mubo and Okeodo soils had the same pH statistically at $p \leq 0.05$. The range of the bulk density of the soil samples was between 2.53±0.12 gcm^{-3} and 3.98±0.03 gcm^{-3}. Higher soil bulk densities were recorded for the second rainy season (2017) than the first rainy season (2016). The lowest bulk density of the soil was recorded for Isale Aluko while the highest bulk density was recorded for Odoore soils. The bulk density of the Control site was higher than all the other sites except for Oyun and Odoore (Table 5). The bulk density of the Control soil was statistically the same as for Olaolu, so also were Otte and Budo Egba, Budo Abio and Okeodo, Ojagboro and Coca cola areas (Table 5). The range of the total acid value (TAV) of the soil samples was between 0.18±0.02 mgKoH/g and 0.45±0.01 mgKoH/g with the lowest recorded for Odoore and the highest in Coca cola soils suggesting lower soil TAV in the second rainy season (2017) than the first rainy season (2016). The TAV of the Control soil was lower than the other sites except for Oyun and Odoore. The Control site had the same TAV statistically with Oyun and Olaolu. There were no significant differences for the TAV of soils of Budo Egba, Coca Cola and Isale Aluko (Table 5). Budo Abio, Mubo, Eroomo and Okeodo had the same TAV statistically.

Organic matter for soils used to raise the vegetable accessions during the second rainy season (2017) was between 3.73±0.02% and 5.12±0.03% with the lowest organic matter recorded for Isale Aluko and the highest for Odoore which was a higher range than for the first rainy season (2016). The organic matter of the Control site was higher than the other sites except for Mubo, Oyun, Olaolu, Eroomo and Odoore soils (Table 5). The Control soils had the same organic matter statistically with Mubo, Eroomo and Okeodo, so also were Otte and Budo Egba. The range of the Cation Exchange Capacity of the soils was between 7.50±0.04 Cmolc/kg and 8.60±0.01 Cmolc/kg with the lowest CEC recorded for Isale Aluko and the highest for Odoore. CEC of soils for the second rainy season (2017) were observed to be higher than the first rainy season (2016). The CEC of the Control site was lower than the other sites except for Mubo, Oyun, Olaolu, Eroomo and Odoore (Table 5). The CEC of the Control soil was statistically the same with Budo Abio, so also were Otte and Budo Egba. No significant differences for the CEC of soils of Mubo, Oyun and Olaolu, Eroomo and Okeodo, so also were Ojagboro and Coca Cola were recorded (Table 5). Available phosporous for soils used during the second rainy season (2017) ranged between 6.32±0.02 mg/l and 8.05±0.02 mg/l with the lowest recorded for Isale Aluko and the highest for Odoore soil, suggesting higher values than for the first rainy season (2016). Availble phosphorous of the Control soil was higher than other sites except for Budo Abio, Mubo, Oyun, Eroomo, Okeodo and Odoore. Nitrogen content of the soil samples ranged between 1.59±0.01% and 2.92±0.03% with the lowest recorded for Ojagboro and the highest for Odoore. Higher soil total nitrogen values were observed for the second rainy season (2017) than for the first season (2016). Nitrogen content of the Control soil was higher than other sites except for Budo Abio, Mubo, Oyun, Olaolu, Eroomo, Okeodo and Odoore (Table 5). Nitrogen content of the Control soil was statistically the same with Budo Abio, so also were Mubo and Okeodo soils.

Significant differences in the physico chemical properties of soil samples within the rainy seasons were recorded at $p \leq 0.05$ (Table 4 and 5). Moisture content of the soils between seasons was in the order of second rainy season ≥ first season≥ second dry season≥first dry season (Tables 5,4,3 and 2). pH was in the order first dry season ≥ second dry season≥second rainy season≥ first rainy season. The seasonal order of the soil bulk densities was second rainy season ≥first rainy season≥second dry season ≥first dry season season. For total acid value of soil samples (TAV), the order was first rainy season ≥second dry season≥second rainy season≥first dry season. Soil organic matter between seasons was in the order second rainy season≥first rainy season≥ second dry season. Cation Exchange Capacity of soils between seasons was in the order second rainy season≥first dry season≥second rainy season≥second dry season. The seasonal order of available phosphorous for soils was second rainy season≥second dry season≥first dry season ≥second rainy season while the total nitrogen of soils between seasons was in the order second rainy season ≥second dry season ≥first dry season≥second rainy season. Significant differences in the physico chemical properties of soils within and between seasons were observed at $p \leq 0.05$ (Tables 2, 3, 4 and 5).

4.2. Total heavy metal in soil samples

Table 6 shows the mean concentrations of the total heavy metals of the soil samples used for planting the vegetables for the first dry season (2015). Total Cadmium mean concentration of soils ranged between 0.21±0.05 mg/kg and 4.67±0.29 mg/kg with the lowest mean Cd concentration recorded for soil of the Control site and the highest mean concentration for the soil of Olaolu. Soil of the Control site had the lowest mean concentration of Cd than soils of the other sites (Table 6). Soils for Budo Abio, Eroomo and the Control site had relatively low Cd concentrations than the other soils (Table 6). The range of the total concentration of Copper of the soils was between 2.00±0.90 mg/kg and 4.50±0.12 mg/kg. The lowest concentration of Copper was recorded for soil of Budo Egba (2.00±0.90 mg/kg) while the highest was recorded for Olaolu soil (4.50 ± 0.12 mg/kg). Soil of the Control site recorded the same statistical mean concentration of Copper with soil of Ojagboro. Soils of Eroomo and Okeodo were statistically the same for total concentration of Copper (Table 6). The Control soil recorded a lower mean concentration of Copper than soils of the other sites except for soil of Budo Egba and Odoore (Table 6). Concentration of Lead for soils used for the first dry season (2015) ranged between 1.58 ±1.63 mg/kg and 11.67±15.12 mg/kg.

The lowest mean Lead concentration was recorded for Odoore while the highest was recorded for Mubo soil (Table 6). Mean Pb concentration of the Control soil had lower value than soils of the other sites except for soil of Odoore that had the lowest mean concentration of Pb (Table 6). Okeodo and Coca cola soils had the same statical concentrations of total Pb (Table 6). Soils of Oyun, Olaolu and Okeodo also had the same statistical mean concentration of total Pb. Soils of Mubo and Coca cola recorded relatively higher mean Pb concentration compared to soils of the other sites (Table 6). Pb (11.67 ± 2.12 mg/kg) ranked highest of the total metals followed by Cu (4.50 ±0.12 mg/kg) and Cd (3.05 ±0.25 mg/kg) for the soil samples, that is, the mean of total concentration of metals in this study was in the order Pb ≥ Cu ≥ Cd (Table 6).

Table 4: The physicochemical properties of soil used to raise vegetable accessions during the first rainy season (2016).

Sites	Moisture (%)	pH	Bulk Density (g/cm^3)	Total Acid Value (mgKOH/g)	Org.Mat (.%)	CEC (Cmolc/kg)	Available Phosphate (Mg/ L)	Total Nitrogen (%)
Otte	14.22 ± 1.71^{bc}	6.91 ± 0.16^{ab}	2.21 ± 0.09^{b}	0.43 ± 0.15^{ab}	3.01 ± 0.20^{a}	6.01 ± 0.80^{ab}	3.02 ± 1.45^{a}	0.90 ± 0.14^{a}
Budo Egba	14.02 ± 1.41^{bc}	6.97 ± 0.19^{a}	2.47 ± 0.16^{a}	0.33 ± 0.14^{b}	2.65 ± 0.50^{bc}	5.86 ± 0.68^{b}	$2.60\pm1.^{95}$	0.91 ± 0.08^{a}
Budo Abio	14.91 ± 0.87^{bc}	6.88 ± 0.16^{ab}	2.22 ± 0.05^{bc}	0.43 ± 0.10^{ab}	2.45 ± 0.48^{d}	5.90 ± 0.61^{b}	2.94 ± 1.95^{b}	0.86 ± 0.14^{a}
Mubo	17.63 ± 2.10^{ab}	6.77 ± 0.23^{ab}	2.16 ± 0.07^{c}	0.49 ± 0.19^{ab}	2.37 ± 0.41^{de}	5.67 ± 0.27^{b}	2.72 ± 1.64^{b}	0.84 ± 0.16^{a}
Oyun	14.84 ± 2.89^{bc}	6.75 ± 0.05^{ab}	2.24 ± 0.19^{bc}	0.52 ± 0.08^{ab}	2.41 ± 0.27^{d}	6.09 ± 1.11^{a}	3.15 ± 0.97^{a}	0.93 ± 0.18^{a}
Oja gboro	13.65 ± 1.35^{c}	6.70 ± 0.17^{ab}	2.24 ± 0.19^{bc}	0.54 ± 0.05^{ab}	2.37 ± 0.16^{d}	5.60 ± 1.80^{b}	2.76 ± 1.09^{b}	0.96 ± 0.11^{a}
Olaolu	15.96 ± 1.74^{b}	6.71 ± 0.13^{ab}	2.30 ± 0.11^{b}	0.51 ± 0.01^{ab}	2.31 ± 0.14^{d}	5.45 ± 1.84^{bc}	2.10 ± 0.05^{c}	0.93 ± 0.08^{a}
Eroomo	14.48 ± 1.25^{bc}	6.59 ± 0.08^{b}	2.21 ± 0.08^{bc}	0.53 ± 0.53^{ab}	2.28 ± 0.22^{e}	4.61 ± 0.71^{c}	1.65 ± 0.79^{d}	0.87 ± 0.04^{a}
Okeodo	14.87 ± 1.26^{bc}	6.60 ± 0.06^{b}	2.24 ± 0.10^{bc}	0.56 ± 0.05^{a}	2.24 ± 0.11^{e}	5.31 ± 0.19^{bc}	1.66 ± 0.75^{d}	0.93 ± 0.13^{a}
Coca cola	15.98 ± 2.81^{b}	6.72 ± 0.28a b	2.34 ± 0.24^{b}	0.51 ± 0.15^{ab}	2.48 ± 0.55^{cd}	5.33 ± 0.31^{bc}	1.72 ± 0.80^{d}	0.90 ± 0.15^{a}
Isale Aluko	14.82 ± 2.90^{bc}	6.86 ± 0.26^{ab}	2.19 ± 0.08^{c}	0.41 ± 0.12^{ab}	2.57 ± 0.44^{c}	5.16 ± 0.58^{bc}	2.48 ± 0.54^{bc}	0.83 ± 0.23^{a}
Odoore	17.79 ± 1.93^{bc}	6.92 ± 0.15^{ab}	2.46 ± 0.18^{a}	0.40 ± 0.11^{ab}	2.75 ± 0.48^{b}	5.51 ± 0.92^{b}	2.52 ± 0.53^{bc}	0.74 ± 0.09^{a}
Botanical garden(Ref.site)	15.43 ± 3.36^{b}	6.93 ± 0.18^{ab}	2.28 ± 0.15^{bc}	0.38 ± 0.16^{b}	2.84 ± 0.47a^{b}	5.31 ± 0.99^{b}	2.49 ± 0.52^{bc}	0.77 ± 0.17^{a}

Mean value with same alphabet along the column are significantly the same at $p \leq 0.05$. Values represent mean ± SD

Table 5: The Physicochemical properties of Soil used to raise the vegetable accessions in the second rainy season (2017).

Site	Moisture (%)	pH	Bulk Density gcm-3	TAV (mgKoH/g	ORGMAT (%)	CEC (Cmolc/kg	Available Phosphorous (mg/l)	Total Nitrogen Content (%)
Otte	16.82 ± 0.03^{f}	8.04 ± 0.01^{cdef}	3.05 ± 0.05^{cdef}	0.39 ± 0.01^{b}	4.36 ± 0.01^{bcde}	8.18 ± 0.12^{c}	6.71 ± 0.01^{de}	2.23 ± 0.02^{ef}
Budo Egba	16.76 ± 0.01^{fg}	7.97 ± 0.02^{def}	3.09 ± 0.04^{cdef}	0.43 ± 0.01^{ab}	4.31 ± 0.02^{bcde}	8.20 ± 0.02^{c}	6.65 ± 0.0^{e}	1.85 ± 0.02^{f}
Budo Abio	17.01 ± 0.03^{e}	8.55 ± 0.03^{cde}	3.18 ± 0.08^{cde}	0.33 ± 0.01^{bc}	4.71 ± 0.01^{bcd}	$8.36\pm0.^{04bc}$	7.14 ± 0.01^{cde}	2.51 ± 0.04^{e}
Mubo	17.58 ± 0.03^{d}	8.67 ± 0.03^{cd}	3.39 ± 0.13^{bcde}	0.30 ± 0.01^{bc}	4.82 ± 0.03^{bc}	8.48 ± 0.11^{ab}	7.20 ± 0.01^{cd}	2.63 ± 0.02^{dc}
Oyun	20.13 ± 0.03^{b}	9.05 ± 0.05^{b}	3.85 ± 0.04^{b}	0.26 ± 0.04^{cd}	4.93 ± 0.02^{b}	8.51 ± 0.04^{ab}	7.59 ± 0.02^{b}	2.85 ± 0.01^{b}
Ojagboro	15.64 ± 0.02^{gh}	7.37 ± 0.02^{ef}	2.67 ± 0.08^{def}	0.40 ± 0.04^{ab}	3.90 ± 0.01^{bcdef}	7.76 ± 0.03^{d}	6.44 ± 0.01^{efg}	1.59 ± 0.01^{h}
Olaolu	18.11 ± 0.02^{c}	8.96 ± 0.04^{bc}	3.62 ± 0.04^{bc}	0.29 ± 0.01^{cd}	4.91 ± 0.03^{b}	8.48 ± 0.02^{ab}	7.45 ± 0.01^{bc}	2.75 ± 0.05^{c}
Eroomo	17.54 ± 0.04^{d}	8.78 ± 0.03^{c}	3.44 ± 0.04^{bcd}	0.33 ± 0.02^{bc}	4.88 ± 0.01^{bc}	8.44 ± 0.02^{b}	7.28 ± 0.01^{c}	2.68 ± 0.02^{d}
Okeodo	16.66 ± 0.02^{fgh}	8.67 ± 0.03^{cd}	3.17 ± 0.05^{cde}	0.30 ± 0.01^{bc}	4.80 ± 0.02^{bc}	8.42 ± 0.03^{b}	7.20 ± 0.03^{cd}	2.62 ± 0.02^{dc}
Cocacola	15.51 ± 0.04^{ghi}	7.29 ± 0.03^{efg}	2.62 ± 0.03^{def}	0.45 ± 0.01^{a}	3.87 ± 0.04^{cdef}	7.72 ± 0.03^{d}	6.40 ± 0.01^{ef}	1.67 ± 0.03^{g}
Isale Aluko	15.36 ± 0.04^{hi}	7.11 ± 0.02^{fg}	2.53 ± 0.12^{ef}	0.41 ± 0.03^{ab}	3.73 ± 0.02^{def}	7.50 ± 0.04^{de}	6.32 ± 0.02^{fg}	1.72 ± 0.02^{fg}
Odoore	22.72 ± 0.02^{a}	9.33 ± 0.02^{a}	3.98 ± 0.03^{a}	0.18 ± 0.02^{d}	5.12 ± 0.03^{a}	8.60 ± 0.01^{a}	8.05 ± 0.02^{a}	2.92 ± 0.03^{a}
Botanical Garden(Control site)	17.91 ± 0.01^{cd}	8.30 ± 0.05^{cde}	3.69 ± 0.02^{bc}	0.27 ± 0.02^{cd}	4.81 ± 0.02^{bc}	8.39 ± 0.01^{bc}	6.86 ± 0.04^{d}	2.50 ± 0.01^{e}

Mean value with same alphabet along the column are significantly the same at $p\leq0.05$. Values represent mean ± SD

Table 7 shows the mean concentrations of total heavy metals of soils used to raise the vegetable accessions for the second dry season (2016). The range of total cadmium of the soil of the second dry season ranged between 0.10±0.07 mg/kg and 0.65±0.14 mg/kg with the lowest total cadmium concentration recorded for the Control soil and the highest for Coca cola (Table 7) indicating a lower range of concentration than the first dry season(2015) (0.21±0.05 mg/kg and 3.05 ±0.25). The Control soil had the lower cadmium content than soils of the other sites. Total Cadmium of the soil of Budo Abio and Mubo were statistically the same $p \leq 0.05$, so also were Ojagboro and Cocacola soil. Total cadmium concentration for soil of Olaolu and Eroomo were statistically the same (Table 7). The mean total copper concentration of the soils ranged between 1.40±0.08 mg/kg and 4.79±0.21 mg/kg which was slightly higher than the first dry seaon (2015). The lowest copper concentration was recorded for Ojagboro while the highest was recorded for Olaolu. The copper concentration of the Control soil was lower than the other sites except for Budo Egba and Ojagboro. There were no significant differences in the total cadmium content of soils of Olaolu and Okeodo with $p \leq 0.05$ (Table 7).

The mean total Lead concentration of soil used for the second dry season (2016) ranges between 1.29±0.13 mg/kg and 7.76±0.68 mg/kg with the lowest recorded for Odoore and the lowest for Mubo soils suggesting lower Pb concentration for the second dry season (2016) than for the first dry season (2015) (11.67 ± 2.12 mg/kg). The total Pb of the Control soil was lower than the other sites except for Odoore. There were no significant differences for the total Pb concentration of Oyun and Olaolu soils. The highest total metal was recorded for Pb (7.76±0.68 mg/kg) followed Cu (4.29±0.21 mg/kg) and lastly Cd (0.65±0.14 mg/kg) (Table 7). Pb and Cd were of higher concentrations for the first dry season (2015) than for second dry season (2016) while Cu concentration was higher for second dry season soils than for the first dry season. The Control soils had higher concentrations of the heavy metals (Cd, Cu and Pb) during the first dry season than the second dry season, this may be due to the variations in the physico chemical properties of the soils. Significant differences between the total concentrations of heavy metals of soils between and within sites and seasons were recorded at $p \leq 0.05$ (Table 6 and 7). Table 8 shows the total cadmium, copper and Lead for soils used to raise the vegetable accessions for the first rainy season (2016). Total cadmium concentration ranged between 0.17±0.04 mg/kg and

2.75±0.20 mg/kg with the lowest total cadmium content recorded for the Control soil while the highest was recorded for Otte. The total Cd content of the Control site was lower than the other sites. Soils of Mubo, Ojagboro and Coca Cola had the same statistical concentration of total Cd. Olaolu soil had the same statistical content of total Cd with Eroomo, so also were Okeodo and Odoore soils (Table 8). The range of total copper was between 2.41±0.29 mg/kg and 30.08±4.40 mg/kg with the lowest recorded for Mubo and the highest for Olaolu. Total Cu of the Control site was higher than other sites except for Otte, Budo Egba , Olaolu and Eroomo (Table 8). Total Lead of the soil samples in the first rainy season (2016) ranged between 5.25±0.25 mg/kg and 48.33±0.14 mg/kg with the lowest obtained for Budo Abio and the highest for Olaolu soil. The total Pb of the Control site was lower than the other sites except for Budo Abio. Table 9 shows the mean concentrations of total heavy metals of the soil samples used for planting the vegetables accessions for the second rainy season (2017).

The range of the mean concentration of Cadmium of soils was between 0.00±0.00 mg/kg and 1.33±1.26 mg/kg suggesting a lower Cd concentration for the second rainy season (2017) than for first rainy season (2016) this could be due to acid rain in the first rainy season which could increase the Cd concentration of the soil. Lowest total Cd was recorded for the soil of the Control while the highest was recorded for soils of Otte (Table 9). Soil of the Control site had a non detectable Cd content (0.00± 0.00 mg/kg) indicating higher Cd concentration for soil of the Control for the first rainy season than the second rainy season. Soils of Budo Abio and Mubo recorded the same statistical value of Cadmium. The range for total Copper of soil was 3.33±1.33 mg/kg and 20.00 ± 2.00 mg/kg. Soil of the Control site recorded lower mean Cu concentration than soils of Otte, Budo Egba, Olaolu and Eroomo (Table 9). The lowest concentration of Cu was recorded for the Control site (3.33±1.33 mg/kg) while the highest concentration was recorded for Eroomo (20.00± 2.00 mg/kg) (Table 9) indicating lower Cu concentration in the second rainy season than for the first rainy season (2016) but higher Cu concentration was recored in the Control soil of the second rainy season than the first rainy season this could be due to higher microbial activities. There were no significant differences in the concentration of Copper for soils of Otte, Budo Egba, Ojagboro and Isale Aluko. Soils of Oyun, Ojagboro and Okeodo had the same statistical concentration of Copper. The range of Lead was 8.00±0.50 mg/kg and 82.00 ± 6.00 mg/kg suggesting higher Pb concentration for the soil for the second rainy season than the first rainy season (2016). The lowest Pb concentration was recorded for the Control site (8.00±0.50 mg/kg) higher than the value for the Control soil of the first rainy season (5.25±0.25 mg/kg) and the highest recorded for Olaolu (Table 9). The concentration of lead of the Control site was lower than the soils of the other sites. Soil of the Control site recorded the lowest concentrations of total metals; Cd, Cu and Pb. Pb (82.00±10.00 mg/kg) recorded the highest concentration for soil followed by Cu (20.00± 2.00 mg/kg) and the lowest heavy metal was Cd (1.33±1.26 mg/kg) for the second rainy season. Total Cd concentration between seasons was in the order first dry season ≥ first rainy season ≥ second dry season ≥second rainy season, Cu concentration was in the order first rainy season ≥second rainy season ≥second dry season ≥ first dry season. While the trend of Pb concentration of the soil in this study was second rainy season ≥first rainy season ≥ first dry season ≥second dry season (Tables 6, 7, 8 and 9).

Table 6. Concentration of total heavy metals of soil samples (mg/kg) used to raise the vegetable accessions in the first dry season (2015)

Site	Cd (mg/kg)	Cu (mg/kg)	Pb (mg/kg)
Otte	2.92±0.38 [cde]	2.42±0.80[cd]	3.92±0.15 [cde]
Budo Egba	2.15±0.14 [def]	2.00±0.90 [def]	3.58± 0.21 [cde]
Budo Abio	0.93±0.07 [e]	3.00±1.52 [bcd]	3.42±0.64 [cde]
Mubo	3.05±0.25 [bcde]	3.67±1.61 [b]	11.67±2.12 [a]
Oyun	2.83±0.12 [cdef]	2.58±0.14 [cd]	5.08±7.54 [c]
Ojagboro	3.76 ±0.14 [bc]	2.33±1.90 [de]	2.50±0.33 [def]
Olaolu	4.67±0.29 [a]	4.50±0.12 [a]	5.08±0.69 [c]
Eroomo	0.75±0.09 [fg]	4.42±3.00 [ab]	3.42±0.64 [cde]
Okeodo	4.62±0.14 [ab]	4.42±3.25 [a b]	5.17±0.47 [c]
Coca cola	3.98±0.14 [b]	3.08±2.02 [bcd]	10.75±0.70[b]
IsaleAluko	1.75±0.25 [ef]	3.42±1.84 [bc]	4.12±0.76 [cd]
Odoore	0.67±0.11 [g]	2.08±2.00 [def]	1.58±0.63 [f]
Botanical garden(C/site)	0.21±0.03[f]	2.33±1.16 [de]	2.25±0.43 [ef]

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean ± SD

EU FAO 1998 :Cd= 3.00, Cu =140.00, Pb = 300.00: USA EPA 2008 Cd= 3.00, Cu= 80.00-200.00, Pb =300.00:

WHO/FAO 2008:Cd=1.40, Cu=63.00, Pb=70.00: UK EPA : Cd=1.50. Cu=100.00, Pb= 100.00 (mg/kg).

Table 7: .Concentration of total heavy metals of soils used (mg/kg) used to raise the second dry season (2016)

Site	Cd	Cu	Pb
Otte	0.32 ± 0.06^{f}	2.18 ± 0.10^{i}	3.74 ± 5.22^{g}
Budo Egba	0.48 ± 0.02^{d}	1.71 ± 0.14^{j}	3.21 ± 5.57^{i}
Budo Abio	0.25 ± 0.00^{g}	2.67 ± 0.38^{f}	4.84 ± 4.94^{c}
Mubo	0.24 ± 0.24^{g}	3.56 ± 0.37^{c}	7.76 ± 0.68^{a}
Oyun	0.21 ± 0.20^{h}	2.39 ± 0.18^{h}	4.30 ± 6.40^{d}
Ojagboro	0.64 ± 0.11^{a}	1.40 ± 0.08^{k}	4.25 ± 3.78^{de}
Olaolu	0.61 ± 0.25^{ab}	4.79 ± 0.21^{a}	4.33 ± 3.82^{d}
Eroomo	0.62 ± 0.53^{ab}	4.00 ± 0.83^{b}	4.92 ± 4.26^{b}
Okeodo	0.55 ± 0.17^{c}	4.25 ± 1.15^{a}	4.08 ± 4.40^{f}
Cocacola	0.65 ± 0.14^{a}	2.77 ± 1.07^{e}	3.25 ± 3.43^{i}
Isale Aluko	0.44 ± 0.23^{de}	3.17 ± 1.84^{d}	3.50 ± 4.16^{h}
Odoore	0.47 ± 0.03^{d}	2.60 ± 2.26^{g}	1.29 ± 0.13^{k}
Botanical Graden(Control site)	0.10 ± 0.03^{i}	2.39 ± 2.13^{h}	1.83 ± 0.38^{j}

Table 8: Mean concentration of total heavy metals in soils used to raise the vegetable accessions in the first rainy (2016).

Site	Cd	Cu	Pb
Otte	2.75 ± 0.20^{a}	20.13 ± 0.03^{cd}	28.91 ± 0.03^{d}
Budo Egba	1.83 ± 0.14^{b}	22.02 ± 0.45^{c}	25.30 ± 0.31^{efg}
Budo Abio	0.58 ± 0.29^{d}	3.50 ± 0.25^{gh}	5.25 ± 0.25^{i}
Mubo	0.67 ± 0.14^{c}	2.41 ± 0.29^{h}	25.25 ± 0.25^{efg}
Oyun	0.42 ± 0.14^{e}	9.48 ± 0.48^{f}	27.62 ± 0.10^{de}
Ojagboro	0.67 ± 0.14^{c}	12.08 ± 0.38^{e}	28.63 ± 0.13^{cde}
Olaolu	0.25 ± 0.00^{gh}	30.08 ± 4.40^{a}	48.33 ± 0.14^{a}
Eroomo	0.25 ± 0.00^{gh}	26.67 ± 1.44^{b}	24.97 ± 0.13^{fg}
Okeodo	0.33 ± 0.14^{fg}	11.17 ± 0.14^{ef}	25.67 ± 0.14^{f}
Cocacola	0.67 ± 0.14^{c}	9.17 ± 0.14^{f}	39.15 ± 0.17^{b}
Isale Aluko	0.50 ± 0.25^{de}	11.67 ± 0.95^{e}	31.79 ± 0.05^{c}
Odoore	0.33 ± 0.14^{fg}	17.42 ± 0.29^{de}	24.23 ± 0.23^{fg}
Botanical Graden(Control site)	0.17 ± 0.14^{h}	18.07 ± 0.16^{d}	5.44 ± 0.25^{gh}

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean ± SD

EU FAO 1998 :Cd= 3.00, Cu =140.00, Pb = 300.00: USA EPA 2008 Cd= 3.00, Cu= 80.00-200.00, Pb =300.00:

WHO/FAO 2008:Cd=1.40, Cu=63.00, Pb=70.00: UK EPA : Cd=1.50. Cu=100.00, Pb= 100.00 (mg/kg).

Table 9 : Mean concentration of total heavy metals (mg/kg) in the soil samples the in the second rainy season (2017).

Sites	Cd	Cu	Pb
Otte	1.33±0.06[a]	14.67±2.26[abcde]	19.67±4.76[def]
Budo Egba	1.17±0.29[ab]	11.83±7.75[bcde]	17.17±3.75[def]
Budo Abio	0.83±0.76[b]	6.33±5.25[def]	14.67±9.25[ef]
Mubo	0.17±0.29[c]	16.67±15.12[abcd]	62.50±60.00[ab]
Oyun	0.00±0.00[d]	8.83±1. 26[cde]	22.50±2.50[cde]
Oja gboro	0.00±0.00[d]	9.00±0.05[bcde]	18.67±2.26[def]
Olaolu	0.18±0.28[c]	19.50±8.00[abc]	82.00±6.00[a]
Eroomo	0.17±0.29[c]	20.00±2.00[ab]	17.75±11.67[def]
Okeodo	0.00±0.00[d]	9.50±3.00[bcde]	19.67±0.29[def]
Coca cola	0.00±0.00[d]	13.83±6.75[abcde]	24.00±0.00[de]
Isale Aluko	0.00±0.00[d]	12.83±3.25[abcde]	58.50±6.00[bc]
Odoore	0.00±0.00[d]	7.83±6.25[de]	28.33±25.06[de]
Botanical garden(Ref.site)	0.00±0.00[d]	3.33±0.33[ef]	8.00±0.50[cde]

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean ± SD

EU FAO 1998 :Cd= 3.00, Cu =140.00, Pb = 300.00: USA EPA 2008 Cd= 3.00, Cu= 80.00-200.00, Pb =300.00:

WHO/FAO 2008:Cd=1.40, Cu=63.00, Pb=70.00: UK EPA : Cd=1.50. Cu=100.00, Pb= 100.00 (mg/kg).

. **4.3: Phytoavailable metal in soil samples**

Table 10 shows the mean phytoavailable heavy metals of the soil samples used for planting the vegetables in the first dry season (2015) Phytoavailable Cd of the soil used for the first dry season ranged between 0.11±0.02 mg/kg and 0.67±0.14 mg/kg. Soil of the Control site recorded the lowest mean phytoavailable Cd while Coca cola soil recorded the highest. Soils of Otte, Oyun and Ojagboro recorded statistically the same mean phytoavailable Cadmium. No significant differences were recorded for the mean phytoavailable Cd of soil of Budo Egba, Mubo and Coca cola (Table 10). Soils of Olaolu and Okeodo had the same phytoavailable Cd. Phytoavailable Copper in the first dry season (2015) ranged between 0.17±0.04 mg/kg and 1.83±0.05 mg/kg. Soil of the Control recorded lower mean phytoavailable Cu than soils of other sites except for Otte and Budo Egba. Highest mean phyto available Copper was recorded for the soil of Mubo (1.83± 0.05 mg/kg) while the lowest was recorded for the soils of Otte and Budo Egba (Table 10). Soils of Budo Abio, Okeodo, Coca cola and Isale Aluko were statistically the same in the mean phytoavailable Copper The mean phytoavailable Cu for soils of Olaolu, Eroomo and Odoore recorded no significant differences (Table 10). Soils of Oyun and Ojagboro were of relatively higher mean Phytoavailable Cu compared to soils of other sites. Soils of the Control site recorded higher mean phytoavailable Cu than soils of Otte and Budo Egba.

Phytoavailable Pb of soils used for planting in the first dry season (2015) ranged between 0.50±0.07 mg/kg and 5.83±0.46 mg/kg. Soil of the Control site was of a significantly low mean phytoavailable Lead compared to soils at the other sites. No significant differences were recorded in the phytoavailable Pb for soils of Budo Egba and Mubo. The mean phytoavailable Pb in soils of Ojagnoro and Olaolu were the same statistically (Table 10). Soil of the Control site recorded the lowest mean concentration of the phytoavailable Pb while the highest was recorded for soil of Ojagboro (Table 10). Soils of sites 6, 7, 10 and 12 recorded comparatively high value of phytoavailable Pb than soils at the other sites. Soils of Otte and Control site recorded relatively low mean phytoavailale Pb than soils of the other sites. Table 11 shows the Phytoavailable Cadmium in soils in the second dry season (2016) between sites was ranged between 0.00±0.00 mg/kg and 0.15±0.03 mg/kg. It was observed that mean phytoavailable Cd in soil was higher for the first dry season (2015) than the second dry season (2016). Soil of the

Control site recorded the lowest mean concentration of phytoavailable Cd of 0.00 ±.0.00 mg/kg , so also were soils of Eroomo and Odoore. Soils of Otte, Oyun and Ojagboro recorded statistically the same mean phytoavailable Cadmium. No significant differences were recorded for the mean phytoavailable Cd of soils of Budo Egba, Mubo, Oyun, Ojagboro and Isale Aluko (Table 11). Soils of Olaolu and Okeodo had the same phytoavailable Cd. Mean phytoavailable copper used for the second dry season (2016) ranged between 0.39±0.02 mg/kg and 3.87±0.06 mg/kg indicating more phytoavailable Cu in the second dry season than in the first dry season (Table 11). Phytoavailable Cu of the Control soil was lower than other soils. Phytoavailable Cu was higher for the Control soil of the second dry season (0.44±0.06 mg/kg) than for the first dry season (0.17±0.04 mg/kg). For second dry season (2016) phytoavailable Pb, the range was 0.83±0.03 mg/kg and 3.00 ±0.02 mg/kg suggesting higher mean phytoavailable Pb for the second dry season (2016) than the first dry season (2015). The lowest mean phytoavai;able Pb was recorded for Odoore soil while the highest was recorded for Coca cola soil.

The mean Phytoavailable Pb for the Control soil was lower than the other soils except for Odoore and Eroomo soil (Table 11). Phytoavailable Pb for the Control soil was lower for the first dry season (0.50 ±0.03 mg/kg) than the second dry season (0.83±0.17 mg/kg). Phytoavailable Pb ranked highest of the phytoavailable metal followed by Cu and lastly Cd. Soils of the Control site recorded relatively high phytoavailable Cu and Pb within site but comparatively low phytoavailable Cd. The mean concentrations of phytoavailable Pb between sites were relatively higher than the other metals. Comparatively, higher phytoavailable Cd, Cu and Pb were recorded for the first dry season than for the second dry season where Cd recorded low concentrations for most of the soils (Tables 10 and 11). Table 12 shows the phytoavailable heavy metals of soils used to raise the vegetable accessions in the first rainy season (2016). Phytoavailable Cd used for the first rainy season was ranged between 0.00±0.00 mg/kg and 0.08±0.14 mg/kg with a non detectable value (0.00 ± 0.00 mg/kg) as the lowest for Budo Abio, Eroomo, Odoore and the Control site while the highest was recorded in Cocacola (Table 12).

Table 10: Mean phytoavailable heavy metals (mg/kg) of the soil samples used for planting the for the first dry season (2015).

Site	Cd	Cu	Pb
Otte	0.42 ± 0.02^{bcd}	$0.33\pm0.09c^{d}$	0.83 ± 0.14^{fg}
Budo Egba	0.50 ± 0.00^{b}	0.41 ± 0.00^{c}	1.33 ± 0.31^{efg}
Budo Abio	0.33 ± 0.02^{cd}	0.20 ± 0.00^{d}	1.92 ± 0.40^{ef}
Mubo	0.50 ± 0.03^{b}	1.25 ± 0.13^{ab}	1.92 ± 0.11^{ef}
Oyun	0.42 ± 0.03^{bcd}	1.83 ± 0.05^{a}	2.92 ± 0.27^{de}
Ojagboro	0.45 ± 0.08^{bcd}	0.75 ± 0.06^{b}	5.17 ± 0.20^{ab}
Olaolu	0.25 ± 0.05^{d}	0.33 ± 0.07^{ab}	4.37 ± 0.40^{b}
Eroomo	0.17 ± 0.03^{de}	0.33 ± 0.09^{cd}	3.17 ± 0.11^{cde}
Okeodo	0.25 ± 0.00^{d}	0.25 ± 0.05^{d}	3.75 ± 0.78^{cd}
Coca cola	0.67 ± 0.14^{a}	0.25 ± 0.25^{d}	5.83 ± 0.46^{a}
IsaleAluko	0.53 ± 0.04^{cd}	0.25 ± 0.05^{d}	1.50 ± 0.18^{fg}
Odoore	0.14 ± 0.03^{a}	0.33 ± 0.09^{cd}	0.92 ± 0.16^{f}
Botanical garden(control.site)	0.11 ± 0.02^{e}	0.17 ± 0.14^{d}	0.50 ± 0.07^{h}

Mean value with same alphabet along the same column are significantly the same at $p\leq0.05$.

Table 11: Phytoavailable heavy metal (mg/kg) of soils used to raise the vegetable accessions for the second dry season (2016)

Site	Cd	Cu	Pb
Otte	0.05±0.09[c]	1.13±0.04[b]	2.52±0.12[b]
Budo Egba	0.11±010b	1.25±0.22[b]	2.27±0.03[c]
Budo Abio	0.04±0.06c[d]	1.05±0.07[bc]	1.02±0.02[h]
Mubo	0.10±0.09[b]	0.93 ±0.13[c]	1.51±0.01[f]
Oyun	0.10±0.00[e]	0.85±0.06[f]	1.31±0.02[g]
Ojagboro	0.10±0.03[b]	3.86±0.1 6[a]	2.16±0.02[d]
Olaolu	0.04±0.08[cd]	1.00±0.00[bc]	1.49±0.58[ef]
Eroomo	0.00±0.00[e]	0.86±0.11[cd]	0.88±0.02[h]
Okeodo	0.06±0.10[c]	0.72±0.05[d]	1.59±0.02[e]
Cocacola	0.15±0.08[a]	0.69±0.19[d]	3.00±0.02[a]
Isale Aluko	0.11±0.04[b]	1.70±0.16[ab]	1.48±0.02[ef]
Odoore	0.00±0.00[e]	0.54±0.02[de]	0.96±0.01[gh]
Botanical Graden(Control site)	0.00±0.00[e]	0.44±0.06[e]	0.83±0.17[h]

Mean value with same alphabet along the column the same are statistically the same at $p \leq 0.05$. Values represent mean ± S

Phytoavailable Cu of soils during the first rainy season (2016) ranged between 3.33±0.38 mg/kg and 9.25±0.25 mg/kg with the lowest recorded for Mubo and the highest recorded for Olaolu. Phytoavailable Cu of the Control site was higher than the other sites except for Otte, Budo Egba, Olaolu and Eroomo. The range of the phytoavailable Pb of the soils used for the first rainy season (2016) was between 0.33±0.03 mg/kg and 6.25±0.25 mg/kg with the lowest recorded for Budo Abio and the highest for Coca cola. Phytoavailable Pb of the Control site was lower than the other sites except for Budo Abio.

Table 13 shows the phytoavailable cadmium, copper and lead in soils used to raise the vegetable accessions in the second rainy season (2017). The range of phytoavailable cadmium of soil ranged between 0.00±0.00 mg/kg and 0.15±0.03 mg/kg. A non detectable value (0.00±0.00 mg/kg) as the lowest was recorded for Eroomo, Odoore and the Control site while the highest was recorded for Coca cola. This indicated higher mean phytoavailable Cd for the second rainy season (0.13±0.03 mg/kg) than the first rainy season 0.08±0.14 mg/kg. Phytoavailable Cadmium content of the Control site (0.00±0.00 mg/kg) was lower than the other sites. Phytoavailble Cd was not detected for the Control site for both the first and second rainy seasons. Phytoavailable Copper content of the soils used for the second rainy season planting ranged between 1.80±0.25 mg/kg and 7.25±0.14 mg/kg indicating lower phytoavailable Cu than for the first rainy season planting (3.33±0.38 mg/kg and 9.25±0.25mg/k).

Lowest phytoavailable Cu was recorded for the Control soil while th highest was recorded for the soil of Isale Aluko. The phytoavailable copper of the Control site was statistically the same with Budo Abio. Phytoavailable Copper concentration of the Control site was lower than the other sites. Phytoavailable copper for the soil of Otte, Mubo and Oyun were statistically the same. Phytoavailable Lead of soils ranged between 0.27±0.09 mg/kg and 3.00±0.05 mg/kg with the lowest recorded for Control soil and the highest for Coca cola soil suggesting lower value than for the first rainy season (0.33±0.03 mg/kg and 6.25±0.25). Phytoavailable Pb of the Control site was lower than the other sites, same report was recorded for the first rainy season (Table 13). There were significant differences for the phytoavailable Pb of Mubo and Isale Aluko. Phytoavailable Cu and Pb were higher for first rainy seaon planting (2016) than for the second rainy season(2017) while Cd was more phytoavailable in the second rainy season(2017) than the first rainy season (2016). There were significant differences in the phytoavailable heavy metals for soils for the second rainy season with Cu≥ Pb ≥ Cd the same sequence recorded for the first rainy season. Phytoavailable heavy metals for this study recorded highest phytoavailable Cu with the highest value (9.25±0.25) recorded for the first rainy season(2016), followed by the second rainy season (2017) with the value (7.25±0.14 mg/kg), the second dry season (2016) recorded (3.86 ±0.16 mg/kg) and lastly the first dry season (2015) with the value (1.83 ± 0.05 mg/kg). Cu was more phytoavailable in the rainy season than the dry season.The sequence of phytoavailable Pb for the planting seasons was first rainy season ≥ second rainy season ≥first dry season ≥second dry season (Tables 10, 11 12 and 13).

Phytoavailable Cd was more in soils used for the first season planting (2015) with the value (0.67±0.14 mg/kg), followed by the second dry season (0.15±0.08 mg/kg), next to it was the second rainy season (0.13±0.03 mg/kg) and lastly was the first rainy season season (0.08±0.14 mg/kg). Cadmium was more phytoavailable in soils for dry seasons planting than the rainy seasons. Soils of the Control site for all the seasons had the lowest phytoavailable heavy metal except for Cu in the rainy seasons. Rainy season Control soils had higher phytoavailable Cu and Pb than the dry season Control soils. Significant differences for the phytoavailable heavy metals for soils for planting in the two intra and inter seasons were recorded with Cu≥Pb≥Cd (Tables 10, 11, 12 and 13). It was observed that soils of Otte, Budo Egba, Mubo, Oyun, Olaolu, Okeodo and Coca cola contain more of Pb and Cd than Cu while Budo Abio, Eroomo and Control soils had relatively low phytoavailable metals (Cd, Cu and Pb). Most of soils were high of phytoavailable Cu.

4.4: Heavy metal partitioning in soil samples (fractionation)

Table 14 shows the mean concentrations and standard deviations of fractionation of cadmium in the soils used to plant vegetables during the first dry season (2015). Exchangeable cadmium in soil used to raise the vegetable accessions in the first dry season was between 0.00±0.00 mg/kg and 1.67±0.00 mg/kg with the lowest recorded in the soil of the Control site and .highest mean concentration recorded in soil of Budo Egba No significant difference was recorded in the mean concentration of the exchangeable fraction of Cd in soils of Budo Abio and Eroomo. Soils of

Mubo, Oyun, Eroomo and Isale Aluko were statistically the same in the concentration of exchangeable Cd. Soils of Ojagboro, Olaolu, Okeodo and Coca cola recorded same mean concentration of exchangeable. Soils of Otte and Budo Egba recorded comparatively higher mean concentrations of exchangeable Cd than soils in the other sites. Cadmium bound to carbon in the first dry season ranged between 0.00±0.00 mg/kg and 1.33±0.00 mg/kg with the lowest obtained in the soils of the Eroomo, Odoore and the Control sites while the highest was obtained in the soil of Okeodo (Table 14). Mean value with same alphabet along the column are significantly the same at $p \leq 0.05$. Values represent mean ± SD.

Soils of Otte and Budo Abio recorded the same Cd bound to Carbon statistically (Table 14). Oyun, Ojagboro and Olaolu were statistically the same in the mean concentration of Cd bound to Carbon (Table 14). Cadmium bound to oxides ranged between 0.00±0.00 mg/kg and 0.67±0.00 mg/kg with the lowest obtained in the soils of the Budo Abio, Odoore and the Control site while the highest was recorded in soil of Otte (Table 14). Soils of Budo Abio, Eroomo and the Control site were statistically the same in the mean concentration of Cd bound to Oxides (Table 14). No significant difference was recorded in the mean concentration of Cd bound to Oxides in soils of Otte and the Budo Egba. Soils of Oyun, Olaolu and Okeodo had the same fraction Cd bound to Oxides at $p \leq 0.05$ (Table 14). Cadmium bound to Organics in the first dry season ranged between 0.00±0.00 mg/kg and 0.89±0.39 mg/kg with the lowest obtained in the soils of the Control site while the highest was obtained in the soil of Mubo (Table 14). Soils of Budo Egba, Coca cola and Isale Aluko were statistically the same in the mean concentration of Cd bound to Organics. Soils of Oyun and Eroomo had the same concentration of Cd bound to Organics (Table 14). Soils of the Otte and Olaolu had the same Cd bound to Organics, so also were the soils of Budo Abio and odo (Table 14). Soils of Otte, Olaolu and Odoore were statistically the same in the Cd bound to Organics, so also were the soils of Budo Egba, Coca cola and Isale Aluko. Soils of Oyun had the same Cd bound to Organics with the soil of Eroomo (Table 14). Residual Cd was in the range of 0.11±0.19 mg/kg and 1.11±0.39 mg/kg with the lowest obtained in the soil of the Control site and the highest in the soil of Mubo (Table 14).

Table 12: Phytoavailable Cd, Cu and Pb in soils used to raise the vegetable accessions in the first rainy season (2016)

Site	Cd	Cu	Pb
Otte	0.08 ± 0.04^{a}	4.75 ± 0.05^{d}	4.08 ± 0.12^{bc}
Budo Egba	0.08 ± 0.02^{a}	5.33 ± 0.09^{c}	4.27 ± 0.03^{ab}
Budo Abio	0.00 ± 0.00^{b}	3.47 ± 0.16^{efg}	0.68 ± 0.12^{e}
Mubo	0.08 ± 0.00^{a}	3.75 ± 0.25^{fg}	4.30 ± 0.29^{ab}
Oyun	0.08 ± 0.11^{a}	3.58 ± 0.12^{f}	3.97 ± 0.63^{abc}
Ojagboro	0.08 ± 0.03^{a}	3.70 ± 0.25^{efg}	2.33 ± 0.12^{c}
Olaolu	0.08 ± 0.03^{a}	9.25 ± 0.25^{a}	3.58 ± 0.02^{b}
Eroomo	0.00 ± 0.00^{c}	8.50 ± 0.25^{b}	0.65 ± 0.36^{ij}
Okeodo	0.08 ± 0.11^{a}	4.17 ± 0.13^{def}	2.42 ± 0.38^{c}
Cocacola	0.08 ± 0.14^{a}	4.20 ± 0.25^{def}	6.25 ± 0.25^{a}
Isale Aluko	0.08 ± 0.11^{a}	4.22 ± 0.10^{def}	1.82 ± 0.38^{d}
Odoore	0.00 ± 0.00^{b}	5.08 ± 0.14^{cd}	0.44 ± 0.12^{ef}
Botanical Graden(Control site)	0.00 ± 0.00^{b}	3.33 ± 0.38^{ef}	0.33 ± 0.03^{f}

Mean value with same alphabet along the column are significantly the same at $p \leq 0.05$. Values represent mean ± SD

Table 13: Mean Phytoavailable heavy metals (mg/kg) of the soil samples used for planting the vegetables for the second rainy season (2017).

Site	Mean conc. Cd	Mean conc. Cu	Mean conc. Pb
Otte	$0.08{\pm}0.00^{ab}$	$3.42{\pm}0.13^{c}$	$2.00{\pm}0.25^{abc}$
Budo Egba	$0.08{\pm}0.00^{ab}$	$3.30{\pm}0.00^{c}$	$1.33{\pm}1.25^{bc}$
Budo Abio	$0.00{\pm}0.00^{b}$	$2.18{\pm}0.14^{cd}$	$0.69{\pm}0.55^{cd}$
Mubo	$0.00{\pm}0.00^{b}$	$5.95{\pm}0.27^{abc}$	$0.82{\pm}0.47^{c}$
Oyun	$0.00{\pm}0.00^{b}$	$5.88{\pm}0.14^{abc}$	$0.85{\pm}0.56^{c}$
Ojagboro	$0.00{\pm}0.00^{b}$	$6.15{\pm}0.25^{a}$	$0.87{\pm}0.43^{c}$
Olaolu	$0.08{\pm}0.00^{b}$	$4.80{\pm}0.00^{bc}$	$2.67{\pm}3.06^{ab}$
Eroomo	$0.00{\pm}0.00^{a}$	$3.65{\pm}0.21^{c}$	$0.52{\pm}0.85^{d}$
Okeodo	$0.08{\pm}0.00^{ab}$	$4.30{\pm}0.22^{b}$	$1.65{\pm}0.11^{b}$
Coca cola	$0.13{\pm}0.03^{a}$	$4.65{\pm}0.17^{b}$	$3.00{\pm}0.05^{a}$
Isale Aluko	$0.08{\pm}0.00^{ab}$	$7.25{\pm}0.14^{a}$	$0.85{\pm}0.56^{b}$
Odoore	$0.00{\pm}0.00^{b}$	$2.97{\pm}0.29^{c}$	$0.33{\pm}0.17^{c}$
Botanical garden(Control.site)	$0.00{\pm}0.00^{b}$	$1.80{\pm}0.23^{d}$	$0.27{\pm}0.09^{d}$

The soil of the Control site recorded lower residual Cd than the other sites. Soils of Budo Abio and Odoore were the same statistically in the mean concentration of residual Cd. Soils of Otte and Ojagboro had the same statistical mean concentration of residual Cd. Soils of Budo Egba, Okeodo and Coca cola recorded the same concentration of residual Cd (Table 14). Soil of the Oyun was the same residual Cd with Isale Aluko. Table 15 presents the cadmium fractionation in soils used to raise the vegetable accessions in the second dry season (2016). The range of the exchangeable fraction of cadmium in the second dry season was between 0.00±0.00 mg/kg and 0.06±0.04 mg/kg suggesting lower fraction than the first dry season (1.67±0.00 mg/kg). Soils of Coca cola and Isale Aluko had higher range of Exchangeable Cd in the second dry season. Ojagboro and Olaolu soil were statistically the same in the fraction of Exchangeable Cd No exchangeable cadmium was recorded in Otte, Budo Abio, Budo Abio, Mubo, Oyun, Eroomo and the Control site, that is not detectable (0.00±0.00 mg/kg). Control soils of both dry season had non detectable fraction of Exchangeable Cd (Tables 14 and 15).

The cadmium bound to Carbon fraction ranged between 0.00±0.00 mg/kg and 0.25±0.00 mg/kg with the highest recorded in Coca cola indicating lower fraction than the first dry season (0.00±0.00 and 1.33± 0.00 mg/kg)(Table14). The bound to carbon fraction of cadmium in the Control site was lower than the other sites (Table 15). The bound to carbon fraction of the soil of Otte and Budo Egba were statistically the same, so also were Ojagboro and Olaolu, Soils of Okeodo and Isale Aluko were significantly the same, and Okeodo and Isale Aluko (Table 15). The cadmium bound to Oxide fraction in the second dry seson ranged between 0.00±0.00 mg/kg and 0.25±0.00 mg/kg with the highest in Ojagboro this shows higher fraction than the first dry season (0.00±0.00 and 0.11±0.19) . The fraction in the Control site was lower than the other sites. The cadmium bound to Oxide fraction were statistically the same in the soils of Otte, Budo Egba and Ojagboro so also were the soils of Mubo and Oyun (Table 15) . There were no statistically differences in the Cd bound to Oxides in the soils of Olaolu and Coca cola. The fraction of Cd bound to Organics in the second dry season ranged between 0.00±0.00 mg/ kg and 0.25±0.00 mg /kg with the highest recorded in Ojagboro indicating lower fraction than the first dry season (0.00±0.00 and 0.89±0.39 mg/kg (Table 15). Budo Abio, Olaolu, Okeodo and Odoore recorded the same significant cadmium bound to Organics (Table 15). Mubo, Oyun and

Isale Aluko had the same significant fraction of Cd bound to Organics (Table 15). Residual Cd in the second dry season ranged between 0.00±0.00 mg/kg and 0.17±0.00 mg/kg indication lower fraction than the first dry season (0.11±0.19 and 1.110.39 mg/kg). Residual Cd in the Control site was lower than the other sites. No residual fraction of Cd was recorded in the Control soil. Table 16 shows the fractionation of Cadmium in the soils used to plant vegetables for the first rainy season (2016) ranged between 0.00±0.00 mg/kg and 0.25±0.00 mg/kg with the non detectable value recorded in Budo Abio, Mubo, Oyun, Eroomo, Okeodo, Odoore and the Control soil. There were no significant differences in the exchangeable fraction of Cd of Otte, Budo Egba and Isale Aluko.The bound to Carbon fraction of Odoore was statistically the same Oyun, Ojagboro, Olaolu, Eroomo, Okeodo, Coca cola and Isale Aluko, so also were Otte and Budo Egba. Bound to Oxide fraction of the soil used for the first rainy season ranged between 0.00±0.00 mg/kg and 1.08±0.12 mg/kg. The bound to Oxide fraction of Budo Abio was statistically the same with Coca cola and Odoore. The range of fraction of Cd bound to Organics was between 0.00±0.00 mg/kg and 0.58±0.14 mg/kg. Bound to Organics Cd of Olaolu was statistically the same with Okeodo and Coca cola. Budo Abio and Mubo had the same fraction of Cd bound to Organics, so also were Budo Egba, Ojagboro, Eroomo and Isale Aluko (Table 16). There was no Cd bound to Organics fraction bound to Organics was found detected in the Control s Cd to Organics was found in soil of Otte.

The residual fraction of Cd used for the first rainy season ranged between 0.00±0.00 mg/kg and 0.27±0.09 mg/kg. The residual fraction of Cd in the Control soil (0.00±0.00mg/kg) was lower than other sites except Odoore that had the same value (0.00±0.00 mg/kg). Residual Cd fraction in Otte soil was significantly the same with Budo Abio soil, Table 17 shows the fractionation of Cd in the soil used for the second rainy season (2017). Exchangeable Cd in soil for the second rainy season ranged between 0.00± 0.00 mg/kg and 0.11±0.19 mg/kg indicating lower fraction than the first rainy season(0.00±0.00 mg/kg and 0.25 ± 0.00 mg/kg) . No significant value (0.00± 0.00 mg/kg) of Exchangeable Cd was recorded in soils of the Control site and other sites except for Budo Egba and Eroomo that had 0.11± 0.19 mg/kg (Table 17). The range of Cd bound to Carbon used for the second rainy season ranged between 0.00±0.00 mg/kg and 0.11±0.19 mg/kg suggesting lower fractions than the first rainy season (0.00±0.00 mg/kg and

1.17± 0.14 mg/kg) (Table 17). Cd bound to Carbon in soil of the Control recorded 0.00±0.00 mg/kg and other sites other than Ojagboro, Olaolu and Coca cola (Table 17). Cd bound to Oxides used for the second rainy season (2017) ranged between 0.00±0.00 mg/kg and 0.11±0.00±0.19 mg/kg showing lower fractions than the first rainy season (0.00 ±0.00 mg/kg and 1.08±0.12 mg/kg). Cd bound to Oxide in the Control soil recorded 0.00±0.00 and other sites other than Budo Egba and Olaolu that had 0.11±0.19. Cd bound to Oxides in soil of Budo Egba and Olaolu were statistically the same (Table 17).

The range of Cd bound to Organic in soils for the second rainy season (2016) was between sites was recorded at 0.00 ± 0.00 mg/kg and 0.33±0.58 mg /kg suggesting lower range of fraction than the first rainy season (0.00±0.00 mg/kg and 0.58 ± 0.14 mg/kg). The lowest was recorded in soils of Olaolu and the Control site (0.00±0.00 mg./kg) and highest fraction of Cd bound to Organics in soil was recorded in Coca cola (Table 17). Soils of sites Budo Abio, Mubo, Oyun, Ojagboro , Isale Aluko and Odoore recorded 0.00 mg/kg , that is, no detectable value of Cd bound to Organics (Table 17). The range of residual Cd in soils for the second rainy season ranged between 0.00 ± 0.00 mg/kg and 1.00 ± 0.00 mg/kg showing higher range of the fraction than the first rainy season (0.00±0.00 mg/kg and 0.27±0.09 mg/kg. There were significant differences in the fraction of the residual Cd in soils.

Soils of Okeodo and Control site recorded statistically the same fraction of residual Cd (0.00±0.00 mg/kg) (Table 17). The fraction of the residual Cd ≥ bound to Organics ≥ bound to Oxides ≥ bound to Carbon ≥ Exchangeable Cd in the soils. Soils of Olaolu and Eroomo showed no significant differences in all the species or fractions of Cd likewise Odoore and the Control soil (Table 17). Soils of Budo Abio, Oyun, Isale Aluko, Odoore and the Control soil showed no significant value of all the fractions of Cd (0.00±0.00 mg/kg) (Table 17). Exchangeable fraction of Cd between the seasons was; first dry season ≥ first rainy season ≥ second rainy season ≥ second dry season, for Cd bound to Carbon fraction, the order was; first dry season ≥ first rainy season ≥ second dry season ≥second rainy season, for Cd bound to Oxides, the sequence was; first dry season ≥ first rainy season ≥ second dry season ≥second rainy season, for

Cd bound to Organics, the order was; first dry season ≥ first rainy season ≥ second rainy season ≥second dry season and for Residual Cd fraction, the order was; first dry season ≥ second rainy season ≥ first rainy season ≥second dry season.

Table 18: shows the mean concentrations of Copper (fractionation) in the soils used to raise the vegetable during the first dry season (2015). The range of Exchangeable fraction of Copper in soils used in the first dry season was between 0.23±0.07 mg/kg and 1.67±0.58 mg/kg with the lowest recorded in the soil of Odoore while the highest was recorded in the soil of Ojagboro. Soil of the Control site recorded a higher mean concentration of exchangeable fraction of Cu than soils of sites 2, 3, 4, 7 and 12 while soils of the other sites recorded higher mean concentrations of exchangeable Cu than the Control site (Table 18). The range of the fraction of Copper bound to Carbon in soil used for the first dry season was ranged between 1.00±0.00 mg/kg and 5.33±0.14 mg/kg with the lowest in the soil of the Control while highest fraction was recorded in soil of Oyun. The fraction of Cu bound to Carbon of the Control soil, Eroomo and Odoore soil were statidtically the same. No significant differences were recorded in the mean concentration of Cu bound to Carbon in soils of Otte, Budo Egba, Olaolu and Coca cola (Table 18). Soils of Mubo, Oyun and Ojagboro recorded relatively high mean concentrations of Cu bound Carbon compared to soils of other sites and with Mubo and Ojagboro soils statistically the same. The mean concentration of Cu bound to Oxides in soils used for the first dry season ranged between 1.33 ± 0.28 mg/kg and 6.67±0.14 mg/kg. The lowest mean concentration of Cu bound to Oxides was recorded in the Control site while the highest was recordedin Isale Aluko soil (Table18)

Table 14: Concentration of Cadmium Fractionation (mg/kg) in the soils used for planting during the first dry season (2015).

Sites	Exchangeable fraction	BTCarbon fraction	BTOxides fraction	BTOrganics fraction	Residuals Cd
Otte	1.33 ± 0.00^{b}	0.33 ± 0.00^{d}	0.67 ± 0.00^{a}	0.67 ± 0.00^{ab}	0.67 ± 0.00^{bc}
Budo Egba	1.67 ± 0.00^{a}	1.00 ± 0.00^{b}	0.60 ± 0.00^{ab}	0.56 ± 0.19^{bc}	0.40 ± 0.19^{cd}
Budo Abio	0.22 ± 0.19^{de}	0.33 ± 0.00^{d}	0.00 ± 0.00^{e}	0.22 ± 0.19^{de}	0.22 ± 0.00^{e}
Mubo	0.33 ± 0.00^{d}	1.00 ± 0.00^{b}	0.56 ± 0.51^{b}	0.89 ± 0.39^{a}	1.11 ± 0.39^{a}
Oyun	0.33 ± 0.00^{d}	0.67 ± 0.00^{c}	0.22 ± 0.35^{cd}	0.44 ± 0.38^{c}	0.33 ± 0.58^{d}
Oja gboro	0.67 ± 0.00^{c}	0.67 ± 0.00^{c}	0.33 ± 0.00^{c}	0.33 ± 0.57^{d}	0.67 ± 0.58^{bc}
Olaolu	0.67 ± 0.00^{c}	0.67 ± 0.00^{c}	0.22 ± 0.19^{cd}	0.67 ± 0.58^{ab}	1.00 ± 0.58^{b}
Eroomo	0.33 ± 0.00^{d}	0.00 ± 0.00^{e}	0.11 ± 0.19^{d}	0.44 ± 0.19^{c}	0.56 ± 0.19^{c}
Okeodo	0.67 ± 0.00^{c}	1.33 ± 0.00^{a}	0.22 ± 0.35^{cd}	0.22 ± 0.39^{de}	0.44 ± 0.39^{cd}
Coca cola	0.67 ± 0.58^{c}	0.57 ± 0.51^{cd}	0.33 ± 0.00^{c}	0.56 ± 0.19^{bc}	0.44 ± 0.39^{cd}
Isale Aluko	0.33 ± 0.00^{d}	0.22 ± 0.19^{d}	0.44 ± 0.77^{bc}	0.56 ± 0.39^{bc}	0.38 ± 0.58^{d}
Odoore	0.19 ± 0.11^{de}	0.00 ± 0.00^{e}	0.00 ± 0.00^{e}	0.67 ± 0.58^{ab}	0.22 ± 0.39^{e}
Botanical garden(control.site)	0.00 ± 0.00^{e}	0.00 ± 0.00^{e}	0.00 ± 0.00^{e}	0.00 ± 0.00^{f}	0.11 ± 0.19^{f}

Mean value with same alphabet along the same colum are statistically the same $p\leq.05$. Values represent mean ± SD BT means Bound To

Table 15: Cadmium fractionation of soils (mg/kg) used to raise the vegetable accessions in the second dry season (2016).

Site	Exchangeable Cd	BTCarbon fraction	BTOxides fraction	BTorganics fraction	Residual/Inert Cd fraction
Otte	0.00±0.00[b]	0.04±0.01[c]	0.21±0.26[b]	0.00±0.00[g]	0.08±0.03[b]
Budo Egba	0.00±0.00[b]	0.04±0.06[c]	0.21±0.07[b]	0.00±0.00[g]	0.07±0.06[b]
Budo Abio	0.00±0.00[b]	0.00±0.00[d]	0.04±0.08[e]	0.08±0.14[e]	0.07±0.02[b]
Mubo	0.00±0.00[b]	0.00±0.00[d]	0.07±0.12[d]	0.15±0.07[bc]	0.06±0.10[b]
Oyun	0.00±0.00[b]	0.00±0.00d	0.08±0.14[d]	0.17±0.14[b]	0.10±0.02[a]
Ojagboro	0.04±0.08[ab]	0.08±0.04[bc]	0.21±0.07[b]	0.25±0.00[a]	0.17±0.00[a]
Olaolu	0.04±0.02[ab]	0.08±0.02[bc]	0.17±0.07[d]	0.08±0.02[e]	0.06±0.10[b]
Eroomo	0.00±0.00[b]	0.00±0.00[d]	0.04±0.08[e]	0.04±0.08[f]	0.08±0.09[b]
Okeodo	0.02±0.01[b]	0.17±0.14[b]	0.21±0.07[b]	0.08±0.14[e]	0.08±0.00[b]
Cocacola	0.06±0.04[a]	0.25±0.00[a]	0.17±0.07[c]	0.13±0.13[d]	0.08±0.00[b]
Isale Aluko	0.06±0.01[a]	0.15±0.17[b]	0.25±0.00[a]	0.17±0.14[b]	0.08±0.00[b]
Odoore	0.01±0.00[b]	0.00±0.00[d]	0.10±0.12[cd]	0.08±0.14[e]	0.07±0.02[b]
Botanical Graden(Control site)	0.00±0.00[b]	0.00±0.00[d]	0.00±0.00[f]	0.00±0.00[g]	0.00±0.00[c]

Mean value with same along the column alphabet are statistically the same at p≤0.05. Values represent mean ± SD. BT means Bound To

Table 16: Cadmium fractionation of soils (mg/kg) used to raise the vegetable accessions in the first rainy season (2016).

Site	Exchageable Cd	BTCarbon fraction	BTOxides fraction	BTorganics fraction	Residual/Inert Cd fraction
Otte	0.25±0.00[a]	1.17±0.10[a]	1.08±0.12[a]	0.58±0.14[a]	0.22±0.09[v]
Budo Egba	0.25±0.00[a]	1.17±0.14[a]	0.68±0.12[b]	0.33±0.04[b]	0.27±0.09[a]
Budo Abio	0.00±0.00[c]	0.33±0.12[c]	0.08±0.14[e]	0.17±0.13[d]	0.22±0.09[b]
Mubo	0.00±0.00[c]	0.17±0.14[a]	0.25±0.00[c]	0.33±0.14[b]	0.17±0.17[c]
Oyun	0.00±0.00 [c]	0.08±0.14[d]	0.17±0.14[d]	0.25±0.00[c]	0.11±0.10[f]
Ojagboro	0.25±0.00[a]	0.08±0.12[d]	0.17±0.14[d]	0.17±0.28[d]	0.00±0.00[d]
Olaolu	0.08±0.14[b]	0.08±0.14[d]	0.17±0.29[d]	0.08±0.14[e]	0.06±0.10[e]
Eroomo	0.00±0.00[c]	0.08±0.14[d]	0.17±0.14[d]	0.17±0.10[d]	0.06±0.10[e]
Okeodo	0.00±0.00[c]	0.08±0.14[d]	0.17±0.14[d]	0.08±0.14[e]	0.06±0.10[e]
Cocacola	0.25±0.00[a]	0.08±0.14[d]	0.08±0.14[e]	0.08±0.14[e]	0.11±0.10[c]
Isale Aluko	0.25±0.00[`a]	0.08±0.14[d]	0.17±0.14[d]	0.17±0.14[d]	0.06±0.10[e]
Odoore	0.00±0.00[c]	0.08±0.14[b]	0.08±0.14[e]	0.08±0.14[e]	0.05±0.10[e]
Botanical Graden(Control site)	0.00±0.00[c]	0.00±0.00[e]	0.00±0.00[e]	0.00±0.00[f]	0.00±0.00[f]

Mean value with same alphabet along the same column are statistically the same at p≤0.05. BT represents Bound To. Values represent mean ± SD

Table 17: Fractionation of Cadmium (mg/kg) in the soils used to plant vegetables during the second rainy season (2017).

Sites	Exchangeable Cd	BTCarbon fraction	BTOxides fraction	BTOrganics fraction	Residuals/Inert Cd fraction.
Otte	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.22±0.38^{a}	0.11±0.19^{d}
Budo Egba	0.11±0.19^{a}	0.00±0.00^{b}	0.11±0.19^{a}	0.22±0.38^{a}	1.00±0.00^{a}
Budo Abio	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{e}
Mubo	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.11±0.19^{d}
Oyun	0.00±0.00^{b}	0.00±0.00^{a}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{d}
Oja gboro	0.00±0.00^{b}	0.11±0.19^{a}	0.00±0.00^{b}	0.11±0.19^{b}	0.33±0.00^{bc}
Olaolu	0.00±0.00^{b}	0.11±0.19^{a}	0.11±0.19^{a}	0.11±0.19^{b}	0.22±0.28^{c}
Eroomo	0.11±0.19^{a}	0.00±0.00^{b}	0.00±0.00^{b}	0.22±0.38^{a}	0.19±0.19^{cd}
Okeodo	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.22±0.38^{a}	0.22±0.38^{c}
Coca cola	0.00±0.00^{b}	0.11±0.19^{a}	0.00±0.00^{b}	0.33±0.58^{a}	0.67±0.33^{b}
Isale Aluko	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{e}
Odoore	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{e}
Botanical garden(control.site)	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{e}

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. BT represents Bound To. Values represent mean ± SD

The mean concentration of Cu bound to Oxide of the Control soil was lower than the other sites (Table 18). Soils of Budo Egba and Ojagboro were statistically the same in the mean concentration of Cu bound to Oxides. Soils of Mubo and Olaolu were statistically the same in the fraction of Cu bound to Oxides. Soils of sites 9, 10 and 11 had comparatively higher mean values of Cu bound to Oxides the other sites (Table 18). Mean concentration range of Cu bound to Or+ganics in soils used for the first dry season ranged between 2.00 ±0.00 mg/kg and 6.97 ± 0.11 mg/kg with the lowest value recorded in the soil of the Control and the highest in the soil of Ojagboro. Soils of the Control site had mean concentration of Cu bound to Organics lower than other soils (Table 18). Soil of the Control site had the same statistical fraction of Cu bound to Organics as soil of Odoore. The mean concentration range of residual Copper in soils used for the first dry season was between 1.15 ± 0.27 mg/kg and 6.67 ±0.28 mg/kg. The lowest mean concentration of residual Copper in soils used to raise vegetables during the first dry season was recorded in soil of Budo Abio while the highest was recorded in soil of Budo Egba. Soils of the Control site had lower mean residual Cu than the other soils except for Budo Abio. Soils of Budo Egba and Coca cola were statistically the same in the mean concentration of residual Cu (Table 18).

Table 19 shows the copper fractionation of soils (mg/kg) used to raise the vegetable accessions in the second dry season (2016) with the range of exchangeable copper between 0.21±0.07 mg/kg and 0.67±0.13 mg /kg with the lowest recorded in Budo Abio and the highest in Cocacola soils suggesting lower fraction than the first dry season (0.23±0.07 mg/kg and 1.67±0.58 mg/kg)(2015). Exchangeable Cu in the soil of the Control site was higher than the other sites except for Coca Cola soil. Exchangeable Cu in the Control soil was statistically the same with Ojagboro and Isale Aluko soils. Budo Egba and Eroomo had the same fraction of exchangeable Cu. No significant differences in the exchangeable Cu in Otte, Budo Abio, Mubo, Oyun, Olaolu , Okeodo and Odoore were recorded (Table 19). Exchangeable Cu in the Control soil of the second dry season (0.42±0.11 mg/kg)(2016) was lower than the first dry season (0.57±0.12 mg/kg)(2015). The range of Cu bound to Carbon in soil used for the second dry season was between 0.25±0.11 mg/kg and 2.92±0.29mg/kg with the lowest fraction in Eroomo and the highest in Coca cola indicating lower fraction than the first dry season (1.00±0.00mg/kg and 5.33±0.14 mg/kg).

Table 18: Concentration ((mg/kg)) of Copper Fractionation in the soils used for plant during the first dry season (2015).

Sites	Exchangeable Fraction	BTCarbon fraction	BTOxides Fraction	BTOrganics Fraction	Residuals/inert fraction
Otte	0.67±0.00^{c}	2.67±0.21^{bcd}	4.33±0.00^{cd}	6.45±0.00^{ab}	4.75±0.39^{abc}
BudoEgba	0.38±0.11^{ef}	2.60±0.11^{bcd}	4.17±0.34^{cd}	5.67±0.00^{bc}	6.67±0.28^{a}
Budo Abio	0.17±0.03^{g}	1.27±0.00^{de}	1.36±0.21^{g}	2.40±0.00^{ef}	1.15±0.27^{f}
Mubo	0.33±0.00^{ef}	3.38±0.21^{bc}	3.67±0.00^{d}	3.25±0.00^{de}	4.33±0.00^{bc}
Oyun	1.67±0.00^{a}	5.33±0.14^{a}	4.67±0.00^{c}	2.15±0.06^{gh}	2.33±0.00^{de}
Ojagboro	1.67±0.58^{a}	3.30±0.11^{bc}	4.00±0.00^{cd}	6.97±0.11^{a}	2.67±0.00^{d}
Olaolu	0.33±0.00^{ef}	2.67±0.18^{bcd}	3.67±0.00^{d}	6.47±0.00^{ab}	3.37±0.11^{c}
Eroomo	1.33±1.00^{ab}	1.04±0.17^{cd}	1.67±0.00^{fg}	3.67±0.00^{d}	5.67±0.00^{b}
Okeodo	0.69±0.38^{b}	1.33±0.11^{fg}	6.00±0.00^{ab}	2.30±0.00^{f}	4.30±0.04^{bc}
Coca cola	0.83±0.00^{b}	2.33±0.21^{cd}	5.37±0.00^{b}	4.67±0.00^{c}	6.56±0.12^{ab}
IsaleAluko	0.79±0.16^{bc}	1.93±0.14^{d}	6.67±0.14^{a}	4.33±0.00^{cd}	4.17.±0.08^{bcd}
Odoore	0.33±0.07^{fg}	1.08±0.07^{e}	3.00±0.00^{e}	2.25±0.11^{fgh}	1.67±0.00^{efg}
Botanicalgarden(control site)	0.57±0.12^{d}	1.00±0.00^{e}	1.33±0.28^{g}	2.00±0.00^{h}	1.33±0.00^{ef}

Mean value with same alphabet along the same column are significantly the same at p≤0.05. BT represents Bound to .

The fraction of Cu bound to Carbon of the Control soil was lower than the other sites except for Eroomo (0.25± 0.11 mg/kg). Cu bound to Carbon fraction in the soil for the second dry season was lower (0.42±0.11 mg/kg)than the first dry season(1.00±0.00 mg/kg). Mubo and Oyun soils had the same statistical fraction of Cu cound to Carbon in the second dry season. Copper bound to Oxide in soils used for the second dry season (2016) ranged between 0.33±0.12 mg/kg and 2.67±0.14 mg/kg with the lowest fraction recorded in the Control soil and the highest in Isale Aluko soil indicating lower fraction than the first dry season (1.33± 0.28 mg/kg and 6.67±0.14 mg/kg (2015). Cu bound to Oxide in the Control soil (0.56±0.12 mg/kg) was lower than the other suggesting lower fraction than the first dry season (1.33±0.28 mg/kg). Cu bound to Oxide in Budo Egba and Odoore soils were statistically the same, so also were Oyun and Olaolu (Table 19).

Cu bound to Organics ranged between 0.25 ±0.21 mg/kg and 1.93±0.29 mg/kg with the lowest in Control soil and the highest in the Isale Aluko soil suggesting lower fraction than the first dry season (2.00±0.00 mg/kg and 6.97±0.11 mg/kg). Cu bound to Organics in the Control soil was lower than the other sites indicating lower fraction than the Control soil of the first dry season (2.00±0.00 mg/kg). Cu bound to Organics in Otte, Budo Abio and Olaolu were statistically the same, so also were soils of Oyun and Coca cola. Residual fraction of Cu in soils used for the second dry season (2016) ranged between 0.17 ±0.00 mg/kg and 1.12 ±0.17 mg/kg with the lowest recorded in Oyun and the highest in Odoore showing lower fraction than the first dry season soils (1.15±0.27 mg/kg and 6.67 ± 0.28 mg/kg)(Table 19). Residual Cu fraction in the Control soil was higher than the other sites except for Otte, Budo Abio, Ojagboro, Okeodo, Coca Cola, Isale Aluko and Odoore. Residual Cu fraction in the Control soil for the second dry season (0.48 ± 0.30 mg/kg) (2016) was lower than the first dry season (1.33±0.00 mg/kg)(2015). The residual Cu in Otte and Ojagboro soils were statistically the same, so also were Budo Abio and Okeodo, Mubo and Eroomo (Table 19).

Table 19: Copper fractionation of soils (mg/kg) used to raise the vegetable accessions in the second dry season (2016).

Site	Exchangeable Cu	BTCarbon Fraction	BTOxides fraction	BTorganics fraction	Residual/Inert fraction
Otte	0.25±0.00^{c}	1.75±0.27^{c}	1.08±0.29 ^{de}	0.67 ±0.58^{f}	0.51 ±0.34^{de}
Budo Egba	0.22±0.00^{cd}	1.08±0.52^{e}	0.92±0.14^{e}	0.63 ±0.14^{fg}	0.20 ±0.12^{h}
Budo Abio	0.21±0.07^{c}	0.50±0.25^{i}	0.38±0.33^{h}	0.33 ±0.17^{i}	0.56 ±0.26^{d}
Mubo	0.25±0.00^{c}	0.68±0.14^{h}	1.50±0.25^{b}	0.58 ±0.12^{g}	0.39 ±0.10^{f}
Oyun	0.25±0.00^{c}	0.67±0.29^{h}	1.15±0.13^{d}	1.00 ± 0.00^{c}	0.17 ±0.00^{hi}
Ojagboro	0.42±0.14^{b}	1.17±0.38^{d}	1.33±0.11^{c}	1.50 ±0.25^{b}	0.51 ±0.34^{de}
Olaolu	0.25±0.11^{c}	0.93±0.52^{ef}	1.11±0.14^{d}	0.67 ±0.32^{f}	0.25 ±0.14^{g}
Eroomo	0.22±0.06c^{d}	0.25±0.11^{k}	0.33±0.12^{hi}	0.42 ± 0.28^{h}	0.40 ±0.11^{f}
Okeodo	0.25±0.00^{c}	2.08±0.52^{b}	0.50±0.25^{gh}	0.83 ±0.10^{d}	0.55 ±0.24^{d}
Cocacola	0.67±0.13^{a}	2.92±0.29^{a}	0.75±0.25^{f}	0.33 ±0.12^{i}	0.68 ±0.30^{c}
Isale Aluko	0.42±0.14^{b}	0.83±0.14^{f}	2.67±0.14^{a}	1.93±0.29^{a}	0.85 ±0.00^{b}
Odoore	0.25±0.00^{c}	0.76±0.66^{g}	0.92±0.28^{e}	0.76±0.05^{e}	1.12 ±0.17^{a}
Botanical Graden(Control site)	0.42±0.11^{b}	0.41±0.14^{ij}	0.56±0.12^{g}	0.25 ±0.21^{j}	0.48 ± 0.30^{e}

Mean value with same alphabet along the same column are statistically the same at p≤0.05. Values represent mean ± SD. BT means Bound to

Table 20 presents the copper fractionation of soils (mg/kg) used to raise the vegetable accessions in the first rainy season (2016). The Exchangeable fraction of copper in the soil used for the first rainy season ranged between 0.67±0.38 mg/kg and 8.42±0.38 mg/kg with the lowest recorded in Budo Abio and the highest in Eroomo soils. The Exchangeable fraction of Cu in soil of the Control was statistically the same with Otte soil. The Exchangeable Cu in soil of the Control was higher than the other sites except for Budo Egba, Olaolu, Eroomo and Odoore. Exchangeable Cu in the soils used in the first rainy season of Budo Egba and Odoore were statistically the same (Table 20). Copper bound to Carbon fraction ranged between 0.25±0.00 mg/kg and 11.67±0.13 mg/kg with the lowest recorded in Budo Abio and the highest in Olaolu . Cu bound to carbon of the Control site was lower than the other sites except for Otte, Budo Egba, Olaolu and Eroomo (Table 20).

The range of Copper bound to Oxide in soils used for the first rainy season (2016)66 was between 1.17±0.14 mg/kg and 10.58±0.12 mg/kg with the lowest recorded in the Control soil while the highest was recorded in Olaolu. The range of the fraction of Cu bound to Organics in soils used for the first rainy season was between 0.75±0.43 mg/kg and 4.58±0.11 mg/kg with the lowest recorded Mubo and the highest in Eroomo. The fraction of Cu bound to Organics of the Control site was higher than all the sites except Eroomo and Odoore, There were no significant differences between the fraction of Cu bound to Organics in Otte and Budo Egba soils, so also were Olaolu and Odoore (Table 20). Residual Cu in soil samples ranged between 0.17±0.00 mg/kg and 4.50±0.00 mg/kg with the lowest recorded in Mubo and the highest in Odoore. Fraction of residual Cu in soil of the Control site was higher than all the sites except Otte and Odoore. No signififcant differences were recorded in the residual Cu of Oyun and Eroomo soils, so also were Budo Abio and Isale Aluko soils. There were no significant differences between the residual Cu of Cocacola and Isale Aluko soils (Table 20).

Table 20: Copper fractionation of soils (mg/kg) used to raise the vegetable accessions in the first rainy season (2016).

Site	Exchangeable Cu	BTCarbon fraction	BTOxides fraction	BTorganics Fraction	Residual/Inert fraction
Otte	4.50±0.25[c]	6.50±0.25[c]	7.53±0.30[c]	2..17±0.14[e]	2.17±0.13[b]
Budo Egba	5.17±0.12[b]	7.08±0.29[b]	7.33±0.28[cd]	2.17±0.28[e]	0.45±0.10[f]
Budo Abio	0.67±0.38[ij]	0.25±0.00[j]	2.17±0.38[h]	1.08±0.14[g]	0.28±0.09[gh]
Mubo	0.75±0.25[i]	0.50±0.25[i]	4.24±0.71[ef]	0.75±0.43[h]	0.17±0.00[h]
Oyun	2.50±0.25[f]	1.75±0.25[g]	3.75±0.25[f]	2.08±0.14[ef]	0.39±0.10[g]
Ojagboro	3.08±0.14[e]	1.50±0.20[gh]	4.67±0.80[e]	2.75±0.25[cd]	0.62±0.20[e]
Olaolu	8.42±0.38[a]	11.67±0.13[a]	10.58±0.12[a]	2.25±0.25[de]	0.91±0.10[d]
Eroomo	8.25±0.25[ab]	5.67±0.14[d]	9.17±0.57[b]	4.58±0.11[a]	0.39±0.10[g]
Okeodo	2.17±0.13[g]	3.50±0.25[ef]	3.33±0.14[g]	1.83±0.14[f]	0.79±0.25[de]
Cocacola	1.58±0.12[h]	1.08±0.12[h]	3.00±0.43[gh]	2..58±0.12[d]	0.74±0.20[de]
Isale Aluko	4.00±0.25[d]	2.17±0.14[fg]	4.08±9,12[ef]	2.25±0.25[de]	0.28±0.10[gh]
Odoore	5.17±0.29[b]	2.67±0.14[f]	5.25±0.00[d]	4.08±0.14[b]	4.50±0.00[a]
Botanical Graden(Control site)	4.50±0.00[c]	3.75±0.00[e]	1.17±0.14[i]	3.58±0.12[c]	1.41±0.94[c]

Mean value with same alphabet along the same colum are statistically the same p≤.05. Values represent mean ± SD. BT means Bound to.

Table 21 shows the fractionation of Copper in the soils used to plant vegetables during the second rainy season (2017). The range of the mean concentration of the Exchangeable fraction of Copper used for the second rainy season (2017) was between 0.00±0.00 mg/kg and 0.44±0.04 mg/kg indicating lower fraction range than the first rainy season (0.67±0.38 mg/kg and 8.42±0.38 mg/kg)(2016). The Exchangeable fraction of Cu in soil of the Control soil was higher than the other soils except for soils of Oyun and Ojagboro (Table 21). Lower fraction of Exchangeable Cu in soils used for the second rainy (0.33±0.00 mg/kg) (2017) season than the first rainy season (4.50±0.00 mg/kg) (2016) was recorded. The lowest Fxchangeable fraction of Copper was recorded in soils of sites 1, 2 , 4, 8, 10 and 12 while the highest was recorded in Ojagboro soil.

The range of the mean concentration of Cu bound to Carbon in the soils used in the second rainy season was between 0.00±0.00 mg/kg and 0.67±0.00 mg/kg showing lower fraction than the first rainy season (0.25±0.00 mg/kg and 11.67±0.13 mg/kg). Soil of the Control soil had higher fraction of Cu bound to Carbon than the other sites except for the soils of Budo Egba, Oyun, Olaolu and Odoore. Cu bound to Carbon fraction of the Control soil for the second rainy season (0.11±0.19 mg/kg) (2017) was lower than the first rainy season (3.75±0.00 mg/kg)(2016). The lowest fraction of Cu bound to Carbon was recorded in Budo Abio, Eroomo, Coca cola and Isale Aluko soils while the highest was recorded in Ojagboro soil (Table 21). There were significant differences in the fraction of Cu bound Carbon of soils of Otte and Mubo. Soils of Budo Egba, Oyun, Olaolu and Isale Aluko were dtatistically the same in the fraction of Cu bound to Carbon. Soils of Okeodo and Control site were statistically the same fraction of Cu bound to Carbon.

The range of the mean concentration of Cu bound to Oxides in the second rainy season (2017) was between 0.00±0.00 mg/kg and 0.31±0.09 mg/kg showing a relatively lower fraction than the first rainy season (1.17±0.14 mg/kg and 10.58±0.12 mg/kg)(2016). Cu bound to Oxides recorded higher concentration in soil of the Control soil (0.31±0.09 mg/kg), higher than other soils indicating a relatively lower fraction than the Control soils for the first rainy season (1.17±0.14 mg/kg) (2016). All soils except soils of Oyun and Control site recorded 0.00±0.00 mg/kg fraction of Cu bound to Oxide (Table 21). The Cu bound to Organic fraction in soil used for the second rainy season (2016) ranged between 3.89±0.19 mg/kg and 23.00± 0.00 mg/kg showing a relatively higher fraction than the first rainy season (0.75±0.43 mg/kg and 4.58±0.11 mg/kg) (2016). Soil of the Control soil had Cu bound to Organic fraction (6.67±0.00 mg/kg) lower than other soils except soil for Odoore indicating higher fraction than the first rainy season Control soils (3.58±0.12 mg/kg) (Table 21). The lowest Cu bound to Organic was recorded in soil of Odoore while the highest was recorded for Ojagboro soil (Table 21). Soils of Budo Abio and Eroomo were statistically the same in the fraction of Cu bound to Organics. No statistical differences in the fraction of Cu bound to organic in soils of sites 2, ,4 ,5 and 9 were recorded. Soils of Coca cola and Isale Aluko showed no statistical differences in the fraction of Cu bound to organic in their soils. The fraction of Cu bound to Organics was higher in soils of other sites than the Control soil except for soil of Odoore that recorded a lower value (3.89 ±0.19 mg/kg) (Table 21).

The range of the fraction of residual Cu used for the second rainy season was between 1.33± 0.00 mg/kg and 10.33±0.00 mg/kg suggestion higher fraction than for the first rainy season (0.17±0.00 mg/kg and 4.50±0.00 mg/kg). The fraction of residual Cu in the Control soil (1.33±0.00 mg/kg) in the second rainy season was lower than soils of the other sites and also lower than the residual Cu in the Control soil of the first rainy season (1.41±0.94 mg/kg) (2016). Statistically, the same value of residual Cu in soils of Otte and Budo Abio were recorded. Soils of sites 2, 8, 9 and 12 were statistically the same in the fraction of residual Cu. The fraction of copper was in the order; Cu bound to Organics ≥ residual Cu ≥ bound Carbon ≥ Exchangeable fraction ≥ bound to Oxides between and within sites (Table 21).

Table 21: Fractionation of Copper in the soils used to plant vegetables during the second rainy season (2017).

Sites	Exchangeable Cu fraction	BTCarbon Fraction	BTOxides Fraction	BTOrganics Fraction	Residuals/inert Fraction
Otte	0.00±0.00[d]	0.33±0.00[c]	0.00±0.00[c]	19.97±0.00[ab]	4.00±0.00[e]
Budo Egba	0.00±0.00[d]	0.67±0.00[b]	0.00±0.00[c]	9.00±0.00[c]	3.00±0.00[g]
Budo Abio	0.33±0.00[cd]	0.00±0.00[d]	0.00±0.00[c]	9.67±0.00[c]	4.00±0.00[e]
Mubo	0.00±0.00[d]	0.33±0.00[c]	0.00±0.00[c]	8.89±1.92[c]	2.11±0.19[h]
Oyun	0.41±0.20[b]	0.67±0.00[b]	0.11±0.19[b]	8.00±0.00[c]	6.33±0.00[c]
Oja gboro	0.67±0.00[a]	2.00±0.00[a]	0.00±0.00[c]	23.00±0.00[a]	5.67±0.00[d]
Olaolu	0.33±0.00 [cd]	0.00±0.00[d]	0.00±0.00[c]	19.67±0.00[ab]	10.33±0.00[a]
Eroomo	0.00±0.00[d]	0.00±0.00[d]	0.00±0.00[c]	9.67±0.00[c]	3.33±0.00[fg]
Okeodo	0.33±0.00 [cd]	0.11±0.19[cd]	0.00±0.00[c]	10.00±0.00[c]	3.33±0.00[fg]
Coca cola	0.00±0.00[d]	0.00±0.00[d]	0.00±0.00[c]	16.33±5.77 [b]	8.00±0.00[b]
Isale Aluko	0.33±0.00[cd]	0.00±0.00[d]	0.00±0.00[c]	16.33±5.77 [b]	5.53±0.00[d]
Odoore	0.00±0.00[d]	0.67±0.00 [b]	0.00±0.00[c]	3.89 ±0.19[d]	3.56±0.11[f]
Botanical garden(control.site)	0.33±0.00 [cd]	0.11±0.19[cd]	0.31±0.09 [a]	6.67±0.00[cd]	1.33±0.00[i]

Mean value with same alphabet along the same column are statistically the same $p \leq .05$. Values represent mean ± SD. BT means Bound to

Table 22 shows the mean concentrations of the fractionation of lead in soils used to plant vegetables during the first dry season (2015). The range of exchangeable lead used for the first dry season (2015) was between 0.00±0.00 mg/kg and 0.67±0.11 mg/kg. The lowest Exchangeable Pb was recorded in the Control soils (0.00±0.00 mg/kg) while the highest was recorded in soil of Otte (0.67±0.11 mg/kg). Control soil had lowest concentration of Exchangeable Pb than soils of the other sites. Most of the soils of the sites had a non detectable concentration of Exchangeable Pb (0.00±0.00 mg/kg). Soils of Budo Egba, Oyun and Coca cola had the same statistical fraction of Exchangeable Pb, so also were Otte, Olaolu and Okeodo soils (Table 22) Mean concentration of Lead bound to Carbon in soils used for the first dry season (2015) ranged between 0.00±0.00 mg/kg and 5.00±0.00 mg/kg with the lowest in the Control soil and the highest for the Olaolu soil. Soil of the Control soil recorded a non detectable concentration of Pb bound to Carbon (0.00±0.00 mg /kg). Soils of Mubo, Oyun and Ojagboro were statistically the same in the concentration of Pb bound to Carbon. Soils of Odoore and the Control (0.00±0.00 mg/kg) were statistically the same in mean concentration of Pb bound to Carbon. Soil of Olaolu recorded a comparatively high mean concentration of Pb bound to Carbon than soils of other sites (Table 22).

Soils of sites 6, and 11 had relatively high mean concentration of Pb bound to Oxides than the soils of the other sites and were statistically the same. Mean concentration of Pb to oxides of Mubo and Eroomo soil were statistically the same (Table 22). Pb bound to Organics fraction in the soils used for the first dry season ranged between 0.30 ±0.00 mg/kg and 7.33 ±0.00 mg/kg. Soil of the Control soil had the lowest mean concentration of Pb bound to Organics while Isale Aluko soil had the highest fraction. Soils of Otte, Budo Egba and Olaolu were statistically the same in the mean concentrations of Pb bound to Organics, so also were soils of Mubo, Oyun and Coca cola (Table 22).

The range of residual Pb of soils for the first dry season (2015) was between 0.33 ± 0.17 mg/kg and 5.00±0.00 mg/kg with the lowest recorded for the Control soil and the highest for Ojagboro soil. The Control soil had lower mean concentration of residual Pb than soils of other sites (Table 22). Soils of Otte and Olaolu were statistically the same in the mean concentrations of residual Pb, so were soils of Budo Egba and Eroomo, Mubo, so also were, Isale Aluko and Okeodo and Odoore (Table 22).

Table 22: Concentration of Lead fractionation (mg/kg) in the soils used for planting during the first dry season (2015).

Sites	Exchangeable fraction	BTCarbon fraction	BTOxides fraction	BTOrganics fraction	Residuals/ Inert fraction
Otte	0.67±0.14[a]	2.85. ±0.00[c]	2.33±0.00[d]	1.31.±0.00[b]	3.33±0.00[c]
Budo Egba	0.33±0.11[c]	2.73±0.00[d]	2.10±0.09[de]	1.30±0.00[def]	4.00±0.00[b]
Budo Abio	0.00±0.00[e]	0.83±0.00[g]	0.33±0.10[g]	1.46±0.00[b]	0.41±0.00[gh]
Mubo	0.17±0.00[d]	3.00±0.00[b]	0.43 ±0. 00[fg]	4.00±0.00[b]	1.67±0.00[d]
Oyun	0.33±0.07[c]	3.33±0.09[b]	0.67±0.39[ef]	4.00±0.00[b]	1.00±0.00[e]
Ojagboro	0.00±0.00[e]	3.00±0.11[b]	5.25±0.25[ab]	3.00±0.10[c]	5.00±0.00[a]
Olaolu	0.67±0.11[a]	5.00±0.00[a]	4.33±0.00[b]	1.33±0.00[def]	3.00±0.00[c]
Eroomo	0.00±0.00[e]	1.33±0.00[e]	0.41±0.19[fg]	1.67±0.00[d]	4.15±0.00[b]
Okeodo	0.67±0.11[a]	2.70±0.00[a]	3.77±0.29[c]	2.25±0.25[cd]	0.50±0.00[fg]
Coca cola	0.33±0.00[c]	2.33±0.00[d]	1.03±0.09[e]	4.20±0.58[b]	0.67±0.00[f]
IsaleAluko	0.58±0.14[b]	0.67±0.11[f]	5.33±0.21[a]	7.33±0.39[a]	1.10±0.00[e]
Odoore	0.00±0.00[e]	0.00±0.00[g]	0.17±0.19[gh]	1.00±0.29[ef]	0.57±0.00[fg]
Botanical Garden (controlsite)	0.00±0.00[e]	0.00±0.00[g]	0.00±0.00[h]	0.33±0.17[f]	0.30±0.00[h]

Mean value with same alphabet along the same column are statistically the same. BT represents Bound To. Values represent mean ± SD.

Table 23 presents the Lead fractionation of soils used to raise vegetable accessions for the second dry season (2016). Exchangeable fraction of Lead of soils used for the second dry season (2016) was between 0.25±0.00 mg/kg and 0.83±0.38 mg/kg suggesting higher fraction than the first dry season (0.00±0.00 mg/kg and 0.67±0.11 mg/kg) (2015). Lowest fraction of the Exchangeable Pb was recorded from the Control soil (0.25±0.00 mg/kg) indicating higher concentration than the Control of the first dry season (0.00±0.00 mg/kg) (2015) while the highest was obtained from Otte (Table 23). The same statistical Exchangeable Pb were recorded in the soils of the Control, Budo Abio, Oyun, Okeodo and Odoore. Soils of Otte and Budo Egba were the same fraction of Exchangeable Pb statistically, so also were Mubo and Olaolu soils, and Ojagboro and Cocacola (Table 23). Pb bound to Carbon fraction ranged between 0.33±0.14 mg/kg and 4.25 ±0.25 mg/kg suggesting lower concentrarion than the first dry season (0.00±0.00 mg/kg and 5.00±0.00) with the lowest recorded of the Control soil (0.33±0.14 mg/kg) but higher than the concentration of the Control soil for the first dry season (0.00±0.00 mg/kg)(2015) and the highest in Coca cola. Pb bound to Carbon of the Control soil was lower than the other sites. Soils of Budo Abio and Odoore were statistically the same for the fraction of Pb bound to Carbon(Table 23).

The range of Pb bound to Oxides in the soils used for the second dry season was between 0.25±0.00 mg/kg and 4.25±0.00 mg/kg (2016) indicating lower values than the first dry season (0.00±0.00 mg/kg and 5.33±0.21) (2015) with the lowest recorded in the Control soil (0.25±0.00 mg/kg) but higher than the concentration for the first dry season (0.00±0.00 mg/kg) (2015) while the highest was obtained from Ojagboro. The Control soil had the lowest Pb bound to Oxides than all the other sites. Pb bound to Organics ranged between 0.25±0.00 mg/kg and 2.08±0.14 mg/kg with the lowest recorded for Oyun and the highest for Isale Aluko (Table 23). This showed lower fraction of Pb bound to Organics for the second dry season (2016) than the first dry season (0.30 ±0.00 mg/kg and 7.33 ±0.00 mg/kg) (2015). The Pb bound to Organics fraction of the Control soil for the second dry season was lower (0.25±0.00 mg/kg) than for the first dry season (0.33±0.17 mg/kg) (2015) Pb bound to Organics of the Control soil was lower than all the sites except for Oyun (0.25±0.00 mg/kg). Pb bound to Organics of the Control soil (0.57±0.11 mg/kg) was statistically the same with Okeodo soil (0.58±0.14 mg/kg), so also were soils of Otte (1.00±0.00 mg/kg) and Eroomo (1.02 ±0.02 mg/kg) (Table 23). Pb bound to Organics of Olaolu (0.77±0.25 mg/kg) and Cocacola (0.75±0.22 mg/kg) were statistically the same. The range of the residual Pb of soils used for the second dry season (2016) was between 0.13±0.17 mg/kg and 1.42±0.49 mg/kg with the lowest recorded of the Control soil and the highest of Otte soil suggesting higher range than the first dry season (0.33 ± 0.17 mg/kg and 5.00±0.00 mg/kg) (2015). The fraction of the residual Pb of the Control soil (0.13±0.17 mg/kg) was lower than the other sites and also lwer than the concentration of the Control soil of the first dry season (0.33 ± 0.17 mg/kg) (2015). Budo Egba (1.19±0.29 mg/kg) and Olaolu (1.19±0.00 mg/kg) soils had the same statistical residual Pb, so also were the soils Mubo (0.40±0.20 mg/kg) and Oyun (.45±0.10 mg/kg), Eroomon (0.17±0.00 mg/kg) and the Control (0.13±0.17 mg/kg), and Budo Abio (0.33±0.00 mg/kg) and Odoore soils (0.34±0.17 mg/kg) (Table 23). Table 24 shows Lead fractionation of soils (mg/kg) used to raise vegetable accessions in the first rainy season (2016).

The Exchangeable fraction of Lead of soils used for the first rainy season (2016) ranged between 0.92±0.08 mg/kg and 11.33±0.29 mg/kg with the lowest recorded of the Control soil and the highest in Cocacola. The Exchangeable fraction of Pb of the Control soil was lower than all other sites (Table 24). There were no statistical differences between the Exchangeable fraction of Pb for the first rainy season of soils of Otte and Isale Aluko, so also were Eroomo and Odoore soils. Pb bound to Carbon fraction of the soil ranged between 0.50±0.25 mg/kg and 18.33±0.72 mg/kg with the lowest recorded of Mubo soil and the highest of Olaolu soil.

The Pb bound to Carbon fraction of the Control soil was lower than the other sites except for Budo Abio and Mubo. Bound to Carbon fraction of Pb of soils of Oyun and Okeodo were statistically the same (Table 24). The bound to Oxide fraction of Pb of soil used for the first rainy season planting ranged between 1.83±0.38 mg/kg and 9.67±0.13 mg/ kg with the lowest recorded of the Control soil and the highest of Isale Aluko. Pb bound to Oxide of the Control soil was lower than other sites (Table 24). Pb bound to Oxides fraction of Budo Egba and Ojagboro soils were statistically the same. The fraction of Pb bound to Organics of soils for the first rainy season planting ranged between 0.75±0.25 mg/kg and 5.58±0.14 mg/kg with the lowest recorded Mubo soil and the highest of Isale Auko soil

Table 23 : Lead fractionation of soils (mg/kg) used to raise vegetable accessions in the second dry season (2016) .

Site	Exchangeable Pb	BTCarbon fraction	BTOxides fraction	BTorganics fraction	Residual/Inert fraction
Otte	0.83±0.38[a]	2.58±0.11[bc]	3.58±0.14[c]	1.00±0.00[c]	1.42±0.49[a]
Budo Egba	0.83±0.14[a]	2.67±0.13[b]	2.75±0.00[e]	0.83±0.14[de]	1.19±0.29[b]
Budo Abio	0.27±0.03[f]	0.50±0.04[gh]	2.17 ±0.13[g]	0.70±0.21[fg]	0.33±0.00[g]
Mubo	0.42±0.14[de]	0.75±0.25[f]	2.25±0.00[f]	1.17±0.15[bc]	0.40±0.20[f]
Oyun	0.25±0.00[f]	0.42±0.14[i]	1.67±0.14[gh]	1.25±0.00[i]	0.45±0.10[f]
Ojagboro	0.52±0.00[d]	0.58±0.12[g]	4.25±0.00[a]	1.25±0.00[b]	0.85±0.34[c]
Olaolu	0.42 ± 0.14[de]	2.00±0.50[c]	1.33±0.38[h]	0.77±0.25[f]	1.19±0.00[b]
Eroomo	0.58±0.12[c]	1.58±0.29[d]	2.83±0.38[d]	1.02 ±0.02[c]	0.17±0.00[h]
Okeodo	0.29±0.07[f]	1.17±0.38[e]	1.00±0.00[jk]	0.58±0.14[g]	0.50±0.30[e]
Cocacola	0.50±0.00[d]	4.25±0.25[a]	1.25±0.00[hi]	0.75±0.22[f]	1.42±0.35[a]
Isale Aluko	0.67±0.14[b]	1.08±0.14[ef]	3.67±0.14[b]	2.08±0.14[a]	0.74±0.20[d]
Odoore	0.27±0.00[f]	0.50±0.00[gh]	1.15±0.05[j]	0.92±0.14[d]	0.34±0.17[g]
Botanical Graden(Control site)	0.25±0.00[f]	0.33±0.14[j]	0.25±0.00[l]	0.57±0.11[g]	0.13±0.17[h]

Mean value with same alphabet along the column are statistically the same. BT represents Bound To. Values represent mean ± S

Pb bound to Organics of the Control soil was lower than other sites except for Mubo and Oyun soils. The fraction of Pb bound to Organics of Okeodo and Cocacola soils were statistically the same.The range of the residual Pb of the first rainy season (2016) soils used for planting ranged between 0.22±0.09 mg/ kg and 1.57±0.63 mg/kg with the lowest recorded for Budo Abio soil while the highest was recorded forOlaolu soil. The fraction of residual Pb of the Control soil was higher than the other sites except for Olaolu and Isale Aluko soils. Residual Pb of Budo Egba and Oyun were statistically the same, so also were Ojagboro and Coca cola soils (Table 24). Table 25 shows the fractionation of lead of the soils used to plant vegetables during the second rainy season (2017).

The range of the Exchangeable fraction of lead of soils used for the second rainy season planting ranged between 0.00±0.00 mg/kg and 0.11±0.19 mg/kg suggesting a lower range of Exchangeable Pb than for soils used for the first rainy season (0.92±0.08 mg/kg and 11.33±0.29 mg/kg). Exchangeable fraction of Pb of the Control soil was 0.00±0.00 mg/kg for the second rainy season while 0.92±0.08 mg/kg was recorded for the Control soil of the first rainy season. Exchangeable fraction of Pb of soils of Otte, Ojagboro and Okeodo were statistically the same (Table 25). The Exchangeable of Pb in soils of most of the soils were not detected. The Pb bound to Carbon fraction of soils used for the second season (2017) planting ranged between 0.00±0.00 mg/kg and 0.33±0.05 mg/kg indicating lower fraction of Pb bound to Carbon for the second rainy season soil than the fraction the first rainy season (0.50±0.25 mg/kg and 18.33±0.72 mg/kg). Soils of other sites except for Otte (0.11±0.19 mg/kg), Budo Egba (0.11±0.14 mg/kg), Olaolu (0.33±0.05 mg/kg) and Cocaola (0.22±0.07 mg/kg) recorded Pb bound to Carbon below the detection limit (0.00 ±0.00 mg/kg).

Table 24 : Lead fractionation of soils (mg/kg) used to raise vegetable accessions in the first rainy season (2016).

Site	Exchangeable Pb	BTCarbon fraction	BTOxides fraction	BTorganics fraction	Residual/Inert Fraction
Otte	8.00±0.00^{e}	8.50±0.25^{c}	7.25±0.25^{c}	4.25±0.25^{cd}	0.79±0.26^{cd}
Budo Egba	7.08±0.12^{f}	7.14±0.13^{de}	6.00±0.10^{de}	2.83±0.38^{de}	0.39±0.10^{ef}
Budo Abio	4.08±0.12^{g}	0.83±0.12^{g}	3.50±0.26^{g}	1.42±0.08^{g}	0.28±0.09^{f}
Mubo	1.25±0.25^{h}	0.50±0.25^{h}	1.92±0.13^{h}	0.75±0.25^{hi}	0.84±0.89^{c}
Oyun	9.00±0.25^{d}	8.30±0.42^{cd}	8.92±0.63^{b}	1.00±0.25^{h}	0.40±0.20^{ef}
Ojagboro	9.92±0.52^{c}	4.33±0.12^{ef}	6.08±0.12^{de}	4.67±0.13^{c}	0.33±0.00^{efg}
Olaolu	10.83±0.63^{b}	18.33±0.72^{a}	7.33±0.14^{bc}	5.25±0.50^{b}	1.57±0.63 ^{a}
Eroomo	6.58±0.12^{fg}	7.67±0.13^{d}	4.33±0.13^{fg}	2.33±0.12^{efg}	0.64±0.19^{d}
Okeodo	8.58±0.12^{de}	8.25±0.00^{cd}	4.58±0.12^{f}	2.50±0.00^{ef}	0.45±0.16^{e}
Cocacola	11.33±0.29^{a}	9.58±0.12^{b}	5.50±0.25^{e}	2.42±0.14^{ef}	0.35±0.10^{efg}
Isale Aluko	8.00±0.25^{e}	9.42±0.13^{bc}	9.67±0.13^{a}	5.58±0.14^{a}	0.91±0.10^{b}
Odoore	6.50±0.25^{fg}	4.67±0.13^{e}	6.50±0.00^{d}	3.08±0.02^{d}	0.58±0.26^{de}
Botanical Graden(Control site)	0.92±0.08i	2.17±0.13^{f}	1.83±0.38^{hi}	1.33±0.14^{gh}	0.22±0.09^{fg}

Mean value with same alphabet along the same column are statistically the same. BT represents Bound To. Values represent mean ± SD

Pb bound to Oxides fraction of soils for the second rainy season (2017) ranged between 0.51± 0.17 mg/kg and 3.30 ± 0.03 mg/kg suggesting lower concentration than for the first rainy season soils (1.83±0.38 mg/kg and 9.67±0.13 mg/ kg) (2016) with the Control soil recording the lowest and highest of Oyun soil (Table 25). Pb bound to Oxides of the Control soil for the second rainy season (0.51± 0.17 mg/kg) (2017) was lower than the Pb bound to Oxides for the first rainy season (1.83±0.38 mg/kg) (2016). Soils of Mubo (2.00± 0.00 mg/kg) and Ojagboro (2.00± 0.07 mg/kg) were statistically the same in the fraction of Pb bound to Oxides, so also were Eroomo (2.20± 0.08 mg/kg), Okeodo (2.28± 0.32 mg/kg) and Isale Aluko (2.22± 0.17 mg/kg). Soil of the Control soil (0.51± 0.17 mg/kg) and Odoore (0.59± 0.14 mg/kg) had the same statistical fraction of Pb bound to Oxides

The range of the fraction of Pb bound to Organics was 0.86 ±0.00 mg/kg and 3.10±0.03 mg/kg with the lowest value recorded for Isale Aluko and the highest for Budo Abio (Table 25). Pb bound to Organics of soils for the second rainy season (0.86 ±0.00 mg/kg and 3.10±0.03 mg/kg) (2017) was lower than for the first rainy season (0.75±0.25 mg/kg and 5.58±0.14 mg/kg) (2016). The fraction of Pb bound to Organics of the Control soil (1.22± 0.13 mg/kg) was lower than soils of other sites except for Isale Aluko soil (0.86± 0.00 mg/kg) (Table 25). The fraction of Pb bound to Organics of the Control soil (1.22± 0.13 mg/kg) for the second rainy season was lower than the Control soil for the first rainy season (1.33±0.14 mg/kg) (2016) Soils of Budo Egba (2.30± 0.00 mg/kg) and Odoore (2.33± 0.00 mg/kg) were statistically the same for the fraction of Pb bound to Organics. The range of the residual Pb of soils used for the second rainy planting was between 0.33±0.03 mg/kg and 4.33 ±0.00 mg/kg. The residual Pb of soils used for the second rainy season (2017) planting was observed to be higer than for the first rainy season (0.22±0.09 mg/ kg and 1.57±0.63) (2016) Soil of the Control soil (0.33± 0.00 mg/kg) recorded the lowest residual Pb while the soil of Ojagboro the highest fraction (4.33± 0.00 mg/kg) (Table 25). Residual Pb of the Control site, was lower than soils of other sites except for Odoore soil that recorded same statistical value (0.33± 0.07 mg/kg). Same statistical fractions of residual Pb were recorded in soils of sites 1, 2, 4, 9 and 11.

Higher residual Pb concentration was recorded for the soil of the Control for the second rainy season (0.33±0.00 mg/kg) (2017) than the first rainy season (0.22±0.09 mg/kg) (2016). Soils of Ojagboro and Coca cola showed no statistical difference of the fraction of residual Pb (Table

25). Fraction of residual Pb of Mubo (1.83± 0.00 mg/kg), Olaolu (1.83± 0.00 mg/kg) and Okeodo soils (1.88± 0.22 mg/kg) were statistically the same, so also were Budo Abio (2.70± 0.00 mg/kg) and Coca cola (2.66± 0.19 mg/kg). Pb bound to Oxides recorded the highest fraction of the Pb species, this was followed by Pb bound to Organics next was residual Pb, bound to Carbon and lastly exchangeable Pb, that is , Pb bound to Pb bound to Oxides ≥ Organics ≥ residuals Pb ≥ Pb bound to carbon ≥ exchangeable fraction of Pb.

4.5: Pollution index of soil

Table 26 shows the pollution index (degree of pollution) of metals of soils for different sites used to raise the vegetables during the first dry season (2015). The range of Cadmium pollution index of soils used for the first dry season (2015) ranged between 0.50±0.08 and 1.50±0.13. The lowest Cd pollution index was recorded for soil of the Control (0.50±0.08) while the highest was recorded for Coca cola soil (1.50±0.13). The Control soil showed no Cd pollution (0.50±0.08) (Pi ≤ 1) but low Cd pollution for the soil of Coca cola (1.50±0.13) (Pi≥1≤2) for the first dry season planting (2015) (Table 26). Soils of Budo Egba (1.34±0.08), Ojagboro (1.34±0.12), Olaolu (1.34±0.10) and Okeodo (1.34±0.19) were statistically the same for their pollution index values showing low Cd pollution of the soils (Pi≥1≤2) (Table 26). Pollution index recorded of Cd for soils of Budo Abio (0.66±0.15) and Odoore (0.66±0.15) were statistically the same indicating no Cd pollution of the soils (P≤1). Soils of Otte, Budo Abio, Mubo, Oyun, Odoore and the Control all recorded pollution indices lower than one (P≤1) indicating no Cd pollution of those soils (Table 26).

Copper pollution index of soils used for the first dry season planting ranged between 0.86 ±0.09 and 1.93±0.08 which indicated low Cu pollution of the soils used for first dry season planting (Pi≤1≥2). Soil of the Control had mean pollution index of Cu of 0.86±0.09 indicating no Cu pollution (Pi≤1) and statistically the same with the soil of Odoore (0.89±0.11) (Table 26). The lowest degree of Copper pollution (pollution index) was recorded for soil of Control (0.86 ±0.09) while the highest degree was recorded for soil of Isale Aluko (1.93±0.08) (Table 26). Otte (1.04±0.06), Budo Egba(1.00±0.11), Budo Abio (1.11±0.00) and Eroomo soils (1.10±0.10) recorded low levels of Cu pollution indices (P≤1≥2). Soils of Okeodo Okeodo (1.90±0.04), Coca cola (1.90±0.11) and Isale Aluko (1.93±0.08) were statistically the same for the degree of pollution of Cu showing low Cu pollution of the soils (Pi≤1≥2) (Table 26).

Pollution index of Cu for soils of Otte (1.04±0.06), Budo Egba(1.00±0.11), Oyun (1.11±0.09) and Ojagboro (1.00±0.10) were statistically the same suggecting no Cu pollution of the soils (Pi≤1). The range of lead (Pb) pollution index of soils used for the first dry season planting ranged between 0.70 ±0.11 and 5.19 ±0.13. Mean pollution index for Lead was lowest for the Control soil and highest for Mubo soil (Table 26). No Pb pollution was observed for the Control soil (0.70 ±0.11) (Pi) while very strong pollution was observed for Mubo soil (5.19 ±0.13) (Pi≥5) used for the first dry season planting. Soil of the Control had lower Pb pollution index (0.70 ±0.11) than the other sites but statistically the same with Budo Abio (1.00±0.09), Eroomo(1.11±0.09) and Odoore soil (1.00±0.02) indicating low pollution level (Pi≤1). Pb pollution index of the soils of Otte (2.74±0.11), Budo Egba (2.82 ±0.14), Olaolu (2.70 ±0.11), Okeodo (2.68 ±0.13) and Coca cola (2.74 ±0.22) were statistically the same indicating moderate pollution of the soils (Pi≥2≤3). Soil of Oyun (4.78 ±0.04) recorded strong level of Pb pollution (Pi≤3≥4). Soils of Mubo (5.19 ±0.13) and Oyun (4.78 ±0.04) recorded relatively high Pb pollution index values compared to soils of other sites (Table 26).

The soils had different levels of heavy metals from no pollution (Pi≤1), low pollution (PI ≥1≤2), moderate pollution (PI≤2≥3), strong pollution PI≤3≥5 and very strong pollution (PI≥5). The result showed that soils of the Control were free from Cd, Cu and Pb, soils of Budo Abio, Eroomo and Odoore showed low pollution for the heavy metals while the other soils ranged between low pollution to very strong pollution especially for soils of Olaolu, Coca cola, Isale Aluko. It was also observed that degree of the pollution of soils varied with the species of the heavy metals (Table 26)

Table 25: Fractionation of Lead of the soils (mg/kg) used to plant vegetables during the second rainy season(2017) .

Sites	Exchangeable Pb	BTCarbon Fraction	BTOxides fraction	BTOrganics Fraction	Residuals/Inert Fraction
Otte	0.11±0.19[a]	0.00±0.00[c]	2.37±0.00[b]	1.40±0.00[cd]	1.70±0.00[ef]
Budo Egba	0.11±0.19[a]	0.00±0.00[c]	2.44±0.06[b]	2.30±0.00[bc]	1.99±1.35[d]
Budo Abio	0.00±0.00[b]	0.00±0.00[c]	1.30±0.00[c]	3.10±0.03[a]	2.70±0.00[b]
Mubo	0.11±0.19[a]	0.00±0.00[c]	2.00±0.00[b]	2.67±0.00[b]	1.83±0.00[deg]
Oyun	0.00±0.00[b]	0.11±0.19[b]	3.33±0.00[a]	0.67±0.00[f]	2.23±0.00[bcd]
Oja gboro	0.11±0.19[a]	0.00±0.00[c]	2.00±0.07[b]	2.40±0.06[bc]	4.33±0.00[a]
Olaolu	0.00±0.00[b]	0.33±0.05[a]	2.20±0.08[b]	1.68±0.03[c]	1.83±0.00[de]
Eroomo	0.00±0.00[b]	0.22±0.08[ab]	0.22±0.08[de]	1.33±0.00[cd]	2.50±0.00[bc]
Okeodo	0.11±0.19[a]	0.00±0.00[c]	2.23±0.00[de]	1.02±0.00[de]	1.88±4.82[de]
Coca cola	0.00±0.00[b]	0.00±0.00[c]	0.22±0.06[de]	1.69±0.00[c]	2.66±0.00[b]
Isale Aluko	0.00±0.00[b]	0.00±0.00[c]	0.33±0.00[d]	0.86±0.00[ef]	1.66±0.00[ef]
Odoore	0.00±0.00[b]	0.11±0.19[b]	0.16±0.00[ef]	2.33±0.00[bc]	0.33±0.03[g]
Botanical garden(Ref. site)	0.00±0.00[b]	0.00±0.00[c]	0.11±0.06[f]	2.22±0.03[bc]	0.33±0.00[g]

Mean value with same alphabet along the same column are statistically the same at p≤ 0.05. BT represents Bound To. Values represent mean ± SD

Table 26 Pollution Index of soils used for planting during the first dry season (2015).

SITES	Cd	Cu	Pb
Otte	0.84±0.11[d]	1.04±0.06[d]	2.74±0.11[c]
Budo Egba	1.34±0.08[b]	1.00±0.11[d]	2.76±0.14[c]
Budo Abio	0.66±0.10[d]	1.11±0.09[d]	1.00±0.09[e]
Mubo	0.50±0.08[ef]	1.58±0.04[b]	5.19±0.11[a]
Oyun	0.66±0.15[e]	1.29±0.07[c]	4.78±0.04[b]
Ojagboro	1.34±0.12[b]	1.32±0.08[c]	1.83±0.12[de]
Olaolu	1.34±0.10[b]	1.47±0.09[b]	2.70±0.11[c]
Eroomo	1.00±0.09[c]	1.00±0.10[d]	1.11±0.09[e]
Okeodo	1.34±0.19[b]	1.90±0.04[a]	2.68±0.13[cd]
Coca cola	1.50±0.13[a]	1.90±0.11[a]	2.74±0.22[c]
IsaleAluko	1.16±0.07[c]	1.93±0.08[a]	2.38±0.12[d]
Odoore	1.00±0.07[c]	0.89±0.11[f]	1.00±0.02[e]
Botanical garden(control site)	0.50±0.08[ef]	0.86±0.09[f]	0.70±0.11[f]

Mean value with same along the same column alphabet are statisticallythe same. Values represent mean ± SD. Pi=pollutin index, Pi≤1 (no pollutin), Pi≥1≤2 (low pollution), Pi≤2≥3 (moderate pollution), Pi ≥3≤5(strong pollution) and Pi≥5 (very strong pollution) (Yang et al., 2011, 2014)

Table 27 shows the pollution index of soil used to raise the vegetable accessions for the second dry season (2016). Pollution index of cadmium of the soils used for the second dry season (2016) planting ranged between 0.43±0.29 and 1.27 ±0.12. The range of the second dry season soils (2016) showed lower pollution index for Cd than the soils of first dry season (0.50±0.08 and 1.50 ±0.13) (2015). The lowest Cd pollution index was recorded for the Control soil (0.49±0.09) while the highest was recorded for Coca cola soil (1.27 ±0.12). The Control site had lower Cd pollution index (0.43±0.29) than the other sites and also lower than for the Control soil for the first dry season (0.50 ±0.08) (2015) both soils for the two intra dry seasons showed no Cd pollution (Pi ≤ 1). Highest Cd pollution index for soil used for the second dry season (2016) was recorded for Coca cola soil (1.27 ±0.12), it was also recorded highest for Coca cola soil (1.50 ±0.13)) for the first dry season (2015) indicating low Cd pollution for the two intra seasons (Tables 26 and 27). Same statistical Cd pollution index for soils of Eroomo and Odoore were recorded (Table 27). Soils of Otte, Budo Egba and Okeodo had statistically the same cadmium pollution index, so also were the soils of Mubo, Oyun and Olaolu (Table 27).

The pollution index of copper for soils used for the second dry season planting (2016) ranged between 1.04 ±0.15 and 2.28±0.17 indicating higher Cu pollution index for soil than for soils for the first dry season (0.86 ±0.09 and 1.93 ±0.11) (2015). The result for Cu pollution index for the second dry season soils suggested that the soils were from low pollution level to low pollution level (P≥1≤2 to P≥2≤3). The lowest pollution index of Cu was recorded for the Control soil (1.04 ±0.15) showing low Cu pollution level (Pi≥1≤2) and the highest for Isale Aluko (2.28±0.17) indicating moderate Cu pollution level (P≥2≤3). Pollution index of Cu of soil of the Control soil (1.04 ±0.15) was lower than the sites but higher than for the Control soil for the first season (0.86±0.11) (Table 27) (2015). Polluition index of Cu of soil of Budo Egba, Ojagboro and Odoore were statistically the same showing low Cu pollution level (P≥1≤2), so also were the soils of Budo Abio and Eroomo, also showing low Cu pollution level (P≥1≤2) (Table 27). Soils of Okeodo (2.04 ±0.03) and Coca cola (2.22 ±0.17) for the second season dry season planting indicated moderate Cu pollution level (P≥2≤3) (Table 27). Pollution index of Lead for soils used for the second dry season (2016) planting ranged between 0.54±0.20 and 3.11±0.06 indicating lower Pb pollution index than for the first dry season soils (0.70 ±0.11 and 5.19 ±0.11) (2015).

This result showed lower Pb pollution for second dry season soils (2016) than for the first dry season soils (2015). The lowest Pb pollution index for second dry season was recorded for the Control soil (0.54

±0.20) (2016) showing lower Pb pollution index than for the first dry season Control soil (0.70 ±0.11) (2015) both recorded no Pb pollution (Pi≤1) while the highest was recorded for Mubo soil (3.11±0.06) showing a strong Pb pollution index (Pi≥3≤5) (2016) also lower than the highest pollution Index for the first dry season soils (5.19 ±0.11) showing a very strong Pb pollution index (Pi≥5) which was recorded for Coca cola soil (Table 27). Soils for the second dry season planting (2016) were less polluted with Cd and Pb but more polluted with Cu than the soils of the first dry season (2015). presents the pollution index of soils used to raise the vegetable accessions in the first rainy season(2016). The range of cadmium pollution index of soils used for first rainy season planting (2016) was between 0.60±0.23 and 2.90±0.10 with the lowest Cd pollution index recorded for the Control soil and the highest for Cocacola soil. The the Control soil had lower Cd pollution index than the other sites (0.60±0.23). Soils of Budo Egba (1.42±0.02) and Isale Aluko (1.31±0.15) had the same statistical Cd pollution index for the first rainy season (2016) recording low Cd level (Pi≥1≤2), so also were soils of Budo Abio (1.08±0.11), Eroomo (1.11±0.21) and Odoore (1.04±0.17) with low Cd pollution level (Pi≥1≤2). Soil of the Control soil had no Cd pollution (0.60±0.23).

Pb pollution index for the second dry season soils of Budo Egba (2.44±0.14) and Ojagboro (2.39 ±0.06) had moderate pollution level (Pi≥2≤3). Pollution index of Pb for soil of Olaolu (2.53±0.19) was statitically the same with Okeodo soil (2.50±0.13) both had moderate Pb pollution (Pi≥2≤3) (27) and the soils of Otte (2.27±0.06) and Isale Aluko (2.20 ±0.21) at moderate Pb pollution level P≥2≤3. Control soil for the second planting season had no Cd and Pb pollution (P≤1) but low Cu pollution (P≥1≤2). Soils of Otte, Budo Egba, Oyun, Ojagboro, Olaolu, Okeodo, Coca cola and Isale Aluko for the second dry season had moderate Pb pollution level (Pi≥2≤3), soils of Budo Abio, Odoore and the Control site were had no Pb pollution (Pi≤1), Mubo soil had strong Pb pollution level (Pi≥3) and Eroomo had a low Pb pollution level (Pi≥1≤1) (Table 27).) (P≤1). Soils of Olaolu (1.94±0.17) and Okeodo (2.00±0.00) had the same statistical Cd pollution index recording low Cd pollution (P≥1≤2). Copper pollution index of soils used for the first rainy season ranged between 2.67±0.29 and 9.00 ±0.85. The lowest copper pollution index was recorded for Odoore soil and the highest for Isale Aluko soil (Table 28). Copper pollution index for the Control soil (2.93±0.29) was lower than other soils except for Odoore soil (2.67±0.29) showing moderate Cu pollution of the soils (Pi≥2≤3). No statistical differences were recorded for the Cu pollution index for the soils of Otte (4.00±0.25), Budo Egba (4.70±0.58), Mubo (4.72±0.22) and Oyun (4.67±0.23) indicating strong Cu pollution level (Pi≥3≤5), so also were Budo

Abio (3.33 ±0.16), Olaolu (3.80±0.25) and Okeodo (3.33±0.22) suggesting strong Cu pollution level of the soils (Pi≥3≤5) (Table 28) Eroomo (2.95±0.35), Coca cola (2.67±0.27), Odoore (2.93±0.58) and the Control soils (2.67±0.29) had the same statistical Cu pollution index showing moderate Cu pollution level (Pi≥2≤3) (Table 27). Copper pollution index for soil of Ojagboro (6.75±0.18) and Isale Aluko (9.00±0.85) were relatively higher than other soils showing strong Cu pollution level (P≥3≤5). Cu pollution of soils used for the first rainy season planting (2016) ranged from moderate pollution to strong pollution level and to very strong pollution (Table 28). Soils used for the first rainy season (2016) were observed to be highly polluted of Cu (Table 28). Lead pollution index for soils used for planting for the first rainy season (2016) ranged between 0.65±0.12 and 4.59±0.14 with the lowest recorded for the Control soil and the highest for Oyun soil (Table 28). Pollution index of Pb for soil of the Control was lower than the other sites (0.65±0.12) suggesting no Pb pollution (Pi≤1). Soils of Otte (3.07±0.11), Budo Egba (3.16±0.13) and Cocacola (3.47±12) had the same statistical Pb pollution index indicating strong Pb pollution (Pi≥3≤5), so also were the soils of Mubo (4.53±0.02) and Oyun (4.59±14) showing strong Pb pollution level (P≥3≤5) (Table 27).

Ojagboro, Olaolu and Isale Aluko had the same statistical Pb pollution index (Table 28). Pb pollution of soils used for planting for the first rainy season was higher than Cu and Cu thanCd (Pb ≥Cu≥Cd). It was observed from the result that some soils were more disposed to a particular heavy metal than the other. Soils of Otte, Budo Egba, Mubo, Oyun, Olaolu, Okeodo and Coca cola were more polluted of Pb and Cd, soils of Ojagboro and Isale Aluko were more polluted of Cd and Cu (Table 28). Soils of Budo Abio. Eroomo, Odoore and the Control were less polluted of the heavy metals (Table 28)

Table 27: Pollution Index of Soil used to raise the vegetable accessions in the second dry season (2016).

SITES	Cd	Cu	Pb
Otte	0.90±0.22^{c}	1.25±0.18^{e}	2.27±0.06^{d}
Budo Egba	0.92±0.42^{c}	1.32±0.04^{d}	2.44±0.14^{cd}
Budo Abio	0.49±0.09^{h}	1.19±0.22^{ef}	0.68±0.47^{fg}
Mubo	1.07±0.33^{bc}	1.48±0.13^{cd}	3.11±0.36^{a}
Oyun	1.09±0.12^{bc}	1.61±0.05^{c}	2.85±0.22^{b}
Ojagboro	1.18±0.12^{b}	1.33±0.17^{d}	2.39±0.06^{cd}
Olaolu	1.09±0.26^{bc}	1.88±0.13^{ab}	2.53±0.19^{bcd}
Eroomo	0.66±0.08^{d}	1.20±0.15^{ef}	1.09±0.23^{e}
Okeodo	0.99±0.41^{c}	2.04±0.03^{ab}	2.50±0.13^{bcd}
Coca cola	1.27±0.12^{a}	1.43±0.07^{cd}	2.62±0.11^{bc}
IsaleAluko	1.20±0.02^{ab}	2.28±0.17^{a}	2.20±0.12^{d}
Odoore	0.60±0.01^{de}	1.36±0.21^{d}	0.91±0.10^{f}
Botanical garden(control site)	0.43±0.29^{e}	1.04±0.15^{f}	0.54±0.20^{g}

Mean value with same along the same column alphabet are statisticallythe same. Values represent mean ± SD. Pi=pollutin index, Pi≤1 (no pollutin), Pi≥1≤2 (low pollution), Pi≤2≥3 (moderate pollution), Pi ≥3≤5(strong pollution) and Pi≥5 (very strong pollution) (Yang et al., 2011, 2014)

Table 28: Pollution Index of Soil used to raise the vegetable accessions in the first rainy season .

SITES	Cd	Cu	Pb
Otte	1.62±0.01[e]	4.00±0.80[c]	3.07±0.00[bc]
Budo Egba	1.40±0.02[ef]	4.70±0.58[c]	3.16±0.02[b]
Budo Abio	1.08±0.11[fg]	3.33±0.16[cd]	1.32±0.01[gh]
Mubo	2.16±0.01[d]	4.72±0.22[c]	4.53±0.13[e]
Oyun	2.65±0.03[b]	4.67±0.19[c]	4.59±0.14[e]
Ojagboro	2.58±0.09[c]	6.75±0.18[b]	2.64±0.02[d]
Olaolu	1.94±0.17[de]	3.80±0.25[d]	2.60±0.23[a]
Eroomo	1.11±0.21[fg]	2.95±0.35[d]	1.02±0.08[bc]
Okeodo	2.00±0.00[de]	2.67±0.27[c]	2.59±0.01[de]
Coca cola	2.90±0.10[a]	3.33±0.22[de]	3.47±0.12[f]
IsaleAluko	1.31±0.15[ef]	9.00±0.85[a]	2.62±0.05[d]
Odoore	1.04±0.17[fg]	2.67±0.29[e]	1.09±0.13[g]
Botanical garden(control site)	0.60±0.23[g]	2.93±0.58d	0.65±0.12[h]

Mean value with same along the same column alphabet are statisticallythe same. Values represent mean ± SD. Pi=pollutin index, Pi≤1 (no pollutin), Pi≥1≤2 (low pollution), Pi≤2≥3 (moderate pollution), Pi ≥3≤5(strong pollution) and Pi≥5 (very strong pollution) (Yang et al., 2011, 2014)

Table 29 shows the mean pollution index of the heavy metals of soils used to raise the vegetables for the second rainy season (2017). The range of the mean Cd pollution Index of the soils used to raise the vegetables in the second rainy season (2017) was 0.00 ± 0.00 and 3.11 ± 0.17. No Cd was detected for all the soils except for the soils of Otte (3.11±0.17), Budo Egba (2.85±0.15), Budo Abio (1.35±0.15), Mubo (0.47±0.22), Olaolu (0.50±0.11) and Eroomo (0.43±19) while the highest was recorded for Otte soil (3.11 ± 0.17). Soil of the Control soil (0.00 ± 0.00) had the no detectable pollution Index (0.00±0.00) indicating no Cd pollution (Table 29). Soils of Otte (3.11±0.17) had strong Cd pollution level (P≥3≤5), Budo Egba (2.85± 0.15) had moderate Cd pollution level (Pi≥2≤3), Budo Abio (1.35±0.15) suggesting low Cd pollution level (Pi≥1≤2), Mubo (0.47±0.14), Olaolu (0.50 ±0.11) and Eroomo (0.43±0.19) recorded no Cd pollution level (Pi≤1) (Table 29).

It was found that most of the soils did not contain Cd (Oyun, Ojagboro, Okeodo, Coca cola, Isale Aluko, Odoore and Control soils) suggesting that the soils were not polluted with Cd. Only soil of Budo Abio was found to be of low Cd pollution, soil of Budo Egba was moderately polluted with Cd while Otte soil was found to be strongly polluted with Cd (Table 29). Cu pollution index for the soils used for the second rainy season (2017) ranged between (1.05 ± 0.14) and (5.37 ± 0.60) showing the range of low Cu pollution level (Pi≥1≤2) to very strong Cu pollution level (Pi≥5). Cu pollution index of the Control soil (1.05 ± 0.14) had the lowest value than other soils (Table 29). Soils of Otte (3.80 ± 0.10), Budo Egba (3.88 ± 0.10) and Ojagboro (3.23 ± 0.18) had the same statistical Cu pollution index indicating strong Cu pollution level (Pi≥3≤5), so also were soils of Budo Abio (2.65 ± 0.27), Mubo (2.74 ± 0.25), Oyun (2.65 ± 0.33), Olaolu (2.72 ± 0.18), Eroomo (2.33 ± 0.25), Coca cola (2.22 ± 0.19) and Odoore (2.08 ± 0.10) suggesting moderate Cu pollution level (Pi≥2≤3) of the soils (Table 36).

Pollution Index for Pb of soils used for the second rainy season planting (2017) ranged between 1.00±0.00 and 14.30 ± 1.77 showing the range of Pb pollution of the soils for the season from low pollution level (Pi≥1≤2) to very strong Pb pollution level (Pi ≥5). The Control soil had the lowest Pb pollution Index (1.00 ± 0.00) while soil of Olaolu (14.30 ± 1.77) recorded the highest value (Table 29). Pollution Index of the Control soil recorded lower Pb pollution index than soils of other sites (Table 29). Soils of Otte (2.44 ± 0.14), Budo Egba (2.13 ± 0.13), Oyun (2.81 ± 0.08), Ojagboro (2.33 ± 0.14) and Okeodo (2.46 ± 0.13) were statistically the same for the Pb pollution index showing moderate Pb pollution level (Pi≥2≤3), so also were soils of Eroomo (3.01 ± 0.19) and Odoore (3.51 ± 0.43) showing strong Pb pollution level (Pi≥3≤5). Relatively high Pb Polution indices were recorded for soils of Olaolu

(14.30 ± 1.77), Coca cola (7.37 ± 1.16) and Isale Aluko (5.10 ± 1.35) which suggested very strong Pb pollution of the soils (Pi≥5) (Table 29). The soils had different levels of Pb pollution. All the soils with Pb pollution index equal or less than 1 recorded no Pb pollution (Control soil), soils with Pb pollution index equal or greater than 1 but less than 2 had low Pb pollutrion level (Budo Abio), soils with Pb pollution index equal or greater 2 but less than 3 had moderate Pb pollution level (Otte, Budo Egba, Oyun, Ojagboro and Okeodo), those with Pb pollution index equal or greater than 3 but less than 5 had strong Pb pollution index (Eroomo) while soils with Pb pollution index equal or greater than 5 had strong Pb pollution index (Coca cola, Isale Aluko and Olaolu). The Control soil for the second rainy season had the lowest pollution indices for all the heavy metals (Cd: 0.00 ± 0.00, Cu: 1.05 ± 0.14 and Pb: 1.00 ± 0.00). Second rainy season soils (2017) used for planting had higher Cd pollution index range (0.00 ± 0.00) and (3.11 ± 0.17) than soils for the first rainy season planting (0.60±0.23 and 2.90±0.10) (2016), so also was Pb (1.00±0.00 and 14.30 ± 1.77) for the season rainy season soils (2017) higher than the Pb pollution range (0.65±0.12 and 4.59±0.14) for first rainy season soils (2016) but lower Cu pollution index for soils of the second rainy season (1.05 ± 0.14) and (5.37 ± 0.60) (2017) than the first rainy season (2.67±0.29 and 9.00 ±0.85) (2016). Heavy metal pollution index of soils used for the second rainy season planting was in the order Pb≥Cd≥Cu (Table 29). Pb rated highest index amongst the metals in this study, Cu ranked second while Cd ranked the least for soils used for the first dry season planting. Table 31 presents the potential ecological risk index of study sites for the second dry season.

Ecological potential risk index of cadmium for the second dry season ranged between 27.80±0.15 and 75.91±0.28 with the lowest recorded for Odoore and the highest for Okeodo (Table 31). The Control site (29.63±0.24) had lower ecological potential risk than other sites except for Odoore (27. 80±0.15). Otte (63.99±0.14) and Oyun (64.08±0.15) had the same statistical Cd potential ecological risk index suggesting low ecological risk, so also were Budo Egba (54.22±0.23) and Isale Aluko (55.69±0.17) (RI≤150). No significant differences were recorded for the Cd potential ecological risk index for Mubo (72.66±0.18), Ojagboro (72.57±0.21), Olaolu (73.33±0.33), Okeodo (75.91±0.29) and Coca cola (73.20±0.30) indicating low Cd eceological risk since they were all lower than 150 (RI≤150).

4.6: Ecological potential risk

Table 30 shows the mean potential ecological risk index of the study sites for the first dry season planting (2015). The range of the potential ecological risk index for Cadmium of the study sites for the first dry season planting (2015) was between 30.00±0.21 and 90.00±0.68 (Table 30). The lowest Cd potential ecological risk index was recorded for the Control site (30.00±0.21) while the highest was recorded for Olaolu (90.00±0.68) (2015). Mubo (80.40±0.32), Ojagboro (80.40±0.34), Okeodo (80.40±0.48) and Coca cola (80.40±0.39) showed statistically the same Cd potential ecological risk index, so also were Otte (69.60±0.27), Budo Egba (60.00±0.22) and Oyun (60.40±0.14) (Table 30). Budo Abio (39.40±0.19), Eroomo (39.60±0.15), Odoore (30.00±0.27) and the Control site (30.00±0.21) had the same potential Cd ecological risk index statistically (Table 30). All the sites recorded low Cd ecological risk (Ri≤150) since RI were all less than 150, therefore, the sites posed no Cd ecological risk (Table 30). The range of the potential ecological risk index for Copper for the first dry season (2015) was between 74.29 ±0.38 and 130.88±0.23 (Table 30). The lowest mean potential ecological risk index for Copper was recorded for Coca cola site (74.29 ±0.38) while the highest was recorded for Eroomo site (Table 30). The Control site (82.66 ± 0.29) recorded a lower potential ecological risk index for Cu than the other sites except for Ojagboro (74.20±0.40), Coca cola (74.29 ±0.38) and Isale Aluko sites (74.40 ±0.25) (Table 30).

Otte, Budo Abio, Oyun and Odoore were statistically the same for Cu potential ecological risk index, so were were Budo Egba, Mubo, Olaolu, Okeodo and the Control site (Table 30). The implication of this result is that the sites posed low ecological risk of Cu (RI≤150) for planting since all the values obtained were less than 150. The mean potential ecological risk index for lead for (Pb) for the first dry season (2015) ranged between 57.55 ± 1.63 and 191.29 ±4.15 with the lowest recorded for Odoore site while the highest was recorded for Olaolu site (Table 30). Potential ecological risk index of the Control site (69.90 ± 2.65) was lower than other sites except for Odoore (56.75 ± 1.90) (Table 30). There were no significant differences between the potential ecological risk index of Otte (158.71 ± 2.23), Budo Egba (158.59 ± 2.23) and Okeodo (153.75 ± 2.85), So also were Mubo (165.50 ± 2.35) and (169.86 ± 2.75). Eroomo (101.29 ± 0.22) and Isale Aluko (119.46 ± 3.27) had the same statistical mean of Pb ecological risk index (Table 30). This result showed that some sites (Otte, Budo Egba, Mubo, Oyun, Olaolu, Okeodo and Coca cola) posed moderate Pb ecological risk since their values were greater than 150 (RI≥150) while the other sites recorded Pb RI≤150, therefore, posed low Pb ecological risk (Table 30). The sites were of low Cd and Cu ecological risk for the first dry season but some of the sites posed low (RI≤150) and moderate Pb ecological risk with their RI ≥ 150 (Table 30). The Control site showed low ecological risk index for all the heavy metals (Cd, Cu and Pb)(RI≤150) (Table 30).

Table 29: Mean Pollution Index of the soils used to raise the vegetables in the second rainy season(2017).

SITES	Cd	Cu	Pb
Otte	3.11±0.17 ^{a}	7.80±8.02^{c}	2.44±0.44^{cde}
Budo Egba	2.85±0.15 ^{b}	7.88±10.15^{c}	2.13±0.34^{cde}
Budo Abio	1.35±0.15 ^{c}	1.65±0.58^{g}	1.89±1.28^{de}
Mubo	0.47±0.22 ^{d}	3.74±3.25^{f}	8.14±8.03^{bc}
Oyun	0.00±0.00 ^{e}	3.65±3.33^{f}	2.81±0.08^{cde}
Oja gboro	0.00±0.00 ^{e}	4.23±4.58^{e}	2.33±0.14^{cde}
Olaolu	0.50±0.11 ^{d}	11.72±13.78^{a}	14.30±1.77^{a}
Eroomo	0.43±0.19 ^{d}	10.33±10.18^{b}	5.10 ±1.35^{de}
Okeodo	0.00±0.00 ^{e}	3.83±2.33^{f}	2.46±0.13^{cde}
Coca cola	0.00±0.00 ^{e}	4.91±1.82^{de}	3.01±0.19^{cde}
Isale Aluko	0.00±0.00 ^{e}	5.37±3.60^{d}	7.37±1.16b^{cd}
Odoore	0.00±0.00 ^{e}	1.08±0.01^{gh}	3.51±3.13^{cde}
Botanical garden	0.00±0.00 ^{e}	1.00±0.00^{gh}	1.00±0.00^{e}

Mean value with same along the same column alphabet are statisticallythe same. Values represent mean ± SD. Pi=pollutin index, Pi≤1 (no pollutin), Pi≥1≤2 (low pollution), Pi≤2≥3 (moderate pollution), Pi ≥3≤5(strong pollution) and Pi≥5 (very strong pollution) (Yang et al., 2011, 2014)

Pb recorded the highest values of ecological risk It was found that potential ecological risk index for all the sites for the second dry season (2016) were lower than the first dry season (2015) indicating that sites for the second dry season (2016) were less polluted with Cd than the first dry season (2015) because all the sites had ecological potentential risk index less than 150 (RI≤150).The ecological potential risk index of copper for the second dry season (2016) ranged between 82.90 ± 3.60 and 169.89±3.27 with the lowest index recorded for Isale Aluko and the highest Eroomo (Table 31). Ecological potential risk index for copper of the Control site was lower than the other sites except for Ojagboro (90.20 ± 3.84), Olaolu (93.77 ± 1.65), Olaolu (91.55 ± 0.90), Coca cola (86.75 ± 1.50) and Isale Aluko (82.90 ± 3.60) (Table 31). All the sites except for Eroomo (169.89 ± 3.27) (RI≥150) were of low Cu potential ecological risk index because their ecological risk index were less than 150 (RI≤150) but Eroomo was moderately polluted with Cu because RI is greater than 150 (169.89 ± 3.27) (Table 31). The result showed that all the sites for the second dry season (2016) recorded higher Cu potential ecological risk index than the first dry season sites (2015) (Table 31).

The range of ecological potential index of Lead for the second dry season (2016) was between 50.71±0.50 and 185.15 ± 5.65 with the lowest recorded for the Control site and the highest for Coca cola The Control site had lower ecological potential risk index of Pb than other sites (Table 31). Olaolu had relative higher Pb ecological poetential risk index (185.15 ± 5.65) compared to the other sites. There were significant no differences between the Pb ecological potential risk index for Otte (150.65±1.80), 2 (150.97±0.68), Oyun (150.80±2.80) and Okeodo (150±65) (Table 38) showing moderate Pb ecological index for the sites because their ecological risk index were higher than 150 (RI≥150≤300), so also were Mubo (160.25 ± 0.75) and Coca cola (169.50±2.50) indicating moderate Pb ecological index because all values were higher than 150 (RI≥150≤300). The result showed that some sites (3,6,8,11,12 and 13) had ecological risk index lower than 150 (RI≤150) while some (1,2,4,5,7,9 and 10) were higher than 150 but less than 300 (RI≥150≤300).

The implication of the result is that, sites that had RI≤ 150 were lowly polluted with Pb while those with RI≥150≤300 were moderately polluted with Pb. Ecological potential risk index for Pb was lower for the sites of the second dry season (2016), than the first dry season (2015). It was observed that sites were more polluted of Cd and Pb for the first dry season (2015) than the second dry season (2016) while Cu pollution of sites was more during the second dry season (2016) than the first dry season (2015) (Table 30 and 31). The result also indicated that some sites were prone to some specie of heavy metal than the other. Otte, Budo Egba, Mubo, Oyun, Olaolu, Okeodo and Coca cola site were more polluted with Cd and Pb than Cu while Budo Abio, Eroomo and Odoore were more of Cu pollution, Ojagboro and Isale Aluko were more polluted of Cd and Cu (Tables 30 and 31). Soils of both dry seasons were of no, low and moderate ecological risk for the heavy metals (Cd, Cu and Pb). Table 32 shows the heavy metals ecological potential risk of sites for the first rainy season (2016). The Cd potential ecological risk index for the sites used for first rainy season (2016) ranged between 15.25±0.35 and 25.20 ± 0.60 with the lowest recorded from the Control site and the highest fronm Ojagboro (Table 32). The Control site had lower ecological risk index than other sites. Relatively low values were recorded for the Cd ecological potential risk for sites used for the first rainy season which implied that there was no Cd ecological risk for the sites.

Table 30 Ecological Pollution Risk Index of the study sites first dry season (2015)

SITE	Cd	Cu	Pb
Otte	69.60 ± 0.27^{d}	97.00 ± 0.20^{b}	158.71 ± 2.23^{cd}
Budo Egba	60.00 ± 0.21^{cd}	85.35 ± 1.60^{c}	158.59 ± 2.17^{cd}
Budo Abio	39.40 ± 0.19^{de}	95.00 ± 0.00^{b}	83.89 ± 1.32^{ef}
Mubo	80.40 ± 0.32^{b}	89.75 ± 2.40^{c}	165.50 ± 2.35^{c}
Oyun	60.40 ± 0.14^{cd}	91.44 ± 0.58^{b}	169.86 ± 2.75^{c}
Ojagboro	80.40 ± 0.34^{b}	74.20 ± 0.40^{d}	95.56 ± 1.08^{e}
Olaolu	90.00 ± 0.68^{a}	84.83 ± 0.96^{c}	191.29 ± 4.15^{a}
Eroomo	39.60 ± 0.15^{de}	130.88 ± 0.25^{a}	101.49 ± 0.22^{de}
Okeodo	80.40 ± 0.48^{b}	85.90 ± 0.35^{c}	153.75 ± 2.85^{cd}
Coca cola	80.40 ± 0.39^{b}	74.29 ± 0.38^{d}	188.65 ± 4.97^{b}
IsaleAluko	50.40 ± 0.21^{d}	74.40 ± 0.25^{d}	119.46 ± 3.27^{d}
Odoore	30.00 ± 0.21^{e}	90.00 ± 1.50^{b}	56.75 ± 1.90^{h}
Botanical garden	30.00 ± 0.21	82.66 ± 0.29^{c}	69.90 ± 2.65^{fh}

Mean value with same alphabet along the same column are significantly the same at $p \leq 0.05$. Values represent mean ± SD

RI ≤ 150 (low ecological risk), RI≥150≤300 (moderate ecological risk), RI≥300≤600 (considerably high ecological risk) RI≥600 (very high ecological risk).

Copper potential ecological risk index for sites used the first rainy season (2016) ranged between 95.43 ± 0.24 and 187.55±0.38 with the lowest recorded for Cocacola and the highest for Eroomo. The Control site had lower Cu potential ecological risk index than other sites except for sites Olaolu and Coca cola. There were no significant differences between the Cu potential ecological risk index for sites Otte (125.34 ± 0.31) and Odoore (124.62 ± 0.18), so also were Budo Egba (143.84 ± 0.61), Ojagboro (143.21 ± 0.10) and Isale Aluko (143.10 ± 0.25). The same statistical potential ecological risk index were recorded for Mubo (102.64 ± 0.22), Oyun (102.52 ± 0.13), Okeodo (102.96 ± 1.04) and the Control sites (102.78 ± 0.24) (Table 32).

The result implied that all the sites had low Cu ecological risk because all values were less than 150 (RI≤150) except for Eroomo (187.55 ± 0.38) that recorded higher value than 150 suggesting a moderate Cu ecological risk of the site (RI≥150≤300) (Table 32). Lead potential ecological risk index for the sites used for the first rainy season (2016) ranged between 38.00 ± 0.50 and 89.94 ± 0.23 with the lowest recorded for the Control site and the highest recorded for Olaolu. Pb potential ecological risk index for the Control site was lower than the other sites (Table 32). Pb ecological potential risk index for Otte (66.55 ± 0.37), Budo Egba (65.73 ± 18) and Oyun (66.25 ± 0.25) were statistically the same, so also were Budo Abio (51.85 ± 0.35), Ojagboro (56.48 ± 0.23) and Eroomo (55.10 ± 0.75). Same statistical Pb potential ecological index were recorded for Olaolu (89.94 ± 0.23), Okeodo (85.81 ± 29), Coca cola (86.05 ± 1.04) and Isale Aluko (82.00 ± 0.10).

The Control site and the Odoore were statistically the same for the Pb ecological index risk. All the sites had low Pb ecological risk because all the values were less than 150 (RI≤150) (Table 32). Potential ecological risk index of Cd for sites used for the second rainy season (2017) was between 18.55 ±0.20 and 29.84±0.22 with the lowest recorded for the Control site while the highest was recorded for Ojagboro (Table 33). Cd potential ecological risk for the Control site (18.55 ±0.20) and was lower than other sites but statistically the same with site Odoore (19.05 ± 0.33). All the sites had low Cd ecological risk (2017) but with slightly higher statistical values than the first rainy season sites (2016). Potential ecological risk index of copper for sites where the vegetables were grown for the second rainy (2017) season ranged between 93.33 ± 0.26 and 132.83 ±3.25. The lowest Cu potential ecological risk index was recorded for the Control site while the highest was recorded for Isale Aluko (Table 33). The Control site had the lowest Cu ecological risk index while Isale Aluko had the highest. The recorded potential ecological risk for the

Control site was lower than the other site (Table 33). All the sites had low ecological risk for Cu because they all have values less than 150 (ER≤150). It was found from the result that Cu ecological risk values for the second rainy season (2017) were slightly lower than the first rainy season (2016) (Table 32 and 33). The potential risk index of lead for the sites used for the second rainy season (2017) was between the range of 42.90±0.10 and 115.67±17.75 with the lowest recorded for the Control site and the highest for Eroomo (Table33). Pb ecological risk of the Control site was lower than other sites (Table 33). Eroomo site (115. 67 ± 17.75) had relatively higher value of ecological risk index than other sites while Odoore and the Control site had significantly lower values of ecological risk index than other sites (Table 33). It was observed that all the sites were of low Pb ecological risk because they all recorded lower values than 150 (RI≤150).

Intra and inter seasonal variation or differences were observed in the potential ecological risk index of the sites for the tested heavy metals. Cd and Pb were observed to be relatively higher in the dry season than in the rainy season. It was also found that Cd and Pb pollution were slightly higher in the first dry season (2015) and second rainy season (2017) than in the second dry season (2016) and the first rainy season (2016), and that, Cu pollution of sites was more in the second dry season (2016) and the first rainy season (2016) (Tables 30,31,32 and 33). Potential ecological risk index analysis showed that, when based on RI_r^i , the order of the three heavy metals was Pb≥Cu≥Cd. Pb showed the highest ecological risk factor, followed by Cu and Cd. Furthermore, the three tested heavy metals all had low and moderate potential ecological risks.

4..7: Physico-chemical properties of water samples

Table 34 shows the physico-chemical properties of the water used to irrigate the vegetables during the first dry season season (2015). The pH range of the water used for the irrigation of the vegetables during the first dry season was between 6.42±0.01 and 6.93±0.02 suggestion that the water used for irrigation in the first dry season were slightly acidic. The lowest pH was obtained in the water used for the Control site (6.42±0.01) while the highest was recorded in the water of Ojagboro (6.93±0.02). Water of Ojabgoro, Coca cola and Isale Aluko recorded no significant statistical differences in their pH (Table 34). There were no statistical differences in the pH of water used for Budo Abio, Budo Egba and Oluolu sites (Table 34). Water of Mubo, Oyun and Okeodo were statistically the same at p≤0.05 (Table 34). Water of Otte, Olaolu and Odoore recorded no significant differences in their pH. The range of the mean total acid value of water used for the irrigation of the vegetables during the first dry season (2015) was between 1.57±0.02 mg/l and 3.97±0.02 mg/l. Water from other sites had higher total acid value than the Control site. The mean total acid value of water used for Ojagboro site had the highest (3.97±0.02 mg/l) while the lowest was recorded in the water used for Control site (1.57±0.02 mg/l).

The range of the mean turbidity value of water used for the irrigation of the vegetables during the first dry season (2015) was between 4.52±0.12 NTU and 6.95± 0.01 NTU. Turbidity value of water from the Control site was lower than the other sites while the highest was obtained for the water used Water of Budo Egba and Mubo were statistically the same for their mean turbidity. Water samples of Okeodo and Control site had significantly the same turbidity values (Table 34). Water of Oyun and Coca cola had the same turbidity value. The range of total hardness of water was between 6.30±0.28 mg/l and 31.60 ± 0.40 mg/l with the lowest obtained for the Control site and the highest for Ojagboro. Water of the other sites had higher total hardness of water than the Control site (Table 34). Water used for Budo Abio, Erooomo and Odoore sites recorded statistically the same total hardness values. The range of the mean chloride ion content of water used for the irrigation of the vegetables during the first dry season (2015) was between 0.61± 0.02 mg/l and 2.73±0.02 mg/l. The mean chloride ion content value of water used for the Control site was lower compared to the other sites (Table 35). Highest mean chloride ion content (2.73±0.02 mg/l) was recorded for water used for Eroomo while the lowest (0.61± 0.02 mg/l) was obtained for water used for the Control site. (Table 35). Physicochemical properties the used water used to irrigate the vegetable accessions in the second dry season (2016) are presented in Table 35. The pH of the water used to irrigate the accession was between 6.55±0.04 and 6.93±0.03 with the lowest pH recorded for the Control site and the highest for Isale Aluko (Table 35) suggesting slightly statistically higher pH than those irrigation water used for the first dry season. The pH for the Control site had a lower pH than the other sites.

The pH for water used for Otte and Budo Egba were statistically the same at $p \leq 0.05$, so also were Budo Abio and Okeodo, Mubo and Eroomo. No significant differences were observed in the pH of water used for Oyun, Olaolu and Odoore (Table 35). The total acid value of the water used for irrigation during the second dry season ranged between 1.49±0.04 mgKoH and 3.69±0.03 mgKoH with the lowest for the Control site and the highest for Isale Aluko (Table 35). Lower total acid values were observed for the irrigation water used for the second dry season (2016) than for the first dry season (2015).

Table 31: Ecological Potential Risk of study sites second dry season (2016)

SITES	Cd	Cu	Pb
Otte	63.99±0.14[c]	115.65±1.35[c]	150.65±1.80[c]
Budo Egba	54.22±0.23[d]	112.73±2.77[c]	152.90±0.25[c]
Budo Abio	37.47±0.42[de]	126.51±4.48[b]	78.50±1.50[f]
Mubo	72.66±0.18[b]	96.53±3.61[d]	160.25±0.75[bc]
Oyun	64.08±0.15[c]	95.88±1.04[d]	157.80±2.80[c]
Ojagboro	72.57±0.54[b]	90.20±3.80[d]	98.00±0.50[e]
Olaolu	73.33±0.33[ab]	93.77±1.65[d]	185.15±5.65[a]
Eroomo	34.50±0.20[e]	169.89 ± 3.27[a]	97.50±0.07e
Okeodo	75.91±0.28[a]	91.55±3.55[d]	150.65± 1.95[c]
Coca cola	73.20±0.30[ab]	86.75±1.50[e]	169.50±2.57[b]
IsaleAluko	55.69±0.17[d]	82.90±3.60[e]	110.25±0.60[d]
Odoore	27.80±0.15[fg]	110.50 ±2.65[c]	52.45±1.45[g]
Botanicalgarden (Control site)	29.63±0.24[f]	94.50±1.50[d]	50.71±0.50[gh]

Mean value with same alphabet along the same column are significantly the same at $p \leq 0.05$. Values represent mean ± SD

RI ≤ 150 (low ecological risk), RI≥150≤300 (moderate ecological risk), RI≥300≤600 (considerably high ecological risk) RI≥600 (very high ecological risk).

Table 32: Ecological Potential Risk of study sites first rainy season (2016).

SITES	Cd	Cu	Pb
Otte	21.84±0.11[c]	125.34±0.31[cd]	66.55±0.15[cd]
BudoEgba	22.09±0.15[bc]	143.84±0.11[b]	65.73±0.18[cd]
BudoAbio	20 50±0.35[c]	135.94±0.16[bc]	51.85±0.34[de]
Mubo	22.43±0.14[bc]	102.64±0.22[d]	75.19±0.33[c]
Oyun	21.65±0.15[c]	102.52±0.13[d]	66.25±0.25[cd]
Ojagboro	25.20±0.60[a]	143.21±0.10[b]	56.48±0.23[d]
Olaolu	21.82±0.23[c]	97.98±1.17[ef]	89.94±0.23[a]
Eroomo	21.01±0.07[c]	187.57±0.38[a]	55.10±0.24[d]
Okeodo	23.60±0.10[b]	102.96±1.04[d]	85.81±0.03[ab]
Coca cola	21.63±0.21[c]	95.43±0.24[f]	86.05±0.04[ab]
IsaleAluko	24.55±0.10[ab]	143.10±0.25[b]	82.01±0.01[b]
Odoore	20.25±0.40[c]	124.62±0.18[cd]	45.71±0.05[e]
Botanical garden(control site)	15.25±0.35[c]	102.78±0.24[h]	38.00±0.50[ef]

Mean value with same alphabet along the same column are significantly the same at $p \leq 0.05$. Values represent mean ± SD

RI ≤ 150 (low ecological risk), RI≥150≤300 (moderate ecological risk), RI≥300≤600 (considerably high ecological risk) RI≥600 (very high ecological risk).

Table 33: Mean Ecological Pollution Index of Study Sites in the second rainy season (2017).

SITES	Cd	Cu	Pb
Otte	21.33± 1.26[c]	112.67±2.26[c]	66.67±4.75[cd]
BudoEgba	22.17±0.29[bc]	111.83±3.42[c]	67.17±3.71[cd]
BudoAbio	20.83±0.76[c]	116.33±2.56[c]	47.67±2.25[e]
Mubo	21.17±0.13[bc]	96.67±4.33[de]	77.50±0.60[c]
Oyun	22.45±0.17[c]	95.83±1.26[de]	69.50±2.00[cd]
Ojagboro	29.84 ±0.22[a]	98.50±1.05[d]	58.67±2.26[d]
Olaolu	22.65±0.34[c]	94.50±0.90[ef]	85.00±0.00[b]
Eroomo	24.20±0.25[c]	125.00±5.00[b]	115.67±17.75[a]
Okeodo	22.84±0.22[b]	98.50±3.00[d]	89.71±1.29[ab]
Coca cola	22.50±0.71[c]	83.35±2.75[f]	89.66±2.28[ab]
IsaleAluko	27.15±0.65[ab]	132.83±3.25[a]	58.50±3.00[d]
Odoore	20.25±0.40[c]	107.83±3.24[cd]	48.33±1.65[de]
Botanical garden(control site)	18.55±0.20[c]	93.33±2.26[ef]	42.90±0.10[ef]

Mean value with same alphabet along the same column are significantly the same at $p \leq 0.05$. Values represent mean ± SD

RI ≤ 150 (low ecological risk), RI≥150≤300 (moderate ecological risk), RI≥300≤600 (considerably high ecological risk) RI≥600 (very high ecological risk).

The Control site recorded the lowest total acid value than the other sites. The same acid value was recorded for Budo Egba and Olaolu, so also were Budo Abio and Oyun. The turbidity for the water used for second dry season irrigation (2016) ranged between 4.64±0.02 NTU and 7.13±0.02 NTU with the lowest recorded for the water used for Cocacola and the highest for Mubo suggesting higher turbidity values than for the first dry season irrigation water (2015). Turbidity of water used for the Control site was higher than the other sites except for Mubo, Ojagboro and Isale Aluko. There were no significant differences in the turbidity of water used for Budo Abio and Odoore. The total hardness of water used for second dry season (2016) irrigation ranged between 5.76±0.23 mg/l and 29.92±0.03mg/l with the lowest recorded for the Control site and the highest for Isale Aluko which indicated lower values than the first dry season irrigation water (2015). There were no significant differences between the total hardness of water used for Budo Abio and Odoore, so also were Olaolu and Okeodo. The Control site recorded the lowest hardness of water than all the other sites (Table 35).

Chloride ion in the water used for irrigation was between 0.53±0.01 mg/l and 2.65±0.01 mg/l with the lowest recorded for water used for the Control site and the highest for Eroomo (Table 35) indicating lower chloride content than irrigation water used for the first dry season (2015). The water used for the Control site had the lowest chloride ion than the other sites (Table35). Chloride ion in Otte and Olaolu were statistically the same at $p \leq 0.05$, so also were Budo Abio and Odoore, Oyun and Okeodo.

Table 36 shows the Physico-chemical properties of water used for planting during the first rainy season (2016). The range of pH in the water used for irrigation was between 6.54±0.04 and 6.76±0.11 with the lowest obtained for Odoore and the highest for Ojagboro indicating slightly acidic irrigation water for the first rainiy season. Water used at the Control site had lower pH than the pH of the water sources of the other sites except for Odoore. Total acid value for water sources ranged between 2.17±0.00 mg/l and 2.57±0.53 mg/l with the lowest obtained for the Control site and the highest for the Coca cola (Table 36). Water source used for the Control site had lower total acid value than water used for the other sites.. The range of turbidity of water between sites was 5.02±0.43 NTU and 6.05±0.34 NTU with the lowest for the Odoore while the highest was obtained for Ojagboro. Water used for the Control site had lower turbidity value than water used for other sites except for Odoore (Table 36).

Total hardness of the water sources was in the range of 9.53 ± 1.13 mg/l and 21.66±3.29 mg/l with the lowest recoreded for Odoore and the highest for Ojagboro (Table 36). Water used for the Control site had lower value of total hardness than water for other sites except for Odoore (Table 36). The range of Chloride ion of for irrigation water during the first rainy season (2016) was between 0.66±0.11 mg/l and 1.33±1.36 mg/l with the lowest obtained for Odoore and the highest for Ojagboro (Table 36). Table 37 shows the physicochemical properties of water used to irrigate the vegetable accessions in the second rainy season (2017). The pH of the water used for irrigation in the second rainy season (2017) ranged between 7.36±0.04 and 8.76±0.02 with the lowest recorded for Coca cola while the highest was recorded for Budo Abio suggesting alkalinity of the irrigation water. Higher pH values for irrigation water during the second rainy season (2017) than the first rainy season (2016) were observed. The pH of water for the Control site was lower than the other sites except for Mubo, Cocacola and Isale Aluko. The water for the Control site had the same pH statistically with Okeodo, so also were water for Otte, Mubo and Oyun (Table 38). Total acid value (TAV) of the water used for second rainy season (2017) irrigation ranged between 1.54±0.01 mg/KOH to 2.03±0.02 mg/KOH with the lowest recorded for Odoore and the highest TAV for Ojagboro suggestion lower total acid values than the first rainy season (2016).

TAV of water of the Control site was lower than the other sites except for Mubo, Oyun, Ojagboro and Coca cola (Table 37). Water for the Control site and Okeodo had statistically the same TAV, so also were water for Otte and Budo Egba. There were no significant differences in the TAV of water of Mubo, Oyun and Isale Aluko. Turbidity of water used for irrigation for the second rainy season (2017) ranged between 3.20±0.04 NTU and 4.14±0.01 NTU with the the lowest turbidity value for water used for Odoore and the highest for the water used for Coca cola indicating higher values than during the first rainy season (2016). Turbidity of water used for the Control site was lower than the other sites except for Budo Abio, Oyun, Olaolu, Eroomo and Odoore. No significant differences in the turbidity of water at the Otte, Budo Egba, Mubo and Okeodo, so also were Budo Abio, Olaolu and Odoore (Table 37). The range of total hardness of water for second rainy season irrigation ranged between 16.19±0.02 mg/l and 17.81±0.02 mg/l with the lowest recorded for the Control site and the highest for Coca cola. Irregular intra seasonal variation for total turbidity for irrigation water was observed.

Table 34 The Physico-chemical properties of Water samples used for irrigating the vegetables during the first dry season (2015).

Sites	pH	TotalAcid Value (mgKOg)	Turbity(NTU)	Total Hardness (mg/L)	Chloride ion Content (mg/l)
Otte	6.70±0.02[c]	3.44±0.04[d]	5.10±0.01[e]	24.53±023[c]	1.32±0.04[d]
BudoEgba	6.72±0.01[c]	3.17±0.02[f]	5.98±0.05[c]	15.27±0.31[f]	0.93±0.02[f]
BudoAbio	6.56±0.02[e]	2.57±0.04[g]	4.96±0.02[f]	14.80±0.40[fg]	0.73±0.02[h]
Mubo	6.62±0.02[d]	3.53±002[c]	5.95±0.01[c]	16.93±0.23[e]	1.26±0.03[e]
Oyun	6.67±0.02[d]	3.39±0.02[d]	5.83±0.03[d]	12.17±0.29[ghi]	0.63±0.02[i]
Ojagboro	6.93±0.02[a]	3.25±0.03[e]	6.95±0.01[a]	31.60±0.40[a]	2.60±0.04[b]
OlaOlu	6.71±0.01[c]	3.13±0.02[f]	4.87±0.12[gh]	12.17±0.29[ghi]	1.27±0.02[e]
Eroomo	6.54±0.02[e]	2.23±0.02[h]	4.92±0.03[f]	13.73±0.23[fgh]	2.73±0.02[a]
Okeodo	6.64±0.04[d]	1.80±0.04[i]	4.62±0.30[g]	12.30±0.26[gh]	0.64±0.06[i]
CocaCola	6.81±0.01[ab]	3.97±0.02[a]	5.85±0.05[d]	20.30±0.26[d]	0.72±0.04[h]
IsaleAluko	6.86±0.01[ab]	3.76±0.04[b]	5.93±0.03[c]	24.80±0.23[b]	1.53±0.02[c]
Odoore	6.48±0.01[ef]	1.70±0.02[i]	4.57±0.03[h]	7.63±0.35[hi]	0.83±0.02[g]
Bot. Garden	6.42±0.02[f]	1.57±0.02[j]	4.52±0.03[h]	6.30±0.26[i]	0.61±0.02[i]

Mean value with same alphabets along the same column are statistically the same at $p \leq 0.05$. Values are presented as Mean±SD.

Table 35 Physicochemical properties of Water used to irrigate the Vegetable accessions in the second dry season (2016).

Site	Ph	TAV(mgKoH)	Turbudity (NTU)	THW (mg/l)	Chloride ion content(mg/l)
Otte	6. 53±0.03^{g}	1.72±0.05^{i}	5.40±0.01^{g}	23.18±0.03^{b}	1.11±0.02^{e}
Budo Egba	6.52±0.02^{g}	3.10±0.04^{f}	4.86±0.04^{j}	21.15±0.31^{c}	0.99±0.03^{f}
Budo Abio	6.59±0.02^{e}	3.33±0.05^{d}	5.12±0.02^{h}	13.92±0.02^{f}	0.72±0.01^{g}
Mubo	6.68±0.02^{d}	1.61±0.06^{j}	7.13±0.02^{a}	16.15±0.03^{e}	1.20±0.01^{d}
Oyun	6.71±0.0.2^{c}	3.33±0.03^{d}	5.09±0.02^{hi}	11.17±0.85^{h}	0.56±0.02^{i}
Ojagboro	6.90±0.02^{a}	2.16±0.03^{h}	6.73±0.02^{b}	7.18±003^{j}	2.50±0.02^{b}
Olaolu	6.74±0.01^{c}	3.08±0.01^{f}	4.72±0.04^{k}	10.88±0.02^{i}	1.12±0.02^{e}
Eroomo	6.67±0.02^{d}	3.17±0.01^{e}	4.74±0.02^{k}	11.73±0;02^{g}	2.65±0.01^{a}
Okeodo	6.57±0.02^{e}	3.47±0.02^{c}	5.90±0.06^{f}	10.85±0.03^{i}	0.58±0.02^{i}
Cocacola	6.81±0.02^{b}	2.50±0.07^{g}	4.64±0.02^{l}	19.00±0.08^{d}	0.61±0.02^{i}
Isale Aluko	6.93±0.03^{a}	3.69±0.03^{a}	6.12±0.03^{d}	29.92±0.03^{a}	1.46±0.02^{c}
Odoore	6.74±0.05^{c}	3.55±0.57^{b}	5.14±0.02^{h}	13.93±0.02^{f}	0.74±0.01^{g}
Botanical Graden(Control site)	6.55±0.04^{+}	1.49±0.04^{k}	5.93±0.02^{e}	5.76±0.23^{k}	0.53±0.01^{ij}

Mean value with same alphabet along the same column are statistically the same with $p \leq 0.05$. Values represent mean ± SD

The total hardness of water for the Control site was lower than the other sites (Table 37). Chloride content of irrigation water in the second rainy season (2017) ranged between 0.48±0.01 mg/l and 1.18±0.02mg/l with the lowest value recorded for Odoore while the highest was recorded for Coca cola indicating lower values of chloride than the irrigation water of the first rainy season (2016). The inter seasonal variation of pH values for water used for irrigation was in the order second rainy season≥ second dry season≥first dry season≥ second rainy season. Lower pH values for irrigation water in the first rainy season could be due to acid rain. Total acid values between the seasons for water used for irrigation was in the order first dry season ≥ second dry season ≥ first rainy season ≥ second rainy season. For turbidity the order was first dry season ≥first rainy season ≥ second dry season ≥ second rainy season.

4.8: Total heavy metal in water samples

Table 38 shows the Mean concentrations of the Total heavy metals of the water used to irrigate the vegetables during the first dry season (2015). The range of the mean concentration of total cadmium of the water used for irrigation for the first dry season ranged between 0.00±0.00 mg/l and 0.07±0.01 mg/l. The lowest total mean Cd recorded a none detectable value (0.00±0.00mg/l) was recorded for the water used for Control site while the highest was recorded for the water used for Coca cola (Table 38). The mean concentration of total Cd of the water used for the Control site was lower than the other water. The mean total Cd for the water for Otte (0.05±0.02 mg/l), Olaolu (0.05±0.01 mg/) and Isale Aluko (0.05±0.00 mg/l) wwere statistically the same, so also were Budo Egba (0.07±0.00 mg/l) and Coca cola (0.07±0.01 mg/l). Water for Budo Abio and Odoore recorded the same statistical total mean Cd, so also were the water for Mubo, Oyun and Eroomo (Table 38)

The range of the mean concentration of total Copper for water used for irrigation of the vegetables during the first dry season (2015) was between 0.00±0.00 mg/l and 0.24±0.03 mg/l with the none detectable value recorded for the Control site and the highest for Ojagboro. Water for Otte (0.21±0.04 mg/l), Ojagboro (0.24±0.03 mg/l) and Okeodo (0.20±0.01 mg/l), showed no statistical differences for the mean concentration of total Copper, so also were water for Budo Egba (0.18±0.01 mg/l), Olaolu (0.18±0.04 mg/l), Coca cola (0.17±0.04 mg/l) and Isale Aluko (0.19±0.01 mg/l). The range of the mean concentration of total Lead of the water used for the irrigation of the vegetables for the first dry season (2015) was between 0.06±0.01 mg/l and 0.63 ± 0.05mg/l. Water for the Control site recorded the lowest and the highest for Oyun (Table 38).

Table 36 Physicochemical properties of Water used to irrigate the Vegetable Accessions in the first rainy season (2016)

Sites	pH	TAV (mg/l)	TURIDITY (NTU)	TWH (Mg/l)	Cl- (Mg/l)
Otte	6.62±0.06^{ab}	2.22±0.02 ^{a}	5.38±0.72^{bc}	15.07±11.90^{c}	1.08±0.25^{cb}
Budo Egba	6.70±0.08 ^{a}	2.19±0.02 ^{a}	5.92±0.35^{ab}	18.80±10.92^{abc}	1.11±0.27^{ab}
Budo Abio	6.76±0.11^{a}	2.19±0.08 ^{a}	5.50±0.75^{b}	16.93±7.42^{bc}	1.05±0.04^{abc}
Mubo	6.67±0.25^{ab}	2.50±0.60 ^{a}	5.50±0.30^{b}	18.20±4.81^{abc}	1.28±0.09^{ab}
Oyun	6.71±0.27 ^{a}	2.54±0.61 ^{a}	5.57±0.70^{b}	19.80±12.02^{ab}	1.22±0.04$^{a\ b}$
Ojagboro	6.76±0.11^{a}	2.54±0.62 ^{a}	6.05±0.30^{a}	21.66±3.29^{a}	1.33±1.36^{a}
Olaolu	6.70±0.18 ^{a}	2.51±0.58 ^{a}	5.21±0.49^{bcd}	12.67±7.41^{cd}	1.05±0.15$^{ab\ c}$
Eroomo	6.62±0.11^{ab}	2.48±0.58 ^{a}	5.14±0.56 ^{cd}	14.40±9.71^{bcd}	1.04±0.15^{abc}
Olaolu	6.60±0.11^{ab}	2.51±0.50	5.50±0.82^{b}	15.80±8.94^{cd}	1.11±0.16^{abc}
Coca cola	6.64±0.07^{ab}	2.57±0.53	5.22±1.06 ^{bcd}	21.13±3.63^{ab}	1.16±0.08^{abc}
Isale Aluko	6.65±0.06^{ab}	2.50±0.55 ^{a}	5.59±0.47 ^{bcd}	13.87±9.12^{bcd}	1.00±0.23^{c}
Odoore	6.54±0.04^{b}	2.51±0.55 ^{a}	5.02±0.43^{d}	9.53±1.13^{de}	0.66±0.11^{c}
Botanical Garden(Control)	6.56±0.06^{b}	2.17±0.00 ^{a}	5.16±0.62 ^{sd}	9.61±1.34^{de}	0.93±0.19^{c}

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean ± SD

Table 37 Physicochemical properties of Water used to irrigate the Vegetable Accessions in the second rainy season (2017).

Site	pH	TAV(mgKoH)	Turbudity (NTU)	THW (mg/l)	Chloride ion content(mg/l)
Otte	8.04±0.01^{d}	1.73+±0.01^{de}	3.69±0.01^{c}	16.69±0.01^{cd}	1.06±0.01^{b}
Budo Egba	8.22±0.03^{c}	1.71±0.04^{de}	3.65±0.05^{c}	16.55±0.02^{d}	1.09±0.03^{b}
Budo Abio	8.76±0.02^{a}	1.56±0.04^{f}	3.22±0.02^{e}	16.20±0.02^{f}	0.68±0.02^{c}
Mubo	7.96±0.01^{d}	1.84±0.01^{c}	3.70±0.18^{c}	17.36±0.01^{bc}	1.04±0.01^{b}
Oyun	8.03±0.02^{d}	1.81±0.02^{c}	3.54±0.36^{d}	16.83±0.02^{c}	1.05±0.01^{b}
Ojagboro	7.66±0.03^{de}	2.03±0.02^{a}	3.95±0.01^{bc}	17.62±0.02^{b}	1.11±0.04^{ab}
Olaolu	8.44±0.01^{b}	1.62±0.03^{e}	3.25±0.03^{e}	16.39±0.01^{e}	0.57±0.01^{cd}
Eroomo	8.37±0.03^{bc}	1.66±0.04^{e}	3.49±0.01^{de}	16.49±0.03^{de}	0.51±0.01^{cd}
Okeodo	8.12±0.02^{cd}	1.78±0.01^{d}	3.67±0.03^{c}	16.74±0.01^{cd}	0.94±0.01^{bc}
Cocacola	7.36±0.04^{f}	1.94±0.01^{b}	4.14±0.01^{a}	17.81±0.02^{a}	1.18±0.02^{a}
Isale Aluko	7.44±0.01^{ef}	1.86±0.01^{c}	4.05±0.01^{b}	17.78±0.02^{ab}	1.18±0.00^{a}
Odoore	8.66±0.02^{b}	1.54±0.01^{f}	3.20±0.04^{e}	16.26±0.02^{ef}	0.48±0.01^{e}
Botanical Graden(Control site)	8.10±0.03^{cd}	1,79±0.01^{d}	3.61±0.00^{cd}	16.19±0.02^{f}	0.94±0.01^{bc}

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean ± SD

Water for Otte (0.40±0.05 mg/l) and Isale Aluko (0.43±0.03 mg/l), so also were Budo Egba (0.31±0.04 mg/l) and Ojagboro (0.34±0.01 mg/). Same statistical total mean concentration of Pb were recorded for water of Mubo (0.55±0.07 mg/), Olaolu (0.52±0.02 mg/) and Coca cola (0.55±0.02 mg/), so also were Budo Abio (0.27±0.04 mg/), Eroomo (0.22±0.04 mg/) and Odoore (0.25±0.05 mg/) and, Oyun (0.63±0.05 mg/) and Okeodo (0.60±0.08 mg/) (Table 38). The order of heavy metal ranking for water used for irrigation for the first dry season was in the order Pb≥ Cu≥ Cd (Table 38)

Table 39 shows the total Cd , Cu and Pb for water (mg/l) used to irrigate the vegetable accessions for the second dry season (2016) (Table 39). The range of cadmium in the water used to irrigate in the second dry season was between 0.00±0.00 mg/l and 0.06±0.01 mg/l with the lowest none detectable value 0.00±0.00 recorded for water of Budo Abio, Eroomo, Odoore and the Control site. The were no significant differences in the Cd concentration of the water used for irrigation most of the sites (Table 39). Total mean Cd for the second dry season (2016) irrigation water were slightly lower than for the first dry season (2015). The mean Copper concentration for water for second dry season irrigation was between 0.08±0.02 mg/l and 0.34±0.03 mg/l with the lowest recorded for the Control site and the highest for Ojagboro (Table 39). Total mean Cu concentration for water of the Control site was lower than the other sites. Water of Otte, Budo Egba, Oyun, Olaolu, Okeodo, Coca cola and Odoore had the same statistical total copper concentration, so also were, the water for Mubo, Ojagboro and Isale Aluko (Table 39).

The result showed that total mean Cu for water used for the second dry season irrigatin were higher than the first dry season. Total lead concentration for the second season irrigation water ranged between 0.04±0.00 mg/l and 0.55 ± 0.05 mg/l with the lowest recorded for the Control site and the highest for Oyun. Pb concentration of the water of the Control site was lower than other sites. There were no statistical differences for the total mean Pb concentration of water for Otte (0.33±0.00 mg/l), Ojagboro (0.39±0.05 mg/l) and Isale Aluko (0.39±0.04 mg/l), Budo Egba (0.25±0.00 mg/l) and Eroomo (0.27±0.03mg/l), so also were water for Budo Abio (0.11±0.01 mg/l) and Odoore (0.18±0.03 mg/l), so also were Mubo (0.51±0.04 mg/l), Oyun (0.55±0.06 mg/l) and Coca cola (0.50±0.03 mg/l). Water for Olaolu (0.49±0.04 mg/l had the same statistical total mean Pb as Okeodo (0.40±0.05 mg/l) (Table 39). It was shown that total mean Pb concentration for irrigation water were lower for the second dry season (2016) than for the first dry season (2015) (Table 39). Total heavy metals for irrigation was highest for Pb, followed by Cu and Cd for both intra season.

Total mean concentration of Cd for water used for irrigation for the first rainy season (2016) ranged between 0.00±0.00 mg/l and 0.03±0.00 mg/l. Water of the Control recorded a none detectable value of (0.00±0.00 mg/l) and the highest for Budo Egba. There were no statistical differences between the total mean Cd concentration for water for Budo Abio, Eroomo, Okeodo, Odoore and the Control site (0.00±0.00 mg/l), so also were Otte, Ojagboro and Isale Aluko (0.02±0.00 mg/l) (Table 40)

The total mean concentration of Cu for water for the first rainy season irrigation (2016) ranged between 0.78±0.22 mg/l and 1.68±0.25 mg/l with the lowest recorded for Budo Egba and the highest for Isale Aluko. Total mean Cu for the Control site (1.07±0.16 mg/l) was lower than other sites except for Otte (0.85±0.13 mg/l) and Budo Egba (0.78±0.22 mg/l). Total mean concentration of Cu for water for Budo Abio (1.11.00±0.01 mg/l), Okeodo (1.17±0.12 mg/l) and Coca cola (1.15±0.13mg/l) were statistically the same, so also were Mubo (1.42±0.28 mg/l) and Odoore (1.45±0.17 mg/l). There were no significant differences for the total mean concentration for Cu for Oyun (1.33±0.37 mg/l) and Olaolu (1.36.00±0.20 mg/l), so also were Eroomo (1.67±0.14 mg/l) and Isale Aluko (1.68±0.23 mg/l) (Table 40).

The Range of total mean concentration for Pb for water used for irrigation for the first rainy season (2016) was between 0.22±.07 mg/l and 0.47±0.05 mg/l with the lowest for the water of Isale Aluko and the highest for Oyun (Table 40). Total mean concentration of Pb for water for the Control site was lower (0.25±0.00 mg/l) than other sites except for Isale Aluko (0.22±0.07 mg/l). Total mean concentration of Pb for water of Otte (0.41±0.04 mg/l), Mubo (0.45±0.003 mg/l) and Oyun (0.47±0.05mg/l) were statistically the same, so also were Budo Egba (0.30±0.03 mg/l), Ojagboro (0.33±0.02 mg/l), Olaolu (0.38±0.04 mg/l), Eroomo (0.37±0.07 mg/l), Okeodo (0.32±0.07 mg/l), Coca cola (0.35±0.00 mg/l) and Odoore (0.31±0.01 mg/l) so also were Budo Abio (0.28±0.03 mg/l) and Isale Aluko (0.22±0.07 mg/l). The mean concentration of Pb in water for irrigation was highest for the first rainy season than Cu and Cd (Table 40), Table 41 showed the total mean concentration for Cd, Cu and Pb for the water used for the second rainy season (2017). It was observed that mean total concentration of Cd for the second rainy season (2017) water were lower than the first rainy sason (2016).

Table 38: Mean concentrations of the total heavy metals (mg/l) of the water used to irrigate the vegetables for first dry season (2015) irrigation

Sites	. Cd	Cu	Pb
Otte	0.05±0.02[ab]	0.21±0.04[ab]	0.40±0.05[c]
Budo Egba	0.07±0.00[a]	0.18±0.01[b]	0.31±0.04[d]
BudoAbio	0.01±0.00[c]	0.10±0.03[ab]	0.27±0.04[ef]
Mubo	0.02±0.01[bc]	0.12±0.03[b]	0.55±0.07[b]
Oyun	0.02±0.01[c]	0.13±0.01[b]	0.63±0.05[a]
Ojagboro	0.05±0.01[b]	0.24±0.03[b]	0.34±0.02[d]
Olaolu	0.07±0.01[ab]	0.18±0.01[b]	0.52±0.04[b]
Eroomo	0.02±0.01[bc]	0.12±0.00[b]	0.22±0.04[f]
Okeodo	0.03±0.00[b]	0.20±0.01[b]	0.60±0.08[ab]
Coca cola	0.09±0.01[a]	0.17±0.04[a]	0.55±0.02[b]
IsaleAluko	0.05±0.00[ab]	0.19±0.01[b]	0.43±0.03[c]
Odoore	0.01±0.01[c]	0.14±0.03[b]	0.25±0.05[d]
Botanical garden(control.site)	0.00±0.00[c]	0.00±0.00[b]	0.06±0.01[h]

Mean value with same alphabets along the same column are statistically the same at $p \leq 0.05$.

Table 39: Total Heavy Metals of water (mg/l) used to irrigate the vegetable accessions for the second dry season irrigation (2016).

Site	Cd	Cu	Pb
Otte	0.05±0.00[ab]	0.26±0.02	0.33±0.00[b]
Budo Egba	0.05±0.00[ab]	0.22±0.04[b]	0.25±0.00[a]
Budo Abio	0.00±0.00[c]	0.18±0.02[ab]	0.11±0.01[f]
Mubo	0.05±0.00[ab]	0.30±0.00[b]	0.51±0.04[gh]
Oyun	0.04±0.00[b]	0.23±0.02[b]	0.55±0.06[gh]
Ojagboro	0.05±0.01[ab]	0.34±0.03[b]	0.39±0.05[c]
Olaolu	0.04±0.01[b]	0.21±0.04[b]	0.49 ±0.04[d]
Eroomo	0.00±0.00[c]	0.27±0.04[b]	0.27±0.03[f]
Okeodo	0.04±0.00[b]	0.24±0.01[b]	0.40±0.05[e]
Cocacola	0.05±0.00[ab]	0.23±0.08[a]	0.50±0.03[e]
Isale Aluko	0.06±0.00[a]	0.34±0.01[b]	0.39±0.04[g]
Odoore	0.00±0.00[c]	0.25±0.00[b]	0.18±0.03[g]
Botanical Graden(Control site)	0.00±0.00[c]	0.08±0.02[b]	0.04±0.00[h]

Mean value with same alphabet along the same column are statitically the same at $p \leq 0.05$. Values represent mean ± SD

Total mean Cd for water used for the second rainy season (2017) ranged between 0.01±0.00 mg/l and 0.09±0.02 mg/l with the lowest recorded for the Control site and the highest was recorded for Mubo. Water for Otte, Budo Egba and Coca cola had the same statistical total mean Cd concentration, so also were the water for Budo Abio and Odoore (Table 41). Total mean concentration of Cd for water for the second rainy season for Mubo, Oyun, Ojagboro, Olaolu and Okeodo were statistically (Table 41). The result showed that total mean Cd for water used for the second rainy season were slightly higher than the first rainy season (2016) (Table 40 and 41). Total mean Cu for water used for the second rainy season (2017) ranged between 0.52 ±0.08 mg/l and 1.09±0.00 mg/l with the lowest recorded for the Coca cola and the highest for Ojagboro.

Total mean concentration of Cu for water used for the second rainy season for the Control site (0.86±0.11 mg/l) was lower than other water except for the water for Olaolu (0.58±0.09 mg/l) and Coca cola (0.52±0.08 mg/l). Water for Otte (0.99 ±0.12 mg/l) and Budo Egba (0.94 ±0.07 mg/l) had the same statistical mean concentration for total Cu, so also were Budo Abio (0.69 ±0.11 mg/l), Eroomo (0.67 ±0.05 mg/l) and Okeodo (0.62 ±0.07 mg/l) had the same statistical mean concentration for total Cu, so also were Mubo (0.80 ±0.12 mg/l), Isale Aluko (0.86 ±0.04 mg/l), Odoore (0.86 ±0.11 ±mg/l) and the Control site (0.81 ±0.10 mg/l), Oyun(1.06 ±0.05 mg/l) and Ojagboro (1.09 ±0.00 mg/l) and Olaolu (0.58 ±0.09mg/l) and Coca cola (0.52 ±0.08 mg/l) (Table 41). It was found that the total mean concentration of Cu for water used for the second rainy season (2017) were lower than the first rainy season (2016) (Table 41). The mean total Pb of water used for the second season irrigation ranged from 0.21±0.00^{c} mg/l and 0.54±0.09 mg/l with the lowest recorded for the Control site and the highest for Olaolu site. Mean total Pb for the was for the Control site (0.24±0.02 mg/l) was lower than other sites but statistically the same with the water for Odoore (0.50±0.05 mg/l), Olaolu (0.54±0.09 mg/l) and Coca cola (0.51±0.07 mg/l) and, Odoore (0.24±0.02 mg/l) and the Control site (0.21±0.00 mg/l). Total mean Concentration for Pb for water used for the second rainy season (2017) were slightly higher than the first rainy season (2016).

Table 40: Total Heavy Metals of water (mg/l) used to irrigate the vegetable accessions for the first rainy season (2016).

Site	Cd	Cu	Pb
Otte	0.02±0.00[ab]	0.85±0.13[efg]	0.41±0.04[a]
Budo Egba	0.03±0.00[a]	0.78±0.22[g]	0.39±0.13[b]
Budo Abio	0.00±0.00[c]	1.10±0.10[e]	0.28±0.03[c]
Mubo	0.01±0.00[b]	1.45±0.17[c]	0.45±0.03[a]
Oyun	0.01±0.00[b]	1.33±0.37[d]	0.47±0.05[a]
Ojagboro	0.02±0.00[ab]	1.58±0.19[b]	0.33±0.02[b]
Olaolu	0.01±0.00[b]	1.36±0.20[d]	0.38±0.04[b]
Eroomo	0.00±0.00[c]	1.67±0.14[ab]	0.37±0.07[b]
Okeodo	0.00±0.00[c]	1.17±0.12[e]	0.32±0.04[b]
Cocacola	0.01±0.00[b]	1.15±0.13[e]	0.35±0.00[c]
Isale Aluko	0.02±0.00[ab]	1.68±0.25[a]	0.22±0.07[c]
Odoore	0.00±0.00[c]	1.42±0.28[c]	0.31±0.11[b]
Botanical Graden(Control site)	0.00±0.00[c]	1.07±0.16[ef]	0.25±0.00[c]

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean ± SD.

Table 41 Mean concentrations of the Total heavy metals (mg/l) for the water used to irrigate the vegetables during the second rainy season (2017) .

Sites	. Cd	Cu	Pb
Otte	0.07±0.00[ab]	0.99±0.12[b]	0.46 ±0.09[b]
Budo Egba	0.07±0.00[ab]	0.94±0.07[b]	0.47 ±0.07[b]
Budo Abio	0.04±0.00[cd]	0.69±0.11[d]	0.34 ±0.03[c]
Mubo	0.09±0.02[a]	0.80±0.12[c]	0.50 ±0.05[ab]
Oyun	0.05±0.00[c]	1.06±0.05[ab]	0.49 ±0.07[b]
Ojagboro	0.06±0.02[bc]	1.09±0.00[a]	0.49 ±0.03[b]
Olaolu	0.06±0.00[bc]	0.58±0.09[e]	0.54 ±0.09[a]
Eroomo	0.02±0.00[d]	0.67±0.05[ab]	0.38 ±0.04[c]
Okeodo	0.06±0.01[bc]	0.62±0.07[d]	0.43±0.04[bc]
Coca cola	0.07±0.00[ab]	0.52±0.08[e]	0.51±0.07[ab]
Isale Aluko	0.05±0.00[c]	0.86±0.04[c]	0.33±0.04[c]
Odoore	0.04±0.00[cd]	0.86±0.11[c]	0.24±0.02[d]
Botanical garden(Ref.site)	0.01±0.00[d]	0.81±0.10[c]	0.21±0.00[d]

Mean value with same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean ± SD

4.9: Description of the vegetable accessions

Three accessions of *Amaranthus hybridus* and two assessions of *Corchorous olitorius* (Five accessions) were finally obtained at harvest from the ten vegetable assessions collected from NACGRAB, Ibadan by morphological grouping using the method of Alege and Daudu (2014), and they are: NG/AA/03/11/010, NG/AO/11/08/039, NGBO125: NG/OA/Jun/09/002 and NG/OA/04/010. *Amaranthus hybridus* (accession NG/AA/03/11/010) has many moderate long and large leaves with long and slender leaf stalk with fewer foliage leaves. The stems are long, slender and smooth with width between 0.4 and 0.8 cm bearing between 15 and 68 leaves (fig.1). The leaf width was between 2.4 and 7.5 cm and the length of 8.1 and 18.8 cm. The plant is green in colour and has the length of the range of 4.8 and 67.9 cm and the width of 0.4 and 1.1cm (Plate 1).

*Amaranthus hybridus (*accession NG/AO/11/08/039) has very long and large leaves with very long and stout leaf stalk with many foliage leaves. Very Long and stout stem with width between 1.2 and 4.8 cm bearing between 40 and 171 leaves (fig 2). The leaves width was between 3.9 and 10.0 cm and the leaf length range of 3.7 and 11.2 cm. The plant is green in colour with the average length between 10.0 and 69.1 cm (Plate 2).

Amaranthus hybridus (accession NGBO125) has as moderately long, large, green-pinkish / reddish leaves with few foliage leaves. Slight pinkish, long and moderately thick stem with width between 0.4 and 1.0 cm bearing between 14 and 46 leaves (fig 3) of average width between 2.4 and 8.9 cm and leaf length was between 7.4 and 18.1 cm (Plate 3) . The plant is slightly pinkish with an average height between 16.0 and 49.5 cm.

Cochorous olitorious (accession NG/OA/Jun/09/002) has long and moderately *large* leaves with width between 2.5 and 8.5 and length between 3.0 and 11.8 cm with many foliage leaves. Leaves are oval *shape*d and smooth on thin and long leaf stalk. The stems are slender stem of width between 0.4 and 0.8 cm bearing leaves (fig 4) was between 11-151. The accession is green in colour with an average height between 5.1 and 59.5cm (Plate 4). *Corchorous olitorious* (accession NG/OA/04/010). The leaf of the accession is broad, moderately long, star shaped and smooth with serrated edges with few foliage leaves of an average length of between 5.1 and 17.8 and width of between 2.4 and 9.9 cm. The accession has slender stem of width between 0.4 and 1.0 cm bearing leaves (fig 5) between 11 and 68 cm with thin and moderately long stalk. The plants are green in colour with height between 8.9 and 48.0 cm (Plate 5).

Plate 1: *Amaranthus hybridus* (accession NG/AA/03/11/010)+

Plate 2: *Amaranthus hybridus* (accession NG/AO/11/08/039)

Plate 3: *Amaranthus hybridus* (accession NGBO125)

Plate 4: *Corchorous olitorious* (accession NG/OA/Jun/09/002)

Plate 5 : *Corchorous olitorious* (accession NG/OA/04/010).

4.10:Heavy metal partitioning in vegetable parts

mg/kg with the lowest cadmium concentration recorded in the accession of the Control site and the highest in the accession of Olaolu (Table 42). The accession of the Control site had the lowest (no detectable) cadmium concentrartion in the shoot than the accession of the other sites. The cadmium concentration in the shoots of accession of Otte (0.40±0.40 mg/kg), Budo Egba (0.40±0.40 mg/kg) and Ojagboro (0.40±0.40 mg/kg) were statistically the same (Table 42). The accession of Budo Abio (0.13±0.20 mg/kg), Mubo(0.13±0.23mg/kg), Oyun(0.13±0.23 mg/kg), Isale Aluko(0.13±0.23 mg/kg) and Odoore (0.13±0.34 mg/kg) had the same cadmium concentration in the shoots (Table 42). The cadmium concentration in the shoots of the accession of Eroomo (0.27±0.46 mg/kg), Okeodo (0.27±0.23 mg/kg) and Cocacola (0.27±0.46 mg/kg) were statitically the same.

The range of the concentration of cadmium in the roots of *Amarathus hybridus accession* NG/AA/03/11/010 was between 0.00±0.00 mg/kg and 0.27±0.23 mg/kg (Table 42). Cadmium concentration in the roots of the accession of the Control site (0.13±0.23 mg/kg) was higher than that the other sites except for Budo Egba (0.27±0.23 mg/kg), Mubo (0.27±0.23 mg/kg), Oyun (0.27±0.23 mg/kg) and Okeodo (0.27±0.23 mg/kg). The roots of the accession of Otte (0.13±0.23 mg/kg), Budo Abio(0.13±0.23 mg/kg), Ojagboro(0.13±0.23 mg/kg) and Eroomo (0.13±0.23 mg/kg) had the same concentration of cadmium (Table 42). No significant differences were recorded in the cadmium concentration in the roots of the accession of Budo Egba (0.27±0.23 mg/kg), Mubo (0.27±0.23 mg/kg), Oyun (0.27±0.23 mg/kg) and Okeodo (0.27±0.23 mg/kg). There were no detactable cadmium concentration in the roots of the accession of Olaolu (0.00±0.00 mg/kg), Coca cola (0.00±0.00 mg/kg), Isale Aluko (0.00±0.00 mg/kg) and Odoore (0.00±0.00 mg/kg) (Table 42). The mean concentration of cadmium in the shoot of *Amarathus hybridus accession* NG/AO/11/08/039 in the first dry season (2015) was between 0.00±0.00 mg/kg and 0.40 ± 0.40 mg/kg with the lowest recorded in the shoots of accession of Mubo and Eroomo while the highest was obtained in the shoots of the accession of Otte and Cocacola. The cadmium concentration in the shoots of the accession of the Control site (0.13±0.10 mg/kg) was lower than other sites except those of Mubo (0.00±0.00 mg/kg) and Eroomo (0.00±0.00 mg/kg). There were no significant differences in the cadmium concentration of the shoots of the accession of Otte (0.40±0.40 mg/kg) and Cocacola (0.40±0.00 mg/kg) (Table 4). Budo Egba (0.27±0.23 mg/kg), Oyun (0.23±0.27 mg/kg), Isale

Aluko (0.27±0.23 mg/kg) and Odoore (0.27±0.23 mg/kg) recorded the same statistical mean concentration of cadmium in the shoot.

The cadmium concentrations in the roots of the accession ranged between 0.00±0.00 mg/kg and 0.40±0.00 mg/kg. The accession of the Control site (0.27±0.23 mg/kg) had a higher cadmium concentration in the root than the accession of other sites except for accession of Budo Abio (0.40±0.00 mg/kg). No significant differences were recorded in the cadmium concentration in the roots of the accession of Otte(0.13±0.23 mg/kg), Budo Abio(0.13±0.23 mg/kg), Ojagboro(0.13±0.23 mg/kg), Eroomo (0.13±0.23 mg/kg), Cocacola (0.13±0.23 mg/kg) and Odoore (0.13±0.23 mg/kg). Accession of Budo Abio had statistically higher cadmium concentration compared with accession of other sites (Table 42). No detectable cadmium content was detected in the accession of Olaolu, Okeodo and Isale Aluko. The accession of Mubo (0.27±0.23 mg/kg), Oyun(0.27±0.23 mg/kg) and the Control sites (0.27±0.23 mg/kg) had the same statistical mean concentrations of cadmium in the roots.

Amarathus hybridus accession NGBO125 recorded the range of cadmium in shoots as 0.00±0.00 mg/kg and 0.27±0.46 mg/kg in the first dry season (2015) with no cadmium content detected in the shoots of the vegetable accession of Otte, Mubo, Olaolu, Eroomo, Odoore and the Control site (Table 42). Cd concentration in the shoots of the accession of Budo Egba, Ojagboro, Okeodo and Coca cola had the same concentration (0.13±0.23 mg/kg). No significant differences were recorded in the Cd concentration in the shoots of the vegetable accession of Budo Abio(0.27±0.23 mg/kg), Oyun(0.27±0.23 mg/kg) and Isale Aluko (0.27±0.23 mg/kg) (Table 42). Cadmium concentration in the roots of the vegetable accession ranged bewteen 0.00±0.00 mg/kg and 0.40±0.00 mg/kg.

The roots of the vegetable accession of the Control site, Otte , Budo Abio , Oyun, Ojagboro, Olaolu and Coca cola recorded a no detectable value (0.00±0.00 mg/kg) of Cd (Table 42). Highest Cd concentration in the root was recorded in the accession of Mubo (0.40±0.00 mg/kg). Accession of Budo Egba (0.13±0.23 mg/kg) and Eroomo (0.13±0.23 mg/kg) had the same Cd concentrations, so also were the roots of accession of Oyun (0.27±0.23 mg/kg) and Okeodo (0.27±0.23 mg/kg) (Table 42). The Cd concentration in the shoots of the *Amarathus hybridus* accessions was in the order NG/AA/03/11/010 ≥ NG/AO/11/08/039 ≥ NGBO125 while Cd concentration in the roots of the accessions was in the order NG/AO/11/08/039 ≥ NG/AA/03/11/010 ≥ NGBO125 (Table 42). The cadmium concentrations in the shoots and roots of accession NGBO125 of the Control site were not detectable (Table 42). The Cd concentration in the shoots of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season (2015) was in the range of 0.00±0.00 mg/kg and 0.40±0.40 mg/kg with the non detectable value of 0.00±0.00 mg/kg recorded in the shoots of the accession of Otte, Olaolu, Odoore and the Control site while the highest concentration of 0.40±0.40 mg/kg was recorded in the shoots of the vegetable accession of Coca cola and Isale Aluko (Table 42).

The Cd concentration in the shoots of the accession of Budo Egba(0.27±0.23 mg/kg), Budo Abio (0.27±0.23 mg/kg), Oyun (0.27±0.23 mg/kg) and Ojagboro (0.27±0.23 mg/kg) were statistically the same, so also were the of accession of Mubo (0.13±0.23 mg/kg), Eroomo (0.13±0.23 mg/kg) and Okeodo (0.13±0.23 mg/kg) (Table 42). There were no significant differences in the Cd concentration in the shoots of accession of Otte (0.00±0.00 mg/kg), Olaolu (0.00±0.00 mg/kg), Odoore (0.00±0.00 mg/kg) and the Control site (0.00±0.00 mg/kg). Cd concentrations range in the roots of the accession was between 0.00±0.00 mg/kg and 0.40±0.00 mg/kg with the no dectablable value obtained from the roots of the accessions of Budo Egba (0.00±0.00 mg/kg), Isale Aluko (0.00±0.00 mg/kg) and the Control site (0.00±0.00 mg/kg) (Table 42). No significant differences in the Cd concentration in the roots of the accession of Budo Abio (0.13±0.23 mg/kg), Mubo (0.13±0.23 mg/kg), Ojagboro (0.13±0.23 mg/kg), Olaolu (0.13±0.23 mg/kg), Cocacola (0.13±0.23 mg/kg) and Odoore (0.13±0.23 mg/kg).

The roots of accession of Otte (0.27±0.23 mg/kg), Eroomo (0.27±0.13 mg/kg) and Okeodo (0.27±0.17 mg/kg) had the same statistical Cd concentration while the roots of the accession of Oyun (0.40±0.00 mg/kg) had a relatively higher Cd concentration than the roots of other sites (Table 42).

The shoots of *Corchorus olitorius accession* NG/OA/04/010 in the first dry season (2015) had the range of 0.00±0.00 mg/kg and 0.40 ± 0.00 mg/kg of Cd concentration with the no detectable value of 0.00±0.00 mg/kg in the shoots of the accessions of Olaolu (0.13±0.23 mg/kg) and Eroomo (0.40±0.00 mg/kg). No significant differences in the Cd concentration in the shoots of the accessions of Otte (0.13±0.23 mg/kg), Budo Egba(0.13±0.23 mg/kg), Mubo (0.13±0.23 mg/kg), Odoore (0.13±0.23 mg/kg) and the Control site (0.13±0.23 mg/kg) were recorded. The shoots of the accession of Budo Abio (0.27±0.23 mg/kg), Oyun (0.27±0.23 mg/kg), Coca cola (0.27±0.23 mg/kg) and Isale Aluko (0.27±0.23 mg/kg) had the same statistical mean concentration of Cd, so also were the shoots of Ojagboro (0.40±0.00 mg/kg) and Okeodo (0.40±0.00 mg/kg) (Table 42). Cadmium concentration in the roots of the accession ranged between 0.00±0.00 mg/kg and 0.40±0.00 mg/kg with the no detectable value of 0.00±0.00 mg/kg recorded in the accession of Isale Aluko and Odoore while the highest Cd concentration was recorded in the shoot of accession of Budo Abio. The roots of the accession of Otte (0.13±0.23 mg/kg), Mubo (0.13±0.23 mg/kg), Oyun (0.13±0.23 mg/kg), Ojagboro (0.13±0.23 mg/kg), Olaolu (0.13±0.23 mg/kg), Eroomo (0.13±0.23 mg/kg) and Okeodo (0.13±0.23 mg/kg) had the same Cd concentration, so also were the roots of Coca cola (0.27±0.23 mg/kg) and the Control site (0.27±0.23 mg/kg) (Table 42). Budo Egba had Cd concentration in the root higher (0.15±0.22mg/kg) than the other roots of the accession except the roots of accession of Budo Abio, Cocacola and the Control site (Table 42). Cadmium concentration in the shoots of the *Corchorus olitorius* accession were higher in NG/OA/Jun/09/002 than the shoots of accession NG/OA/04/010 (Table 43).

No Cd was detected in the shoots and roots of the accession of the Control site of *Corchorus olitorius* NG/OA/Jun/09/002 (Table 42). It was found that all the shoots of *A. hybridus* accession NG/AA/03/11/010 had low Cd pollution level except for the accession of Otte (0.40±0.40 mg/kg), Budo Egba (0.40±0.40 mg/kg), Ojagboro (0.40±0.40 mg/kg), Olaolu (0.27±0.46 mg/kg), Eroomo(0.27±0.46 mg/kg), Okeodo(0.27±0.23 mg/kg) and Coca cola (0.53±0.23 mg/kg) that were polluted with Cd because their Cd content were above the WHO/FAO safe limit for Cd in vegetables while the all the roots of the accession were free of Cd pollution except for the accession in Budo (0.27±0.23 mg/kg), Abio Mubo (0.27±0.23 mg/kg), Oyun (0.27±0.23 mg/kg) and Okeode(0.27±0.23 mg/kg) that were polluted of Cd since their Cd content were above the WHO/FAO safe limit (0.20 mg/kg), for *A. hybridus* accession NG/AO/11/08/039 all the shoots were polluted of Cd except for the accession of Budo Abio, Mubo, Ojagboro, Olaolu, Eroomo, Okeodo and the Control site that had Cd content lower than the sfae limit (0.20 mg/mg) while all the roots of the accession were Cd free except for the accession of Budo Abio (0.40±0.00 mg/kg), Mubo(0.27±0.23 mg/kg), Oyun(0.27±0.23 mg/kg) and the Control site(0.27±0.23 mg/kg) that were polluted of Cd (Table 42), all the shoots of *A. hybridus* accession NGBO 125 were Cd free except for the accession of Budo Abio (0.27±0.23 mg/kg), Oyun (0.27±0.23 mg/kg) and Isale Aluko (0.27±0.46 mg/kg) that were Cd polluted since their values were higher than the recommended safe limit (0.20 mg/kg) while all the roots of the accession were Cd free except for the accession of Mubo (0.27±0.23 mg/kg), Oyun(0.27±0.23 mg/kg) and Okeodo(0.27±0.46 mg/kg) that were polluted of Cd with their value higher than 0.20 mg/kg.

The result also showed that all the shoots of *C. olitorius* NG/OA/Jun/09/002 were Cd free except for the accession of Budo Abio (0.27±0.23 mg/kg), Budo Abio (0.27±0.23 mg/kg), Oyun (0.27±0.23 mg/kg), Ojagboro (0.27±0.23 mg/kg), Coca cola (0.40±0.00 mg/kg) and Isale Aluko (0.40±0.00 mg/kg) that were polluted of Cd while all the roots of the accession were Cd free except for the accession of Otte (0.27±0.23 mg/kg), Oyun (0.40±0.00 mg/kg), Eroomo (0.27±0.13 mg/kg) and Okeodo (0.27±0.17 mg/kg) that were polluted of Cd with their Cd content above the recommended safe limit (WHO/FAO, 2011). It was found that the roots of *A. hybridus* accession NG/AA/03/11/010 of Otte (0.26±0.03 mg/kg) and Oyun (0.25±0.05

mg/kg), *A. hybridus* accession NG/AO/11/08/039 of Otte (0.20±0.02 mg/kg), Ojagboro (0.22±0.04 mg/kg) and Coca cola (0.21±0.04 mkg) and *A. hybridus* accession NGBO 125 of Otte (0.25±0.05 mg/kg), Okeodo (0.22±0.01 mg/kg) and Isale Aluko (0.22±0.03 mg/kg) in the firstb dry season (2015) all recorded Cd content above the safe limit of WHO/FAO (2011) (Table 42).

Table 43 presents the cadmium concencentrations of the shoots and roots of the vegetable accession *Amaranthus hybridus* and *Corchorus olitorius* in the second dry season (2016). The range of cadmium content in the shoots of *Amaranthus hybridus* NG/AA/03/11/010 was between 0.03±0.01 mg/kg and 0.15±0.00 mg/kg with the lowest in the accession of the Control site and the highest in the accession of Cocacola. The cadmium content in the shoot of the accession of the Control site was lower than the other sites (Table 43). The content of Cd in the shoots of the accession in Otte, Budo Egba, Mubo, Oyun, Olaolu and Okeodo were statistically the same. It was observed that the Cd content in the shoots of the accession in the first dry season (2015) were higher than in the second dry season (2016) (Tables 42 and 43). Cadmium content in the roots of the accession ranged between 0.07±0.01mg/kg and 0.28±0.02 mg/kg with the lowest in the accession of Odoore and the highest in the accession of Otte (Table 43). The Cd in the root of the accession of the Control site was higher than the roots of the accession of the other sites except Odoore (Table 43). There were no significant differences between the Cd content of the roots of the accession of Budo Egba, Mubo and Oyun (Table 43). The roots of the accession of Budo Abio, Olaolu, Eroomo and Okeodo had the same statistical at $p \leq 0.05$. The Cd content in the roots of the accession of Ojagboro and Isale Aluko were statistically the same at $p \leq 0.05$, so also were the roots of the accession of the Control site and Odoore (Table 43). The result indicated higher Cd content in the roots of the accession in the first dry season (2015) than in the second dry season (2015) (Tables 42 and 43).

The range of cadmium concentration in the shoots of *Amaranthus hybridus* accession NG/AO/11/08/039 in the second dry (2016) was between 0.03±0.01mg/kg and 0.19±0.03 mg/kg with the lowest recorded in the shoot of the accession of Budo Abio and the highest in the shoot of the accession of the Control site. Cd content in the shoot of the accession of the Control site was lowerthan the other site except for Budo Abio (Table 43). There were no significant differences in the Cd content of the shoots of the accession of Otte, Olaolu and Okeodo (Table 43). The same statistical content of Cd were recorded in the shoots of the accession of Budo Egba, Mubo, Oyun, Coca cola and Isale Aluko. The shoots of the accession of the Control site, Budo Abio, Eroomo and Odoore had the same statistical Cd content (Table 43). It was found that the Cd content in the shoots of the accession in the second dry season (2016) were lower than in the first dry season (2015) (Tables 42 and 43).

Cadmium content in the roots of *Amaranthus hybridus* accession NG/AO/11/08/039 in the second dry season (2016) ranged between 0.05±0.00 mg/kg and 0.22±0.01 mg/kg with the lowest recorded for the accession of the Control site while the highest was recorded for the accession of Ojagboro (Table 43). The cadmium content in the roots of the Control site was lower than the other sites except Budo Abio. There were no significant differences in the Cd content in the roots of the accession of Otte, Budo Egba, Mubo and Cocacola.

Table 42: Cadmium concentration in the shoots and roots of the vegetable accessions in the first dry season (2015) .

	Amarathus hybridus						*Corchorus olitorius*			
Site	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.40±0.40[b]	0.13±0.23[b]	0.40±0.40[a]	0.13±0.23[c]	0.00±0.00[c]	0.00±0.00[d]	0.00±0.00[c]	0.27±0.23[b]	0.13±0.23[b]	0.13±0.17[C]
Budo Egba	0.40±0.40[b]	0.27±0.23[a]	0.27±0.23[b]	0.13±0.23[c]	0.13±0.23[b]	0.13±0.23[b]	0.27±0.23[ab]	0.00±0.00[d]	0.13±0.23[b]	0.15±0.22[c]
Budo Abio	0.13±0.2[3b]	0.13±0.23[b]	0.13±0.23[c]	0.40±0.00[a]	0.27±0.23[a]	0.00±0.00[d]	0.27±0.23[ab]	0.13±0.23[c]	0.27±0.23[b]	0.40±0.00[a]
Mubo	0.13±0.23[d]	0.27±0.23[a]	0.00±0.00[d]	0.27±0.23[b]	0.00±0.00[c]	0.40±0.00[a]	0.13±0.23[b]	0.13±0.23[c]	0.13±0.23[b]	0.13±0.23[c]
Oyun	0.13±0.23[d]	0.27±0.23[a]	0.27±0.23[b]	0.27±0.23[b]	0.27±0.23[ab]	0.27±0.23[b]	0.27±0.23[ab]	0.40±0.00[a]	0.27±0.23[b]	0.13±0.23[c]
Ojagbooro	0.40±0.40[b]	0.13±0.23[b]	0.13±0.23[c]	0.13±0.23[c]	0.13±0.23[b]	0.00±0.00[d]	0.27±0.23a b	0.13±0.23[c]	0.40±0.00[a]	0.13±0.23[c]
Olaolu	0.27±0.46[c]	0.00±0.00[c]	0.13±0.23[c]	0.00±0.00[d]	0.00±0.00[c]	0.00±0.00[d]	0.00±0.00[c]	0.13±0.23[c]	0.00±0.00[d]	0.13±0.23[c]
Eroomo	0.27±0.46[c]	0.13±0.23[b]	0.00±0.00[d]	0.13±0.23[c]	0.00±0.00[c]	0.13±0.23[c]	0.13±0.23[b]	0.27±0.13[b]	0.00±0.00[d]	0.13±0.23[c]
Okeodo	0.27±0.23[c]	0.27±0.23[a]	0.13±0.23[c]	0.00±0.00[d]	0.13±0.23[b]	0.27±0.23[b]	0.13±0.23[b]	0.27±0.17[b]	0.40±0.00[a]	0.13±0.23[c]
Cocacola	0.53±0.23[a]	0.00±0.00[c]	0.40±0.00[a]	0.13±0.23[c]	0.13±0.23[b]	0.00±0.00[d]	0.40±0.40[a]	0.13±0.23[c]	0.27±0.23[b]	0.27±0.23[b]
Isale Aluko	0.13±0.23[d]	0.00±0.00[c]	0.27±0.23[b]	0.00±0.00[d]	0.27±0.46[a]	0.00±0.00[d]	0.40±0.40[a]	0.00±0.00[d]	0.27±0.23[b]	0.00±0.00[d]
Odoore	0.13±0.23[d]	0.00±0.00[c]	0.27±0.46[b]	0.13±0.23[c]	0.00±0.00	0.00±0.00[d]	0.00±0.00	0.13±0.23[c]	0.13±0.23[c]	0.00±0.00[d]
Botanical garden(control site)	0.07±0.00[e]	0.13±0.23[b]	0.13±0.10[c]	0.27±0.23[b]	0.05±0.00	0.00±0.00[d]	0.04±0.00	0.00±0.00[d]	0.13±0.23[c]	0.27±0.23[c]

Values with the same superscript along the column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO (2011). Recommended Safe limit of Cd =0.20mgkg^{-}. Cd=cadmium

The same statistical content of Cd were recorded in the roots of the accession of Budo Abio, Olaolu, Okeodo and Isale Aluko (Table 43). Cadmium content in the shoots of *Amaranthus hybridus* accession NGBO 125 im the second dry season (2016) between 0.02±0.00 mg/kg and 0.09±0.06 mg/kg with the lowest content recorded for Budo Abio and the highest for Isale Aluko (Table 43). The content of cadmium in the shoot of the Control site was lower than the other sites except Budo Abio. There were no significant differences in the Cd content in the shoots of the accession except the shoots of Coca cola and Isale Aluko (Table 43). The result showed that lower content of Cd were recorded in the shoots of the accession in the second dry season (2016) than the first dry season (2015) (Tables 42 and 43).

The range of cadmium in the roots of the accession (*Amaranthus hybridus* NGBO 125) in the second dry season (2016) was between 0.05±0.00 mg/kg and 0.21±0.01 mg/kg with the lowest for the accession of Odoore and the highest for Otte (Table 43).The roots of the accession of the Control site had lower Cd content than the roots of the other sites except for Eroomo and Odoore (Table 43). No significant differences in the Cd content of the roots of Budo Egba and Okeodo were recorded. The roots of the accession of the Control site, Budo Abio, Mubo, Oyun, Olaolu and Isale Aluko had the same content of Cd (Table 43). The same Cd content in the roots of the accession of Ojagboro and Coca cola were recorded (Table 43).

Result showed lower Cd content in the roots of the accession in the second dry season (2016) than in the first dry seaon (2015). *Corchorus olitorious* accession NG/OA/jun/09/002 had the range of 0.00±0.00 mg/kg and 0.11±0.01 mg/kg of cadmium concentration in the shoots in the second dry season (2016) with the lowest content obtained in the shoots of accession of Budo Abio and the highest for Isale Aluko. Cd content in the shoot of the Control site accession was lower than the other sites except for Budo Abio and Okeodo (Table 43). Accession of the Control site, Budo Abio, Oyun, Olaolu and Okeodo had the same statistical Cd content in the shoots (Table 43). The Cd content of the shoots of Otte, Budo Egba, Mubo, Ojagboro. Eroomo, Coca cola and Odoore were statistically the same at $p \leq 0.05$ (Table 43). It was observed that Cd content in the shoots of the accession were slightly lower in the second dry season (2016) than the first dry season (2015). Cadmium content of the roots of the accession (*Corchorus olitorious* accession NG/OA/jun/09/002) in the second dry season (2016) showed the range of 0.08±0.07 mg/kg and 0.34±0.03 mg/kg with the lowest Cd content obtained in the accession of the Control site and the highest in Coca cola. Cd content in the root of the Control site was lower than the other sites (Table 43). There were no significant differences in the Cd content in the roots of the accession of Otte, Budo Egba, Mubo Olaolu and Okeodo. The roots of the accession of Oyun, Ojagboro and Eroomo were statistically the same at $p \leq 0.05$. Higher Cd content were recorded in the roots of the accession in the second dry season (2016) than the first dry season (2015). Cadmium content in the shoots of *Corchorus olitorious* accession NG/OA/04/010 was between 0.04±0.00 mg/kg and 0.14±0.06 mg/kg with the lowest Cd content obtained in the shoot of the accession of Budo Abio and the highest from Isale Aluko. The Cd content in the shoot of the accession of the Control site was lower than all the other sites except for the accession of Budo Abio and Odoore. All the shoots of the accession had the same statistical content of Cd except for the shoots of accession of Coca cola and Isale Aluko (Table 43). The result suggested lower Cd contents in the shoots of the accession in the second dry season (2016) than in the first dry season (2015).

The range of the cadmium content in the roots of the accession (*Corchorus olitorious accession* NG/OA/04/010) in the second dry season (2016) was between 0.19±0.02 mg/kg and 0.34±0.03 mg/kg with the lowest cadmium content obtained in the root of the accession of Budo Abio and the highest in the accession of Olaolu (Table 43). Cadmium content in the root of the Control site was lower than the roots of the other sites except for the accession of Budo Abio. The accession of the Control site, Budo Abio and Odoore had the same statistical content of Cd in the roots (Table 43).There were no significant differences in the Cd content in the roots of the accession of Otte, Budo Egba, Mubo, Oyun, Ojagboro, Eroomo, Okeoodo and Isale Aluko. Lower Cd content in the roots of the accession in the second dry season (2016) than the first dry season (2015) was recorded. Furthermore, the result indicated that all the shoots of all the accession in the second dry season were lowly polluted of Cd because they all recorded Cd content values below the WHO/FAO recommended safe limit (0.2 mg/kg).

It was also found that Cd contents were higher in the roots of the *Cochorous species* than in the *Amaranthus hybridus* with *C.olitorius* accession NG/OA/04/010 having slightly higher Cd content than *C.olitorius* accession NG/OA/jun/09/002 (Table 43). *Amaranthus hybridus* accession NG/AA/03/11/010 had the highest Cd content in both their shoots and roots and more polluted with Cd in some of the sites followed by *Amaranthus hybridus* accession NG/AO/11/08/039 and lastly, *Amaranthus hybridus* accession NGBO 125. The result also showed that the roots of *Amaranthus hybridus* accession NG/AA/03/11/010 of Otte (0.28±0.02 mg/kg), Mubo (0.20±0.00 mg/kg), Oyun (0.20±0.03 mg/kg), Ojagboro (0.25±0.02 mg/kg), Coca cola (0.21±0.01 mg/kg) and Isale Aluko (0.22±0.01 mg/kg) were all polluted of Cd because they all recorded higher values than the WHO/FAO (2011) recommended safe limit for vegetables (0.2mg/kg), for *Amaranthus hybridus* accession NG/AO/11/08/039, all the roots had Cd content below the safe limit except for the accession of Ojagboro (0.22±0.01 mg/kg) that had Cd content higher than the WHO/FAO Cd safe limit (0.2 mg/kg), *Amaranthus hybridus* accession NGBO 125 had Cd free roots except for the accession of Otte (0.21±0.01 mg/kg) that was polluted of Cd. The result also showed all the roots of *C.olitorius* accession NG/OA/jun/09/002 were all polluted of Cd because they recorded values above the WHO/FAO (2011) recommended safe limit except for the accession of Budo Abio (0.14±0.02 mg/kg), Isale Aluko (0.16±0.04 mg/kg), Odoore (0.18±0.02 mg/kg) and the Control site (0.18±0.07 mg/kg) that recorded lower values than the Cd recommended safe limit. The roots of *Corchorus olitorious* accession NG/OA/04/010 were all polluted with Cd since they all recorded values higher than the recommended Cd safe limit except for Otte Budo Abio (0.19±0.02 mg/kg), Olaolu (0.19±0.07 mg/kg), Odoore (0.19±0.07 mg/kg) and the Control site (0.19±0.03 mg/kg) that recorded lower values of Cd below the recommended limit (0.2 mg/kg) (Table 43).

Table 44 shows the cadmium concentration (mg/kg) in the shoots and roots of the vegetable accessions in the first rainy season (2016). The range of cadmium in the shoots of *Amaranthus hybridus* accession NG/AA/03/11/010 in the first rainy season (2016) was between 0.00±0.00 mg/kg and 0.22±0.13 mg/kg with the no detectable cadmium in the accession of Budo Abio and the highest in the accession of Coca cola (Table 44). Total Cd in the shoot of the Control site was lower than other sites except for Budo Abio. There were no sighnficant differences in the total Cd in the shoots of the accession of the Control site (0.08±0.05 mg/kg), Oyun(0.08±0.12 mg/kg), Olaolu (0.08±0.07 mg/kg), Eroomo (0.08±0.14 mg/kg) and Odoore (0.08±0.11 mg/kg) (Table 44). The same statistical Cd content were recorded in the shoots of accession of Otte (0.17±0.14 mg/kg), Budo Egba(0.17±0.14 mg/kg) and Mubo (0.17±0.00 mg/kg). Accession of Ojagboro (0.11±0.13 mg/kg) and Isale Aluko (0.11±0.08 mg/kg) were statistically the same in the Cd content in the shoots. The range of the total Cd in the roots of the accession was 0.00±0.00 mg/kg to 0.00±0.00 mg /kg. No Cd was detected in all the roots of the accession (Table 44).

The range of the Cd content in the shoots of accession NG/AO/11/08/039 was between 0.00±0.00 mg/kg and 0.08±0.14 mg/kg in the first rainy season (2016) with the no detectable Cd in the accession of Budo Abio, Mubo, Oyun and Olaolu. The Cd content in the shoots of *Amaranthus hybridus* accession NGBO125 in the first rainy season (2016) was between 0.00±0.00 mg/kg and 0.25±0.00 mg/kg with the lowest Cd content obtained in the shoots of the accession of Budo Abio, Mubo, Oyun, Ojagboro, Olaolu, Okeodo, Odoore and the Control site while the highest were recorded in the shoots of the accession of Otte, Budo Egba, Ojagboro, Coca cola and Isale Aluko (Table 44). The accession of the Control site had no Cd in the shoots (Table 44).

The Cd content in the shoot of *Corchorus olitorius accession* NG/OA/Jun/09/002 was in the range of 0.00±0.00 mg/kg and 0.17±0.11 mg/kg in the first rainy season (2016). The shoots of accession of Budo Abio, Mubo, Oyun, Olaolu, Eroomo, Okeodo, Odoore and the Control site had no Cd content. The shoots of the accession of Otte (0.08±0.02 mg/kg) and Budo Egba (0.08±0.06 mg/kg) had the same Cd content in the shoots, so also were the shoots of Ojagboro (0.17±0.11 mg/kg), Coca cola (0.17±0.15 mg/kg) and Isale Aluko (0.17±0.14 mg/kg) (Table 44). Cd content in the roots of *Corchorus olitorius* accession NG/OA/Jun/09/002 were no detectable (Table 44). Cd content in the shoots of *Corchorus olitorius* accession NG/OA/04/010 in the first rainy season (2016) was in the range of 0.00±0.00 mg/kg and 0.25±0.00 mg/kg. The shoot of the accession of the Control site had no Cd content (Table 44). The was no Cd content detected in the roots of the accession (Table 44).

The order of Cd in the shoots of *Amaranthus hybridus* accessions was NG/AA/03/11/010 ≥ NGBO125≥ NG/AO/11/08/039 while the roots of all the accession were free of Cd. The roots of *Corchorus olitorius* accessions had no Cd content while the Cd content of the shoots was in the order NG/OA/04/010≥ NG/OA/Jun/09/002 while there was no Cd detected in the roots of the accession (Table 44). The result showed that the roots of both vegetable species were all free of Cd because no Cd was detected in their roots. The shoots of *Amaranthus hybridus* NG/AA/03/11/010 were all free of Cd because they all recorded Cd content below the WHO/FAO recommended limit except for the accession of Coca cola (0.22±0.13 mg/kg) that had Cd content higher than the safs limit while all the roots were free of Cd, for *Amaranthus hybridus* accession NG/AO/11/08/039, all the shoots and roots were free of Cd because they all had lower Cd content than the safe limit (0.20 mg/kg), so also were the shoots and roots of *Amaranthus hybridus* accession NGBO N125 that all recorded Cd content lower than the safe limit except for the shoots of Otte (0.25±0.00 mg/kg), Budo Egba

Table 43. Cadmium concentrations (mg/kg) in the shoots and roots of the vegetable accession*s* second dry season (2016).

	Amaranthus hybridus accessions						*Corchorus olitorious accessions*			
	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/jun/09/002		NG/OA/04/010	
Site	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.06±0.01^{ab}	0.28±0.02^{a}	0.07±0.01^{bc}	0.17±0.01^{ab}	0.05±0.02^{b}	0.21±0.01^{a}	0.05±0.01^{ab}	0.30±0.01^{ab}	0.06±0.01^{b}	0.27±0.02^{bc}
Budo Egba	0.07±0.00^{ab}	0.19±0.00^{b}	0.10±0.02^{ab}	0.19±0.01^{ab}	0.04±0.01^{b}	0.19±0.01^{ab}	0.07±0.00^{ab}	0.29±0.02^{ab}	0.08±0.01^{b}	0.28±0.02^{bc}
Budo Abio	0.00±0.00^{b}	0.13±0.01^{bc}	0.04±0.02^{c}	0.05±0.00^{c}	0.03±0.00^{b}	0.11±0.01^{bc}	0.02±0.00^{b}	0.14±0.02^{cd}	0.04±0.00^{b}	0.19±0.02^{c}
Mubo	0.08±0.01^{ab}	0.20±0.00^{b}	0.11±0.01^{ab}	0.18±0.01^{ab}	0.04±0.01^{b}	0.12±0.02^{bc}	0.05±0.01^{ab}	0.31±0.04^{ab}	0.06±0.01^{b}	0.26±0.03^{bc}
Oyun	0.07±0.01^{ab}	0.20±0.02^{b}	0.10±0.01^{ab}	0.14±0.01^{b}	0.04±0.00^{b}	0.11±0.01^{bc}	0.04±0.00^{b}	0.20±0.01^{bc}	0.07±0.01^{b}	0.30±0.01^{bc}
Ojagboro	0.11±0.01^{a}	0.25±0.02^{ab}	0.19±0.03^{a}	0.22±0.01^{a}	0.05±0.02^{b}	0.15±0.01^{b}	0.06±0.00^{ab}	0.23±0.02^{bc}	0.06±0.01^{b}	0.27±0.01^{bc}
Olaolu	0.07±0.00^{ab}	0.14±0.00^{bc}	0.07±0.02^{bc}	0.10±0.00^{bc}	0.03±0.02^{b}	0.09±0.01^{bc}	0.04±0.02^{b}	0.29±0.02^{ab}	0.05±0.00^{b}	0.19±0.07^{c}
Eroomo	0.05±0.00^{b}	0.13±0.00^{bc}	0.04±0.01^{c}	0.06±0.03^{c}	0.04±0.02^{b}	0.06±0.01^{c}	0.05±0.02^{ab}	0.21±0.04^{bc}	0.06±0.03^{b}	0.29±0.02^{bc}
Okeodo	0.07±0.00^{ab}	0.10±0.00^{bc}	0.07±0.02^{bc}	0.10±0.02^{bc}	0.04±0.02^{b}	0.18±0.02^{ab}	0.02±0.01^{b}	0.28±0.01^{ab}	0.05±0.01^{b}	0.28±0.01^{bc}
Cocacola	0.15±0.00^{a}	0.21±0.00^{b}	0.12±0.01^{ab}	0.18±0.01^{ab}	0.07±0.02^{ab}	0.14±0.01^{b}	0.05±0.02^{ab}	0.34±0.05^{a}	0.09±0.01^{ab}	0.34±0.03^{b}
Isale Aluko	0.13±0.06^{a}	0.22±0.01^{ab}	0.14±0.03a^{b}	0.11±0.09^{bc}	0.09±0.06^{a}	0.12±0.11^{bc}	0.11±0.01^{a}	0.16±0.14^{c}	0.14±0.06^{a}	0.30±0.17^{bc}
Odoore	0.04±0.02^{b}	0.07±0.01^{c}	0.04±0.01^{c}	0.07±0.00^{c}	0.04±0.01^{b}	0.05±0.00^{c}	0.10±0.03^{ab}	0.18±0.02^{c}	0.04±0.02^{b}	0.19±0.07^{c}
Botanical Garden (Control site).	0.03±0.01^{b}	0.08±0.00^{c}	0.03±0.01^{c}	0.12±0.01^{bc}	0.02±0.00^{b}	0.09±0.08^{bc}	0.00±0.00^{b}	0.08±0.07^{d}	0.05±0.01^{b}	0.09±0.03^{c}

Values with same superscript along the same column are the same at $p \leq 0.05$. WHO/FAO (2011) Recommended Safe limit of Cd = 0.2 $mgkg^{-1}$.

Table 44: Cadmium concentration (mg/kg) in the shoots and roots of the vegetable accessions first rainy (2016) .

Site	*Amaranthus hybridus*						*Corchorus olitorius*			
	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.17±0.14^{b}	0.00±0.00^{a}	0.08±0.14^{a}	0.00±0.00^{a}	0.25±0.00^{a}	0.00±0.00^{a}	0.08±0.02^{b}	0.00±0.00^{a}	0.08±0.11^{b}	0.00±0.00^{a}
Budo Egba	0.17±0.14^{b}	0.00±0.00^{a}	0.08±0.04^{b}	0.00±0.00^{a}	0.25±0.00^{a}	0.00±0.00^{a}	0.08±0.06^{b}	0.00±0.00^{a}	0.08±0.14^{b}	0.00±0.00^{a}
Budo Abio	0.02±0.00^{e}	0.00±0.00^{a}	0.02±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}
Mubo	0.17±0.00^{b}	0.00±0.00^{a}	0.02±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}
Oyun	0.08±0.12^{d}	0.00±0.00^{a}	0.02±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}
Ojagboro	0.11±0.13^{c}	0.00±0.00^{a}	0.08±0.14^{a}	0.00±0.00^{a}	0.25±0..00^{a}	0.00±0.00^{a}	0.17±0.11^{a}	0.00±0.00^{a}	0.25±0.00^{a}	0.00±0.00^{a}
Olaolu	0.08±0.07^{d}	0.00±0.00^{a}	0.01±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}
Eroomo	0.08±0.14^{d}	0.00±0.00^{a}	0.01±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}
Okeodo	0.17±0.22^{b}	0.00±0.00^{a}	0.02±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}
Cocacola	0.22±0.13^{a}	0.00±0.00^{a}	0.08±0.14^{a}	0.00±0.00^{a}	0.25±0.00^{a}	0.00±0.00^{a}	0.17±0.15^{c}	0.00±0.00^{a}	0.17±0.05^{b}	0.00±0.00^{a}
Isale Aluko	0.11±0.08^{c}	0.00±0.00^{a}	0.08±0.07^{b}	0.00±0.00^{a}	0.25±0.00^{a}	0.00±0.00^{a}	0.17±0.14^{a}	0.00±0.00^{a}	0.25±0.00^{a}	0.00±0.00^{a}
Odoore	0.08±0.11^{d}	0.00±0.00^{a}	0.01±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{c}	0.00±0.00^{a}
Botanical garden(Control site)	0.08±0.05^{d}	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}

Values with the same superscript along the same column are statistically the same at p ≤0.05. Values represents ±SD. WHO/FAO (2011). Recommended Safe limitof Cd=0.20mgkg^{-}. Cd=cadmium

(0.25±0.00 mg/kg), Ojagboro (0.25±0.00 mg/kg), Olaolu (0.25±0.00 mg/kg), Coca cola (0.25±0.00 mg/kg) and Isale Aluko (0.25±0.00 mg/kg) the were polluted of Cd because they had Cd values above the recommended safe limit. The shoots and roots of both accessions of *Corchorus olitorius* were all free of Cd since they all recorded Cd content lower than the safe limit (0.20 mg/kg) except the shoots of *Corchorus olitorius* NG/OA/04/010 in Ojagboro (0.25±0.00 mg/kg) and Isale Aluko (0.25±0.00 mg/kg) that had Cd content above the safe limits (0.20 mg/kg) (Table 44).

Table 45 shows the cadmium, copper and lead concentration in the shoot and root of each of the different accessions of *Amaranthus hybridus and Corchorus olitorius* in the second rainy season (2017). The range of cadmium conten in the shoot of *Amarathus hybridus* NG/AA/03/11/010 was 0.01 ± 0.00 mg/kg to 0.10±0.01 mg/kg. Highest cadmium was recorded in the shoot of the accession of Coca-cola area while the lowest cadmium was recorded in the shoot of the accession of the Control site (Table 45). Accession of the Control site had a lower concentration of cadmium in the shoot with the value of 0.01±0.00 mg/kg than the other sites. Cadmium concentrations in the shoot of the accession of Otte, Budo Egba , Oyun and Odoore were statitically the same at $p \leq 0.01$ (Table 45).

Cadmium concentration in the root of the accession was in the range of 0.09±0.04 mg/kg and 0.26±0.03 mg/kg which were recorded in Odoore and Otte respectively. The concentration of cadmium in the root of the accession of the Control site was significantly the same as Budo Abio, Eroomo and Okeodo, higher than Odoore but lower than Otte, Budo Egba, Mubo, Oyun, Ojagboro, Olaolu and Isale-Aluko. The cadmium concentration in the root of the accession of Otte and Oyun were statistically the same at $p \leq 0.05$ (Table 45). There were no significant differences in cadmium concentrations in the root of the accession of Budo-Egba, Mubo, Ojagboro and Isale Aluko (Table 45).

The range of cadmium concentration in the shoot of the *Amarathus hybridus* accession NG/AA/03/11/010 in the second rainy season (2017) was between 0.02±0.01 mg/kg and 0.11±0.04 mg/kg. Highest concentration of cadmium in the shoot was recorded in the accession of Isale Aluko while the lowest was recorded in accession of Eroomo and Odoore (Table 45). At the Control site, the accession recorded cadmium concentration in shoot at the value of 0.03±0.01 mg/kg which was greater than Cd concentrations of the shoots of Eroomo and Odoore but lower than the other sites (Table 45). Accession of Budo-Egba, Mubo and Oyun recorded statistically the same Cd concentrations in the shoot. Statistically, the same concentrations of cadmium were also recorded in the shoots of the accession in Ojagboro, Coca-cola and Isale –Aluko (Table 45). Mean cadmium concentration in the roots of the accession NG/AO/11/08/039 was between 0.07± 0.04 mg/kg and 0.22 ±0.04mg/kg with the lowest concentration recorded in Control site and the highest in Ojagboro (Table 45). Cadmium concentrations in the roots of the accession of Otte, Budo- Egba, Ojagboro and Coca-cola were statistically the same at $p \leq 0.01$ (Table 45).

Accession NGBO125 of *A. hybridus* in the second rainy season (2017) had the range of cadmium concentration in shoot between sites at 0.00±0.00 mg/.kg and 0.02±0.01 mg/kg with no detectable amount of cadmium recorded in accession of Budo Abio, Oyun, Olaolu and Okeodo (Table 45). Mean cadmium concentration in the shoots of accession NGBO125 of *A. hybridus* in Mubo, Eroomo, Odoore and the Control site, were the same (0.01±0.01 mg/kg), also, Otte, Budo Egba, Ojagboro, Coca cola and Isale Aluko had the same concentration(0.02±0.01 mg/kg). The shoots of A. hybridus accession NG/AO/11/08/039 were found to have the highest concentrations of cadmium followed by accession NG/AA/03/11/010 and lowest in the shoots of NGBO125 in the second rainy season (2017), that is, the sequence of cadmium in the shoots of A. hybridus accessions between sites was NG/AO/11/08/039 ≥ NG/AA/03/11/010 ≥ NGBO125.

The shoots of *Corchorous olitorius* NG/OA/Jun/09/002 recorded the range of 0.00 ±0.00 mg/kg and 0.05±0.01 mg/kg in the second rainy season (2017) with the lowest recorded in the accession of the Control site (Table 45). No cadmium was detected in the shoots of the accession NG/OA/Jun/09/002 of *Corchorous olitorius* of Odoore and the Control site. Most of the shoots of the accession had the same concentration of cadmium (Table 45). No significant differences were recorded in the cadmium concentrations in the shoots of the accession NG/OA/Jun/09/002 of *Corchorous olitorius* of the other sites except that of Otte and Budo Egba (Table 42). The range of cadmium in the root of accession *NG/OA/Jun/*09/002 of *Corchorous olitorius* was between 0.12±0.02 mg/kg and 0.38±.0.02 mg/kg with the lowest recorded in the root of the accession of Control site while the highest in the accession of Otte. Cadmium concentration in the root of the accession of the Control site, were lower than the other roots except the root of Eroomo (0.12±0.02 mg/kg). No significant differences in the cadmium concentrations of the roots of the accession of Otte and Mubo were recorded. Ojagboro, Coca-cola and Isale Aluko had the same cadmium concentrations (Table 45). The mean cadmium concentration in the shoots of accession NG/OA/04/010 of *Corchorous olitorius* in the second rainy season (2017) ranged between 0.01±0.01 mg/kg and 0.07±0.01 mg/kg with the lowest in the shoot of Odoore and the highest in Isale Aluko (Table 45).

The shoot of the accesson of the Control site had the same cadmium concentration as that of Okeodo, higher value than Odoore but lower than the shoots of the other sites. Shoots of the accession of Budo Egba were statistically the same as Isale Aluko.

The range of the mean cadmium concentration of the roots in accession NG/OA/04/010 of *Corchorous olitorius* was between 0.08±0.04 mg/kg and 0.48±0.08 mg/kg with the lowest recorded in accession of Control site and the highest in Olaolu. No significant mean concentration of cadmium was recorded in the roots of the Control site and Budo Egba (Table 45). Roots of the accession had no significant differences in the mean concentrations of cadmium of Budo Egba, Mubo, Oyun, Eroomo and Okeodo (Table 45). Otte and Ojagboro had the same mean concentrations of cadmium in their roots. Higher concentration of cadmium in the shoots of *C.* olitorius accession were recorded in the accession NG/OA/04/010 than of accession NG/OA/Jun/09/002 (Table 45). Highest content of cadmium was recorded in the shoots of *C. olitorious* accession NG/OA/04/010 of Isale Aluko while the lowest was recorded in Odoore and Control site in accession NG/OA/Jun/09/002. Accession NG/OA/04/010 had higher content of cadmium than NG/OA/Jun/09/002.The result showed that the cadmium content in the shoots of both vegetable vegetable species were all below the WHO/FAO (2011) recommended safe limit for Cd in vegetables (0.20 mg/kg), therefore, all shoots were safe for consumption but the roots of *Cochorous olitorius* specie had more Cd content than *Amaranthus hybridus* specie with higher Cd contents in the roots of *C. olitorius* accession NG/OA/04/010 in the first rainy season (2016). It was also observes that all the roots of *C. olitorius* accession NG/OA/04/010 in all the sites except the accession of the Control site (0.18±0.04 mg/kg) had Cd concentration above the WHO/FAO safe limit while the roots of *C. olitorius* accession NG/OA/Jun/09/002 of all the sites except Eroomo (0.12±0.02 mg/kg), Okeodo (0.19±0.01 mg/kg) and the Control site (0.15±0.08 mg/kg) also recorded Cd concentration above the WHO/FAO safe limit.

It was found that the roots of *A. hybridus* accession NG/AA/03/11/010 of Otte (0.26±0.03 mg/kg) and Oyun (0.25±0.05 mg/kg), *A. hybridus* accession NG/AO/11/08/039 of Otte (0.20±0.02 mg/kg), Ojagboro (0.22±0.04 mg/kg) and Coca cola (0.21±0.04 mkg) and *A. hybridus* accession NGBO 125 of Otte (0.25±0.05 mg/kg), Okeodo (0.22±0.01 mg/kg) and Isale Aluko (0.22±0.03 mg/kg) all recorded Cd content above the safe limit of WHO/FAO (2011) (Table 45).

Table 46 shows the mean total copper in the shoots and roots of *Amaranthus hybridus and Corchorus olitorius* in the first dry season (2015). Copper concentration in the shoots of the *Amaranthus hybridus* accession NG/AA/03/11/010 in the first dry season (2015) ranged between 0.05±0.03 mg/kg and 0.73±0.14 mg/kg. The accession of the Control site had the lowest concentration of Copper than other sites (Table 46). The accession of Otte (0.13 ± 0.01 mg/kg), Mubo (0.13± 0.04 mg/kg), Olaolu (0.12±0.01 mg/kg), Eroomo (0.11±0.04 mg/kg), Cocacola (0.12±0.02 mg/kg) and Odoore(0.15±0.01 mg/kg) were statistically the same in the concentration of copper in their shoots. The accession had the range of copper in the roots of the accession between the range of 0.15±0.04 mg/kg and 0.59±0.04 mg/kg with the highest copper concentration recorded in the root of Ojagboro accession while the lowest was recorded in the accession of Okeodo (Table 46). The root of the accession of the Control site (0.17±.00 mg/kg), had lower concentration of copper than the roots of the accession of other sites except for Okeodo (0.15±0.04 mg/g). No significant differences were recorded in the concentration of copper in the roots of the accession of Otte (0.17±.04 mg/kg), Mubo (0.17±.01 mg/kg), Okeodo (0.15± 0.04 mg/kg), Isale Aluko(0.18± 0.02 mg/kg), Odoore (0.17± 0.00 mg/kg) and the Control (0.16 ± 0.00 mg/kg) (Table 46). Budo Abio (0.22± 0.02 mg/kg) and Coca-Cola (0.22± 0.00 mg/kg) area were statistically the same in the concentration of the copper in roots.

Amaranthus hybridus accession NG/AO/11/08/039 in the first dry season (2015) had the range of 0.05±0.05 mg/kg and 0.65±0.11 mg/kg copper in their shoots. The concentration of copper in the accession of the Control site was lower the other sites except for Okeodo (0.05± 0.00 mg/kg) (Table 46). No significant differences were recorded in the concentration of copper in the shoots of the accession of Otte (0.09± 0.01 mg/kg), Budo Egba (0.11± 0.02 mg/kg), Mubo (0.08±0.00 mg/kg), Olaolu (0.11± 0.00 mg/kg), Coca-cola (0.10± 0.05 mg/kg), Odoore (0.07±0.02 mg/kg) and the Control site (0.07±0.01 mg/kg), (Table 46).The concentration of copper in the shoots of the accession of Budo Abio (0.15±0.03 mg/kg) and Eroomo (0.15± 0.01 mg/kg) were statistically the same (Table 46). The copper concentration in the roots of the accession ranged between 0.10±0.01 mg/kg and 1.37±0.14 mg/kg with the lowest obtained in Odoore and the highest in Oyun. The concentration of copper in the root of the accession of the Control site (0.15±0.02 mg/kg) , which was lower than other site except for

Okeodo (0.11±0.04 mg/kg) and Odoore(0.10±0.01 mg/kg), (Table 46).The roots of the accession of Otte (0.20 ± 0.04 mg/kg), Mubo (0.21± 0.01 mg/kg) and Coca-cola (0.21±0.00 mg/kg) had the same concentration of copper (Table 46). *Amaranthus hybridus* accession NGBO125 in the first dry season (2015) had the range between 0.05±0.05 mg/kg and 0.43±0.03 mg/kg of copper concentration in the shoots with the lowest in the shoot of the accession of Olaolu and Okeodo while the highest was obtained in Oyun (Table 46). Copper in the shoot of the accession of the Control site was lower than the other sites except for Olaolu (0.05± 0.05 mg/kg) and Okeodo (0.05± 0.01 mg/kg) (Table 46). The same value of copper was recorded in the accession of Budo-Egba (0.15±0.04 mg/kg) and Budo Abio (0.18±0.01 mg/kg). No significant differences were recorded in the copper in the shoots of the accession Mubo (0.09±0.01 mg/kg), Eroomo (0.09±0.01 mg/kg) and Odoore (0.11±0.03 mg/kg). Accession of Olaolu (0.05±0.05 mg/kg), Okeodo (0.05±0.01 mg/kg) and the Control site (0.06±0.02 mg/kg) had the same concentration of copper in their shoots (Table 46).

The range of copper in the roots of the accession in the first dry season (2015) was between 0.11±0.02 mg/kg and 1.15± 0.13 mg/kg which were recorded in Olaolu and Oyun respectively (Table 46). The copper concentration in the root of the accession of the Control site (0.12±0.02 mg/kg) was lower than other sites except for Olaolu (0.11± 0.05 mg/kg). No significant differences were recorded in the concentration of copper in the root of the accession of Otte (0.13±0.09 mg/kg) and the Control site (0.12± 0.02 mg/kg), so also were the accession of Mubo (0.17± 0.03 mg/kg), Okeodo (0.19±0.03 mg/kg) and Odoore (0.18±0.04 mg/kg) (Table 46). Copper concentration in the roots of the accession of Oyun (1.15±0.13 mg/kg), Ojagboro (0.53±0.02 mg/kg) and Isale Aluko (0.50±0.00 mg/kg) were slightly higher than the other sites (Table 46). The copper in the shoots of the three *Amaranthus hybridus* accessions was in the order NG/AA/03/11/010 greater than NGBO125 greater NG/AO/11/08/039 (Table 46).

Table 45: Cadmium concentrations (mg/kg) in the shoots and roots of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius*) during second rainy season (2017)

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Site	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.03±0.02^{d}	0.26±0.03^{a}	0.07±0.02^{c}	0.20±0.02^{ab}	0.02±0.01^{a}	0.25±0.05^{a}	0.03±0.00^{ab}	0.35±.0.02^{a}	0.04±0.01^{bc}	0.30±0.04^{bcd}
Budo Egba	0.04±0.01^{d}	0.15±0.02^{b}	0.09±0.04^{ab}	0.19±0.01^{ab}	0.02±0.01^{a}	0.17±0.04^{b}	0.05±0.01^{ab}	0.33±0.01^{b}	0.06±0.01^{ab}	0.33±0.02^{bc}
Budo Abio	0.02±0.00^{de}	0.11±0.01^{c}	0.05±0.05^{cd}	0.15±0.03^{c}	0.00±0.00^{b}	0.12±0.00^{c}	0.01±0.01^{b}	0.20±0.04^{d}	0.03±0.00 ^{c}	0.20±0.03^{de}
Mubo	0.05±0.02^{cd}	0.17±0.09^{b}	0.09±0.02^{ab}	0.19±0.05^{a}	0.01±0.01^{ab}	0.14±0.01^{bc}	0.01±0.00^{b}	0.38±0.02^{a}	0.03±0.01^{c}	0.34±0.03^{bc}
Oyun	0.04±0.05^{d}	0.25±0.05^{a}	0.08±0.09^{ab}	0.17±0.01b	0.00±0.00^{a}	0.19±0.07^{a}	0.02±0.01^{b}	0.22±0.03^{cd}	0.04±0.01^{bc}	0.33±0.01^{bc}
Ojagbooro	0.07±0.01^{cd}	0.16±0.07^{b}	0.10±0.02^{a}	0.22±0.04^{ab}	0.02±0.01^{a}	0.15±0.00^{bc}	0.02±0.01^{b}	0.27±0.01^{c}	0.05±0.01^{abc}	0.30±0.02^{bcd}
Olaolu	0.05±0.01^{a}	0.18±0.01^{b}	0.03±0.02^{d}	0.10±0.01^{d}	0.01±0.01^{ab}	0.12±0.01^{c}	0.01±0.01^{b}	0.33±.0.04^{b}	0.04±0.01^{bc}	0.48±0.08^{a}
Eroomo	0.02±0.00^{de}	0.10±0.05^{c}	0.02±0.01^{d}	0.13±0.02^{cd}	0.01±0.01^{ab}	0.05±0.01^{d}	0.02±0.00^{b}	0.12±0.02^{f}	0.03±0.00^{c}	0.33±0.04^{bc}
Okeodo	0.04±0.01^{d}	0.11±0.05^{c}	0.05±0.01^{cd}	0.14±0.01^{cd}	0.00±0.00^{b}	0.22±0.01^{e}	0.01±0.00^{c}	0.19±0.01^{de}	0.02±0.00^{c}	0.33±0.07^{bc}
Cocacola	0.10±.0.01^{a}	0.16±0.09^{b}	0.10±0.02^{a}	0.21±0.04^{ab}	0.02±0.01^{a}	0.16±0.02^{b}	0.01±0.01^{b}	0.29±0.05^{c}	0.05±0.02^{abc}	0.37±0.04^{b}
Isale Aluko	0.09±0.01^{b}	0.17±0.04^{b}	0.11±0.04^{a}	0.13±0.06^{d}	0.02±0.00^{a}	0.22±0.03^{a}	0.02±0.01^{b}	0.25±0.00^{c}	0.07±0.01^{a}	0.25±0.01^{ef}
Odoore	0.04±0.01^{d}	0.09±0.04^{bc}	0.02±0.01^{d}	0.11±0.02^{cd}	0.01±0.01^{ab}	0.12±0.14^{c}	0.00±0.00^{b}	0.33±0.29^{bc}	0.01±0.01^{de}	0.23±0.05^{de}
Botanical gard en(control site)	0.01±0.00^{e}	0.10±0.08^{c}	0.03±0.01^{d}	0.07±0.04^{d}	0.00±0.00^{b}	0.08±0.02^{cd}	0.00±0.00^{b}	0.15±0.08^{e}	0.02±0.01^{bc}	0.18±0.04^{f}

Values with the same superscript along the column are statistically the same at $p \geq 0.05$. Values represents ±SD. WHO/FAO (2011). Recommended Safe limit of Cd =0.20mgkg^{-}. Cd=cadmium

The range of copper in the shoot of the *Corchorus olitorius* NG/OA/Jun/09/002 accession in the first dry season (2015) was between 0.04±0.01 mg/kg and 0.37±0.04 mg/kg which were recorded in the Control site and Oyun respectively. Copper in the shoot of the accession of the Control site (0.04±0.01 mg/kg) was lower than the other sites except for Okeodo (0.04±0.02 mg/kg). No significant differences were recorded in the copper concentration of the shoots of the accession of Otte (0.09±0.01 mg/kg), Mubo (0.07±0.01 mg/kg), Olaolu (0.09±0.01 mg/kg) and Coca-cola sites (0.09±0.03 mg/kg) (Table 46). Copper content in the shoots of the accession of Budo Abio (0.11±0.01 mg/kg) and Isale Aluko (0.11±0.05 mg/kg) were statistically the same, so also were Budo- Egba (0.14±0.01 mg/kg), Eroomo(0.15±0.02 mg/kg) and Odoore(0.16±0.01 mg/kg). Cu in the shoots of the accession were slightly higher in Oyun (0.37±0.04 mg/kg) and Ojagboro (0.22±0.06 mg/kg) than other sites (Table 46). Copper in the roots of the accession ranged between 0.11±0.02 mg/kg and 0.89±0.18 mg/kg with the lowest concentration obtained in the accession of Okeodo and the highest in Oyun. Copper concentration in the roots of the accession of the Control site was lower (0.19±0.02 mg/kg) than other sites except for Mubo (0.15±0.02 mg/kg), Eroomo(0.19±0.01 mg/kg), Okeodo (0.11±0.02 mg/kg) and Coca-cola area (0.16±0.04 mg/kg) (Table 46). No significant differences were recorded in the copper concentration in the roots of accession of Otte, Olaolu, Eroomo, Odoore and the Control site (Table 46). Copper concentration in the root of the accession of Oyun (0.89±0.18 mg/kg) and Ojagboro (0.42±0.01 mg/kg) were slightly higher other sites (Table 46).

The range of copper in *Corchorus olitorius* accession NG/OA/04/010 in the first dry season (2015) was between 0.04.±0.01 mg/kg and 0.55±0.04 mg/kg with the lowest obtained in the shoot of the accession of Okeodo and the highest in Oyun (Table 46). Copper content in the shoot of the accession of the Control site (0.07±0.03 mg/kg) was lower than the other sites except for Okeodo (0.04±0.01 mg/kg). There were no significant differences in the copper content in the shoots of the accession of Otte(0.19±0.01 mg/kg) and Budo-Egba (0.21±0.01 mg/kg), so also were the accession of Budo-Abio (0.14±0.04 mg/kg) , Olaolu(0.14±0.01 mg/kg), Eroomo (0.13±0.02 mg/kg) and Isale Aluko (0.13±0.09 mg/kg) . Copper in the accession of Okeodo (0.13±0.09 mg/kg) and the Control site (0.15±0.01 mg/kg) were the same. Copper content was higher in the shoot of the accession of Oyun (0.55±0.04 mg/kg) and Ojagboro (0.34±0.00 mg/kg) than the other sites.

Copper content in the roots of *Corchorus olitorius* accession NG/OA/04/010 in the first dry season (2015) ranged between 0.12 ±0.01 mg/kg and 1.18±0.19 mg/kg with the lowest from Coca-cola area and the highest from Oyun (Table 46). Copper from the soil to the root of the Control site was greater than the accession of sites Mubo, Olaolu ,Okeodo ,Coca cola, Isale Aluko and Odoore but less than Otte, Budo Egba, Budon Abio, Oyun, Ojagbor, Eroomo (Table 46). No significant differences were recorded in the copper concentration in the roots of the accession of Otte and Budo Abio , also of, Olaolu and Eroomo (Table 46). Significant differences in the copper transfer from the soils to the roots were recorded between sites (Table 46). The copper content in the shoots of the accessions of *Corchorus olitorius was* higher in accession NG/OA/04/010 than in the accession NG/OA/Jun/09/002 (Table 46). It was shown in the result that all the shoots and roots of all the accessions of the vegetables were free of Cu pollution because their values were lower than the recommended safe limit for Cu in vegetables (40.00 mg/kg) (WHO/FAO, 2011).

Table 47 presents the copper concentration (mg/kg) in the shoots and roots of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius*) in second dry season (2016). The range of the copper content in the shoots of *Amaranthus hybridus* NG/AA/03/11/010 was between 0.25±0.11 mg/kg and 3.50±0.25 mg/kg with the lowest recorded in the accession of Budo Abio and the highest in the accession of Budo Egba (Table 47). Copper content in the shoots of the accession of the Control site (2.58 ±0.11 mg/kg) was higher than the accession of the other sites except the accession of Budo Egba (3.50±0.25 mg/kg), Olaolu (3.25±0.25 mg/kg) and Eroomo (3.37±0.11 mg/kg) (Table 47). Copper content in the shoots of the accession of Budo Abio (0.25±0.11 mg/kg) and Mubo (0.50 ±0.25 mg/kg) had comparatively lower copper content than the other sites.

Cu content in the roots of the accession in second dry season (2016) was in the range of 0.67±0.13 mg/kg and 2.58±0.11 mg/kg with the lowest recorded in the accession of Budo Abio and the highest in the accession of Olaolu (Table 47). The Cu content in the root of the the Control site (1.58±0.11 mg/kg) was higher than the roots of the other sites except for the roots of the accession of Olaolu (2.58 ±0.11 mg/kg) and Isale Aluko(2.41±0.14 mg/kg). Cu content in the roots of the accession of Control site (1.50±0.12 mg/kg) and Okeodo (1.54±0.11 mg/kg) were statistically the same (Table 46). The roots of the accession of Mubo (0.92±0.03 mg/kg), Oyun (0.92±0.14 mg/kg) and Coca cola(0.92±0.18 mg/kg) had the same Cu content (Table 47).

The concentration of Cu in the shoots of *Amaranthus hybridus accession* NG/AO/11/08/039 in second dry season (2016) was in the range of 0.25±0.00 mg/kg and 4.25±0.25 mg/kg with the lowest recorded in the shoot of the accession of Cocacola and the highest in the shoot of the accession of Olaolu (Table 47). Cu concentration of the shoot of the accession of the Control site (3.67±0.13 mg/kg) was higher than the sites except for Olaolu (4.25±0.25 mg/kg) (Table 47). There were no significant differences between the Cu contents in the shoots of Mubo (0.67±0.13 mg/kg) and Okeodo (0.67±0.13

mg/kg), so also were the accession of Oyun (1.33±0.17 mg/kg) and Ojagboro (1.33±0.12 mg/kg). Cu concentration in the roots of the accession was in the range of 0.33±0.17 mg/kg and 4.58±0.12 mg/kg with the lowest Cu concentration obtained in the root of the accession of Budo Abio and the highest in the root of the accession of Olaolu (Table 47). Cu concentration in the root of the accession of the Control site (2.33±0.12 mg/kg) was higher than the other sites except the accession for Otte (2.58±0.12 mg/kg), Budo Egba (3.33±0.12 mg/kg), Olaolu (4.58 ±0.12 mg/kg) Eroomo (4.42 ±0.18 mg/kg) and Isale Aluko (2.41±0.14 mg/kg) (Table 47).

The range of the Cu content in the shoots of *Amaranthus hybridus accession* NGBO125 in second dry season (2016) was between 0.42±0.18 mg/kg and 5.25±0.25 mg/kg with the lowest obtained in the accession of Budo Abio and the highest in the accession of Olaolu. Cu concentration of the shoot of the accession of the Control site (2.75±0.00 mg/kg) was higher than the other sites except Budo Egba(3.25±0.14 mg/kg), Olaolu (5.25±0.25 mg/kg) and Eroomo (4.33±0.12 mg/kg) (Table 47). Cu content of the roots of the accession in second dry season (2016) was in the range of 0.39±0.14 mg/kg and 3.75±0.00 mg/kg with the lowest recorded in the accession of Budo Abio and the highest in the accession of Olaolu (Table 47). Cu content in the root of the Control site (1.52±0.10 mg/kg) was lower than the other sites except Budo Abio (0.39±0.14 mg/kg), Mubo (0.67±0.13 mg/kg), Oyun (0.50 ±0.14 mg/kg), Ojagboro (1.17±0.13 mg/kg) and Okeodo (1.17±0.13 mg/kg) (Table 47).

Cu content in the root of the accession of Ojagboro (1.17±0.13 mg/kg) and Okeodo(1.17±0.13 mg/kg) were statistically the same (Table 47). The range of the Cu content in the shoots of *Corchorus olitorius accession* NG/OA/Jun/09/002 in second dry season (2016) was 0.25±0.00 mg/kg and 2.42±0.14 mg/kg with the lowest obtained in the accession of Budo Abio and the highest in the accession of Eroomo (Table 47). Cu content in the accession of the Control site (1.17±0.13 mg/kg) was higher than the other sites except for Budo Abio (0.25±0.00 mg/kg), Mubo(0.50±0.25 mg/kg), Oyun (0.42±0.16 mg/kg), Ojagboro(0.29±0.17 mg/kg), Okeodo (0.58±0.14 mg/kg), Coca cola (0.58±0.11 mg/kg) and Isale Aluko (1.08 ±0.14 mg/kg) (Table 47). Cu content in the shoots of the accession of Budo Egba(1.33±0.14 mg/kg), Odoore(1.33±0.12 mg/kg) and the Control site (1.33±0.10 mg/kg) were statistically the same, so also were Mubo (0.50±0.25 mg/kg), Okeodo (0.58±0.14 mg/kg) and Eroomo(0.58±0.11mg/kg) (Table 47). Cu content of the roots of the accession ranged between 1.17±0.15 mg/kg and 4.67±0.13 mg/kg with the lowest Cu in the roots of the accession of Budo Abio and the highest in the accession of Olaolu (Table 47). Cu content in the roots of the accession of the Control site (1.18±0.22 mg/kg) was higher than other sites except for Budo Abio (1.17±0.15 mg/kg), Mubo (1.42±0.11 mg/kg) and Oyun (1.67±0.23 mg/kg) (Table 47).

The Cu content in the shoots of *Corchorus olitorius* accession NG/OA/04/010 in second dry season (2016) was in the range of 0.25±0.00 mg/kg and 1.33±0.14 mg/kg with the lowest in the shoot of the accession of Budo Abio and the highest in the shoot of the accession of Olaolu. Cu content in the shoot of the accession of the Control site (1.00±0.00 mg/kg) was higher than the sites except for Olaolu (1.33±0.14 mg/kg). No significant differences in the Cu contents of the shoots of Budo Abio (0.25±0.00 mg/kg) and Okeodo (0.25±0.00 mg/kg), so also were Mubo (0.33±0.14 mg/kg) and Oyun(0.35±0.25 mg/kg), so also, were Otte (0.83±0.29 mg/kg) and Isale Aluko (0.83±0.29 mg/kg), so also were Eroomo (0.67±0.13 mg/kg) and Odoore (0.67±0.13 mg/kg), and Ojagboro (0.42±0.13 mg/kg) and Cocacola (0.42±0.14 mg/kg) (Table 47).

Table 46 : Copper concentration (mg/kg) in the shoot and root of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius*) first dry season (2015) .

	Amaranthus hybridus						*Corchorus olitorius*			
	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.13 ± 0.01^{ef}	0.17 ± 0.04^{fg}	0.09 ± 0.01^{ef}	0.20 ± 0.04^{de}	0.09 ± 0.05^{efg}	0.13 ± 0.09^{e}	0.09 ± 0.01^{de}	0.21 ± 0.02^{de}	0.19 ± 0.01^{c}	0.25 ± 0.02^{de}
Budo Egba	0.21 ± 0.05^{d}	0.32 ± 0.03^{c}	0.11 ± 0.08^{ef}	0.39 ± 0.01^{bc}	0.15 ± 0.01^{d}	0.48 ± 0.02^{bc}	0.14 ± 0.01^{c}	0.39 ± 0.04^{bc}	0.21 ± 0.01^{c}	0.34 ± 0.02^{c}
Budo Abio	0.19 ± 0.02^{de}	0.22 ± 0.02^{de}	0.15 ± 0.03^{ed}	0.27 ± 0.01^{c}	0.18 ± 0.04^{cd}	0.22 ± 0.02^{d}	0.11 ± 0.01^{cd}	0.29 ± 0.02^{c}	0.14 ± 0.04^{d}	$0.25\pm0.0.03^{de}$
Mubo	0.13 ± 0.04^{ef}	0.17 ± 0.01^{fg}	0.08 ± 0.02^{ef}	0.21 ± 0.01^{de}	0.09 ± 0.01^{efg}	0.17 ± 0.03^{de}	0.07 ± 0.01^{de}	0.15 ± 0.02^{ef}	0.10 ± 0.03^{ef}	0.17 ± 0.03^{f}
Oyun	0.73 ± 0.14^{a}	0.55 ± 0.03^{ab}	0.65 ± 0.41^{a}	1.37 ± 0.14^{a}	0.43 ± 0.03^{a}	1.15 ± 0.13^{a}	0.37 ± 0.04^{a}	0.89 ± 0.18^{a}	0.55 ± 0.04^{a}	1.18 ± 0.19^{a}
Ojagbooro	0.55 ± 0.10^{b}	0.59 ± 0.04^{a}	0.31 ± 0.05^{b}	0.48 ± 0.03^{b}	0.31 ± 0.02^{bc}	0.53 ± 0.02^{bg}	0.25 ± 0.05^{b}	0.42 ± 0.01^{b}	0.34 ± 0.00^{b}	0.58 ± 0.02^{b}
Olaolu	0.12 ± 0.01^{ef}	0.20 ± 0.10^{ef}	0.11 ± 0.07^{ef}	0.27+`$\pm0.04^{cd}$	0.05 ± 0.05^{fg}	0.11 ± 0.05^{g}	0.09 ± 0.01^{de}	0.22 ± 0.06^{d}e	0.14 ± 0.01^{d}	0.21 ± 0.03^{e}
Eroomo	0.11 ± 0.04^{ef}	0.25 ± 0.01^{d}	0.15 ± 0.01^{cd}	0.17 ± 0.02^{e}	0.09 ± 0.10^{efg}	0.21 ± 0.04^{d}	0.15 ± 0.02^{c}	0.19 ± 0.01^{de}	0.13 ± 0.02^{d}	0.22 ± 0.18^{e}
Okeodo	0.08 ± 0.01^{fg}	0.15 ± 0.04^{fg}	$0.05\pm0.0.5^{f}$	0.11 ± 0.04^{def}	0.05 ± 0.01^{fg}	0.19 ± 0.03^{de}	0.04 ± 0.02^{e}	0.11 ± 0.02^{f}	$0.04.\pm0.01^{g}$	0.13 ± 0.01^{ij}
Cocacola	0.12 ± 0.02^{ef}	0.22 ± 0.00^{de}	0.10 ± 0.05^{ef}	0.21 ± 0.00^{de}	0.32 ± 0.01^{bc}	0.50 ± 0.00^{b}	0.09 ± 0.03^{de}	0.16 ± 0.04^{e}	0.09 ± 0.01^{ef}	0.12 ± 0.01^{gh}
Isale Aluko	0.26 ± 0.05^{c}	0.18 ± 0.02^{fg}	0.21 ± 0.01^{c}	0.19 ± 0.02^{de}	0.39 ± 0.05^{ab}	0.42±0.02b c	0.11 ± 0.05^{cd}	0.25 ± 0.02^{cd}	0.15 ± 0.01^{d}	0.18 ± 0.03^{ef}
Odoore	0.15 ± 0.01^{ef}	0.17 ± 0.00^{fg}	0.07 ± 0.02^{ef}	0.10 ± 0.01^{f}	0.11 ± 0.03^{efg}	0.18±0.04d e	0.16 ± 0.01^{c}	0.20 ± 0.01^{de}	0.11 ± 0.11^{ef}	0.19 ± 0.01^{ef}
Botanical garden (control site)	0.05 ± 0.03^{g}	0.16 ± 0.02^{fg}	0.07 ± 0.01^{ef}	0.15 ± 0.02^{ef}	0.06 ± 0.02^{fg}	0.12±0.02e	0.04 ± 0.01^{e}	$0.19.\pm0.02^{de}$	0.07 ± 0.03^{fg}	0.21 ± 0.01^{e}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO (2011). Recommended Safe limit of. WHO/FAO, 2011. Recommended Safe limit of Cu = 40.00 mgkg-^{1}

Cu range in the roots of the accession was 0.53±0.26 mg/kg and 3.58±0.17 mg/kg with the lowest in the root of the accession of Budo Abio and the highest in the root of the accession of Olaolu (Table 46). Cu content in the root of the accession of the Control site (1.33±0.14 mg/kg), was lower than the other sites except Budo Egba,Budo Abio, Mubo (Table 47). Cu content in the roots of the accession of Ojagboro and Isale Aluko, Otte and Okeodo, Budo Abio and Mubo were statistically the same (Table 47). Accession of Oyun and the Control site were statistically the same (Table 47). The order of the Cu content in the shoots of *Amaranthus hybridus* accessions was NGBO125 greater than NG/AA/03/11/010 greater than NG/AO/11/08/039 while the order of Cu in the roots of the accession was NG/AO/11/08/039 greater than NG/AA/03/11/010 greater than NGBO125. The order of the Cu content in the shoots of the *Corchorus olitorius* accessions was NG/OA/Jun/09/002 greater than NG/OA/04/010 while the Cu content in the roots of the accessions was also NG/OA/Jun/09/002 greater than NG/OA/04/010 (Table 47). It was found that the shoots and roots of all the vegetables in this study were free of Cu pollution because they all had Cu content lower than the WHO/FAO (2011) safe limit (40.00 mg/kg). Table 48 presents the copper concentrations in the shoots and roots of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius*) in the first rainy season (2016).]

The range of copper in the shoots of *Amaranthus hybridus* NG/AA/03/11/011) in first rainy season (2016) was between 0.45±0.10 mg/kg and 4.00±0.25 mg/kg with the lowest recorded in the accession in Budo Abio and the highest in the accession in Olaolu. Copper content in the shoots of the accession in the Control site (2.49±0.14 mg/kg) was higher than the accession in the other sites except the accesdsion in Budo Egba (3.50±0.25 mg/kg), Olaolu (4.00±0.25 mg/kg) and Eroomo (3.67±0.11 mg/kg) (Table 47). Copper content in the shoots of the accession in Budo Abio (0.45±0.10 mg/kg) and Mubo (0.50±0.25 mg/kg) had comparatively lower copper content than the other sites. Cu content in the roots of the accession (*Amaranthus hybridus* NG/AA/03/11/011) was in the range of 0.67±0.13 mg/kg and 2.58±0.11 mg/kg with the lowest recorded in the accession in Budo Abio and the highest in the accession in Olaolu. The Cu content in the root of the Control site was higher than the roots of the other sites except the roots of the accession in Olaolu (2.50±0.11 mg/kg) and Isale Aluko (2.61±0.14 mg/kg).

Cu content in the roots of the accession of Control site (1.50±0.15 mg/kg) and Okeodo (1.54±0.11 mg/kg) were statisticantly the same (Table 48). The roots of the accession in Eroomo (1.17±0.13 mg/kg) and Odoore (1.18±0.10 mg/kg) were the same. The roots of the accession in Mubo (0.92±0.03 mg/kg), Oyun (0.92±0.14 mg/kg) and Coca cola (0.92±0.18 mg/kg) had the same Cu content (Table 48).

The concentration of Cu in the shoots of *Amaranthus hybridus accession* NG/AO/11/08/039 in the first rainy season (2016) was in the range of 0.25±0.00 mg/kg and 4.41±0.23 mg/kg with the lowest recorded in the shoot of the accession of Cocacola and the highest in the shoot of the accession of Olaolu (Table 48). Cu concentration of the shoot of the accession of the Control site (3.61±0.10 mg/kg) was higher than the sites except Olaolu (4.43±0.13 mg/kg) (Table 48). There were no significant differences between the Cu contents in the shoots in Mubo (0.67±0.13 mg/kg) and Okeodo (0.7±0.13 mg/kg), so also were the accession of Oyun (1.33±0.17 mg/kg) and Ojagboro (1.33±0.12mg/kg). Cu concentration in the roots of the accession (*Amaranthus hybridus* accession NG/AO/11/08/039) in the first rainy season (2016) was in the range of 0.33±0.17 mg/kg and 4.58±0.12 mg/kg with the lowest Cu concentration obtained in the root of the accession of Budo Abio and the highest in the root of the accession of Olaolu (Table 48).

Cu concentration in the root of the accession of the Control site (2.39±0.07 mg/kg) was higher than the other sites except the accession in Otte (2.58±0.12 mg/kg), Budo Egba (3.33 ±0.12 mg/kg), Olaolu(4.62±0.10 mg/kg), Eroomo (4.42±0.18 mg/kg) and Isale Aluko (2.41±0.14 mg/kg). The range of the Cu content in the shoots of *Amaranthus hybridus* accession NGBO125 in the first rainy season (2016) was between 0.42±0.18 mg/kg and 5.60±0.00 mg/kg with the lowest obtained in the accession in Budo Abio and the highest in the accession in Olaolu. Cu concentration of the shoot of the accession of the Control site (2.72±0.07 mg/kg) was higher than the other sites except for Budo Egba (3.25±0.25 mg/kg), Olaolu (5.25±0.25 mg/kg) and Eroomo (5.33±0.09 mg/kg) (Table 48).

Cu content of the roots of the accession in the first rainy season (2016) was in the range of 0.39±0.14 mg/kg and 3.75±0.00 mg/kg with the lowest recorded in the accession in Budo Abio and the highest in the accession of Olaolu. Cu content in the root of the Control site (1.55±0.05 mg/kg) was lower than the other sites except for Budo Abio (0.50±0.00 mg/kg), Mubo(0.67±0.13 mg/kg), Oyun (0.39±0.14 mg/kg), Ojagboro (1.17±0.13 mg/kg) and Okeodo (1.17±0.15 mg/kg) (Table 48). Cu content in the root of the accession of Ojagboro (1.17±0.13 mg/kg) and Okeodo (1.17±0.15 mg/kg) were statistically the same.

The range of the Cu content in the shoots of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first rainy season (2016) was 0.25±0.00 mg/kg and 2.68±0.17 mg/kg with the lowest obtained in the accession in Budo Abio and the highest in the accession in Eroomo (Table 48). Cu content in the accession in the Control site (1.30±0.11 mg/kg) was higher than the other sites except for Otte (1.75±0.00 mg/kg), Budo Egba (1.33±0.12 mg/kg), Oyun (2.47±0.11 mg/kg), Okeodo (2.08±0.38 mg/kg), Coca cola (1.08 ±0.14 mg/kg) and Isale Aluko (1.33±0.12 mg/kg) (Table 48). Cu content in the shoots of the accession in Budo Egba (1.33±0.14 mg/kg), Odoore (1.33±0.12 mg/kg) and the Control site (1.30±0.11 mg/kg) were statistically the same, so also were Budo Abio (0.58±0.11 mg/kg), Mubo (0.50±0.25 mg/kg) and Okeodo(0.58±0.14mg/kg).

Cu content of the roots of the accession in the first rainy season (2016) ranged between 1.17±0.15 mg/kg and 4.67±0.13 mg/kg with the lowest Cu in the roots of the accession of Budo Abio and the highest in the accession in Olaolu (Table 48). Cu content in the roots of the accession in the Control site (1.04±0.03 mg/kg) was lower than other sites except for Oyun (1.67±0.23 mg/kg), Olaolu (1.42±0.11 mg/kg) and Isale Aluko (1.10±0.11 mg/kg) (Table 48). The Cu content in the shoots of *Corchorus olitorius* accession NG/OA/04/010 in the first rainy season (2016) was in the range of 0.23±0.04 mg/kg and 1.37±0.10 mg/kg with the lowest in the shoot of the accession in Okeodo and the highest in the shoot of the accession in Olaolu. Cu content in the shoot of the accession of the Control site (1.04±0.03 mg/kg) was higher than the sites except Olaolu (1.37±0.10 mg/kg). No significant differences in the Cu contents of the shoots of Budo Abio and Okeodo, Mubo and Oyun, so also, were Otte and Isale Aluko, Eroomo and Odoore, Ojagboro and Cocacola, (Table 48).

Cu range in the roots of the accession was 0.53±0.26 mg/kg and 3.58±0.17 mg/kg in the first rainy season (2016) with the lowest in the root of the accession in Budo Abio and the highest in the root of the accession in Olaolu (Table 48). Cu content in the root of the accession in the Control site was lower than the other sites except for Budo Egba, Budo Abio and Mubo. Cu content in the roots of the accession of Ojagboro and Isale Aluko, Otte and Okeodo, Budo Abio and Mubo were statistically the same (Table 48). Accession in Oyun and the Control site were statistically the same. The order of the Cu content in the shoots of the *Amaranthus hybridus* accessions *was* NGBO125 greater than NG/AA/03/11/010 greater than NG/AO/11/08/039 while the order of Cu in the roots of the accession was *NG/AO/11/08/039* greater than NG/AA/03/11/010 greater than NGBO125. The order of the Cu content in the shoots of the *Corchorus olitorius* accessions was NG/OA/Jun/09/002 greater than NG/OA/04/010 while the Cu content in the roots of the accessions was also NG/OA/Jun/09/002 greater than NG/OA/04/010 (Table 48).

Table 47: Copper concentration (mg/kg) in the shoot and root of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius*) second dry season (2016).

Site	*Amaranthus hybridus*						*Corchorus olitorius*			
	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	2.42±0.14^{d}	1.92±0.08^{c}	1.42±0.13^{f}	2.58±0.12^{d}	2.58±0.14^{e}	1.83±0.12^{e}	1.75±0.00^{bc}	2.08±0.12^{fg}	0.83±0.29^{c}	1.42±0.23^{e}
Budo Egba	3.50±0.25^{a}	1.88±0.29^{d}	1.83±0.07^{d}	3.33±0.12^{c}	3.25±0.25^{c}	1.42±0.12^{g}	1.33±0.14^{c}	2.58±0.14^{d}	0.77±0.10^{cd}	0.92±0.29^{g}
Budo Abio	0.25±0.11^{j}	0.67±0.13^{h}	0.42±0.18^{i}	0.33±0.17^{l}	0.42±0.18^{l}	0.39±0.14^{k}	0.25±0.00^{g}	1.17±0.15^{j}	0.25±0.00^{f}	0.53±0.26^{hi}
Mubo	0.50±0.25^{i}	0.92±0.03^{g}	0.67±0.13^{h}	0.58±0.12^{k}	0.67±0.13^{k}	0.67±0.13^{i}	0.50±0.25^{e}	1.42±0.11^{i}	0.33±0.14^{ef}	0.67±0.13^{h}
Oyun	2.00±0.25^{d}	0.92±0.14^{g}	1.33±0.17^{g}	1.42±0.13^{h}	1.67±0.11^{g}	0.50±0.00^{j}	0.42±0.16^{f}	1.67±0.23^{h}	0.35±0.25^{ef}	1.33±0.12^{f}
Ojagboro	1.33±0.14^{g}	1.42±0.13^{ef}	1.33±0.12^{g}	1.33±0.14^{i}	1.42±0.13^{h}	1.17±0.13^{h}	0.92±0.27^{de}	2.17±0.11^{f}	0.42±.0.13^{e}	1.58±0.22^{d}
Olaolu	3.00±0.25^{b}	2.58±0.11^{a}	4.25±0.25^{a}	4.58±0.12^{a}	5.25±0.25^{a}	3.75±0.00^{a}	2.08±0.38^{b}	4.67±0.13^{a}	1.33±0.14^{a}	3.58±0.17^{a}
Eroomo	3.37±0.11^{ab}	1.17±0.13^{f}	3.50±0.25^{bc}	4.42±0.18^{b}	4.33±0.12^{b}	3.58±0.10^{b}	2.42±0.14^{a}	3.58±0.12^{bc}	0.67±0.13^{d}	2.67±0.10^{b}
Okeodo	0.83±0.12^{h}	1. 54±0.11^{e}	0.67±0.13^{h}	1.17±0.23^{j}	1.33±0.12^{i}	1.17±0.15^{h}	0.58±0.14^{e}	2.17±0.13^{f}	0.25±0.00^{f}	1.42±0.18^{e}
Cocacola	1.83±0.14^{e}	0.92±0.18^{g}	0.25±0.00^{j}	1.33±0.17^{i}	1.08±0.12^{j}	1.67±0.13^{f}	0.58±0.11^{e}	3.69±0.10^{b}	0.42±0.13^{e}	2.83±0.17^{ab}
Isale Aluko	1.75±0.00^{f}	2.41±0.14^{b}	1.67±0.13^{e}	2.41±0.14e	2.33±0.07^{f}	1.92±0.11^{d}	1.08±0.14^{d}	2.42±0.12^{e}	0.83±0.29^{c}	1.58±0.13^{d}
Odoore	2.33±0.12^{cd}	1.18±0.10^{f}	2.17±0.11^{c}	2.08±0.11g	2.67±0.13^{d}e	2.42±0.18^{c}	1.33±0.12^{c}	2.92±0.08^{c}	0.67±0.13^{d}	2.25±0.00^{c}
Botanical garden(Control site)	2.58±0.14^{c}	1.58±0.12^{e}	3.67±0.13^{b}	2.33±0.12f	2.75±0.00^{d}	1.52±0.10^{f}	1.33±0.10^{c}	1.88±0.22^{g}	1.00±0.00^{b}	1.33±0.17^{f}

Values with the same superscript along the column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO Recommended Safe limit of Cu = 40.00mgkg^{-1}. Cu=copper.

The result of Cu content in the shoots and roots of all the vegetable accessions in the first rainy season(2016) showed that all the accessions were Cu pollution free because they all had values below the recommended safe limit for Cu in vegetables (40 mg/kg) WHO/FAO (2011).

Table 49 shows the result of the copper (mg/kg) concentration in the vegetable accessions in the second rainy season (2017).The range of copper concentration in the shoots of *Amarathus hybridus* accession was between 0.00±0.00 mg/kg and 0.53±0.23 mg/kg with the non detectable value of 0.00±0.00 mg/kg recorded in the shoot of the accession of Eroomo and the highest Cu concentration recorded in the accession of Odoore (Table 49). The Cu concentration in the shoot of the accession in the Control site (0.40±0.40 mg/kg) was higher than the shoots of the accession in the other sites except for Ojagboro (0.50±0.26 mg/kg) and Odoore (0.53±0.23 mg/kg). Cu concentration in the shoots of the accession in Oyun (0.40±0.00 mg/kg), Olaolu(0.40±0.00 mg/kg), Okeodo(0.40±0.00 mg/kg), Isale Aluko (0.40±0.40 mg/kg) and Control site (0.40±0.40 mg/kg) were statistically the same (Table 49). Copper concentration in the shoots of the accessions in Otte(0.13±0.23 mg/kg) and Budo Egba (0.13±0.17 mg/kg) were statistically the same. Accession of Budo Abio, Mubo and Coca cola recorded the same concentration of copper in the shoots (Table 48). Accession of Ojagboro (0.50±0.26 mg/kg) and Odoore (0.53±0.23 mg/kg) had relatively higher concentration of copper in the shoots than the others.

The copper concentration in the roots of the accession were between 1.07±0.23 mg/kg and 5.33±0.61 mg/kg with the lowest obtained in the root of the accession of the Control site and the highest in the root of the accession of Olaolu (Table 49). The copper concentration in the root of the accession of the Control site was lower than the roots of other sites. Accession of the roots of Otte Budo Egba, Eroomo and Okeodo recorded the same statistical mean concentration of copper (Table 49). Copper concentration in the shoots of *Amarathus hybridus* NG/AO/11/08/039 was in the range of 0.13±0.23 mg/kg and 0.53±0.23 mg/kg with the lowest values obtained in the shoots of the accession of Eroomo, Okeodo, Isale Aluko and the Control site. No significant differences were recorded in the mean copper concentration in the shoots of the accession in Otte, Budo Egba, Budo Abio, Olaolu and Odoore (Table 49). Shoots of accession in Mubo, Oyun and Ojagboro had the same value of copper concentration. Copper content in the shoot of the accession in Cocacola was relatively higher than the other sites (Table 49).

Copper content in the roots of the accession in the second rainy season ranged between 1.87±0.23 mg/kg and 7.07±0.23 mg/kg with the lowest recorded in the root of the accession in Control site and the highest in root of the accession in Otte (Table 49). Copper concentration in the roots of accession in Mubo, Eroomo and Cocacola were statistically the same, so also were the accession of Budo Egba and Isale Aluko (Table 49). There were no significant differences in the copper concentration of the roots in the accession of Budo Abio and Okeodo. The copper content in the shoots of *Amarathus hybridus* NGBO125 was between 0.27±0.23 mg/kg and 0.80±0.00 mg/kg with the lowest recorded in the shoots of the accession of Budo Egba, Mubo and Coccola while the highest were recorded in the shoots of the accession of Olaolu and Okeodo (Table 49). Copper concentration in the shoot of the accession in the Control site was lower than the other sites except for the shoots of accession in Budo Egba , Mubo and Cocacola. Same statistical concentration of copper was recorded in the shoots of the accession in Budo Egba, Mubo and Cocacola (0.40±0.00 mg/kg), same with Otte, Budo Abio and Eroomo (Table 49).

The shoots of the accession of Ojagboro, Isale Aluko and the Control site recorded same copper concentration (0.40±0.00 mg/kg). No significant differences in the copper concentration in the shoots of the accession in Oyun and Odoore were recorded, so also were the shoots of the accession of Olaolu and Okeodo (Table 49). Copper content in the roots of the accession was between 1.20±0.69 mg/kg and 4.53±0.83 mg/kg with the lowest concentration recorded in the root of the accession of the Control site and the highest in the root of the accession of Eroomo. Copper concentration in the root of the accession of the Control site was lower than the other sites (Table 48).

Statistically, the same copper concentration was obtained in the roots of the accession in Otte and Isale Aluko (Table 49), also in the shoots of the accession in Budo Egba and Okeodo, Mubo and Ojagboro, Oyun and Odoore. Amongst the *Amarathus hybridus* accessions, the shoots of accession NGBO125 recorded the highest copper concentrations than accession NG/AO/11/08/039 and than NG/AA/03/11/010, that is, copper concentration in the shoots of the *Amarathus hybridus* accessions was in the order of NGBO125 greater than NG/AO/11/08/039 greater than NG/AA/03/11/010 while the order of copper concentration in the roots was NG/AO/11/08/039 greater than NG/AA/03/11/010 greater than NGBO125 (Table 49). *Corchorus olitorius accession* NG/OA/Jun/09/002 had the range of 0.00±0.00 mg/kg and 0.40±0.40 mg/kg of copper concentration in the shoots of the accession with the lowest concentration in copper obtained in the accession of Odoore and the highest in the shoots of the accession in Otte, Ojagboro, Okeodo and Cocacola (Table 49).

Table 48: Copper concentration (mg/kg) in the shoot and root of the vegetable accessions(*Amaranthus hybridus and Corchorus olitorius*) in the first rainy season (2016).

Site	*Amaranthus hybridus*						*Corchorus olitorius*			
	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	2.42 ± 0.14^{d}	1.92 ± 0.08^{c}	1.42 ± 0.13^{f}	2.58 ± 0.12^{d}	2.58 ± 0.14^{e}	1.83±0.12e	1.75 ± 0.00^{bc}	2.08 ± 0.12^{fg}	0.83 ± 0.29^{c}	1.42 ± 0.23^{e}
Budo Egba	3.50 ± 0.25^{bc}	1.88 ± 0.29^{d}	1.83 ± 0.07^{d}	3.33 ± 0.12^{c}	3.25 ± 0.25^{c}	1.42±0.12g	1.33 ± 0.14^{c}	2.58 ± 0.14^{d}	0.77 ± 0.10^{cd}	0.92 ± 0.29^{g}
Budo Abio	0.25 ± 0.11^{j}	0.67 ± 0.13^{h}	0.42 ± 0.18^{i}	0.33 ± 0.17^{l}	0.42 ± 0.18^{l}	0.39±0.14k	0.25 ± 0.00^{g}	1.17 ± 0.15^{j}	0.29 ± 0.06^{f}	0.53 ± 0.26^{hi}
Mubo	0.50 ± 0.25^{i}	0.92 ± 0.03^{g}	0.67 ± 0.13^{h}	0.58 ± 0.12^{k}	0.67 ± 0.13^{k}	0.67±0.13i	0.50 ± 0.25^{e}	1.42 ± 0.11^{i}	0.33 ± 0.14^{ef}	0.67 ± 0.13^{h}
Oyun	2.00 ± 0.25^{d}	0.92 ± 0.14^{g}	1.33 ± 0.17^{g}	1.42 ± 0.13^{h}	1.67 ± 0.11^{g}	0.50±0.00j	0.42 ± 0.16^{f}	1.67 ± 0.23^{h}	0.35 ± 0.25^{ef}	1.33 ± 0.12^{f}
Ojagboro	1.33 ± 0.14^{g}	1.42 ± 0.13^{ef}	1.33 ± 0.12^{g}	1.33 ± 0.14^{i}	1.42 ± 0.13^{h}	1.17±0.13h	0.92 ± 0.29^{de}	2.17 ± 0.11^{f}	$0.42\pm.0.13^{e}$	1.58 ± 0.22^{d}
Olaolu	4.00 ± 0.25^{a}	2.58 ± 0.11^{a}	4.41 ± 0.23^{a}	4.58 ± 0.12^{a}	5.60 ± 0.00^{a}	3.75±0.00a	2.08 ± 0.38^{b}	4.67 ± 0.13^{a}	1.37 ± 0.10^{a}	3.58 ± 0.17^{a}
Eroomo	3.67 ± 0.11^{b}	1.17 ± 0.13^{f}	3.50 ± 0.25^{bc}	4.42 ± 0.18^{b}	4.33 ± 0.12^{b}	3.58±0.10b	2.68 ± 0.14^{a}	3.58 ± 0.12^{bc}	0.67 ± 0.13^{d}	2.67 ± 0.10^{b}
Okeodo	0.83 ± 0.12^{h}	$1. 54\pm0.11^{e}$	0.67 ± 0.13^{h}	1.17 ± 0.23^{j}	1.33 ± 0.12^{i}	1.17±0.15h	0.58 ± 0.14^{e}	2.17 ± 0.13^{f}	0.23 ± 0.04^{f}	1.42 ± 0.18^{e}
Cocacola	1.83 ± 0.14^{e}	0.92 ± 0.18^{g}	0.25 ± 0.00^{j}	1.33 ± 0.17^{i}	1.08 ± 0.12^{j}	1.67±0.13f	0.58 ± 0.11^{e}	3.69 ± 0.10^{b}	0.42 ± 0.13^{e}	2.83 ± 0.17^{ab}
Isale Aluko	1.75 ± 0.00^{f}	2.41 ± 0.14^{b}	1.67 ± 0.13^{e}	2.41±0.14e	2.33 ± 0.07^{f}	1.92±0.11d	1.08 ± 0.14^{d}	2.42 ± 0.12^{e}	0.83 ± 0.29^{c}	1.58 ± 0.13^{d}
Odoore	2.33 ± 0.12^{cd}	1.18 ± 0.10^{f}	2.17 ± 0.11^{c}	2.08±0.11g	2.67 ± 0.13^{d}e	2.42±0.18c	1.33 ± 0.12^{c}	2.92 ± 0.08^{c}	0.67 ± 0.13^{d}	2.25 ± 0.00^{c}
Botanical garden(Control site)	2.58 ± 0.14^{c}	1.58 ± 0.12^{e}	3.67 ± 0.13^{b}	2.33±0.12f	2.75 ± 0.00^{d}	1.52 ± 0.10^{f}	1.33 ± 0.10^{c}	1.88 ± 0.18^{g}	1.04 ± 0.03^{b}	1.33 ± 0.17^{f}

Values with the same superscript along the column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO Recommended Safe limit of Cu = 40.00mgkg^{-1}. Cu=copper

The copper concentration in the shoot of the accession of the Control site was higher than the shoots of the accession in the other sites excep sites Otte, Ojagboro, Okeodo and Coca cola (Table 49). The same statistical mean copper concentration were recorded in the shoots in the Control site, Mubo, Olaolu, Eroomo and Isale Aluko (0.27±0.23 mg/kg), so also were the shoots in Budo Egba, Budo Abio and Oyun (0.13±0.23 mg/kg) and the shoots of the accession in Otte, Ojagboro , Okeodo and Coca cola (Table 49). Copper content in the root of the accession was ranged between 1.07±0.46 mg/kg and 4.67±0.61 mg/kg with the lowest concentration recorded in the root of the accession of the Control site and the highest in the root of the accession of Coca cola area (Table 49). Copper content in the root of the accession in the Control site was lower than the other sites (Table 49). There were no significant differences in copper content in the roots of the accession in Otte, Budo Egba , Cocacola and Olaolu, so also were the roots of the accession of Mubo and Eroomo and also in the roots of Oyun and Ojagboro (Table 49).

Copper concentration ranged between 0.27±0.23 mg/kg and 1.20±0.80 mg/kg in the shoots of accession NG/OA/04/010 of *Corchorus olitorius* in the second rainy season. The lowest copper concentration were recorded in the shoots of the accession in Otte, Mubo and Isale Aluko while the highest was recorded in the shoot of the accession of Olaolu (Table 49). Copper concentration in the shoot of the accession in the Control site was higher than the other sites except for Olaolu (Table 49). There were no significant differences in the copper concentration in the shoots of the accession in Otte and Mubo (0.27±0.23 mg/kg), accession in Budo Egba and Budo Abio (0.67±0.23 mg/kg), accession of Ojagboro and Eroomo (0.53±0.23 mg/kg).

Copper concentration in the roots of the accession in the second rainy season ranged between 1.47±1.01 mg/kg and 6.40±0.69 mg/kg with the lowest recorded in the accession in the Control site and the highest in the accession in Coca cola (Table 49). The root of the Control site had the lowest copper concentration than the roots in the other sites. No significant differences in the copper concentration in the roots of the accession in Otte, Oyun and Eroomo (Table 49). Copper concentration in the roots of the accession in Mubo and Olaolu were statistically the same. Significant differences were also recorded in the copper concentration between the

Corchorus olitorius accessions (Table 49). The shoots of *Corchorus olitorius* NG/OA/04/010 recorded higher copper concentration than the shoots of *Corchorus olitorius* NG/OA/Jun/09/002 so also were the roots (Table 49).

Table 50 shows the lead concentration in the shoots and roots of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius*) in the first dry season season (2015). Lead in the shoot of accession NG/AA/03/11/010 of *Amaranthus hybridus* ranged between 0.00±0.00 mg/kg and 0.40±0.40 mg/kg with the lowest Pb concentration in the shoot of the accession in the Control site and the highest in Coca-cola area (Table 50). The concentration of Pb in the shoot of the accession in Control site (0.00±0.00 mg/kg) (not detectable) was lower than the other sites (Table 50). Table 50 shows the lead concentration in the shoots and roots of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius*) in the first dry season season (2015). Lead in he shoot of accession NG/AA/03/11/010 of *Amaranthus hybridus* ranged between 0.00±0.00 mg/kg and 0.40±0.40 mg/kg with the lowest Pb concentration in the shoot of the accession in the Control site and the highest in Coca-cola area (Table 50).

The concentration of Pb in the shoot of the accession in Control site (0.00±0.00 mg/kg) (not detectable) was lower than the other sites (Table 50). No significant differences were recorded in the Pb content in the shoots of the accession of Otte (0.13±0.23 mg/kg), Budo-Egba (0.13±0.23 mg/kg), Budo Abio (0.13±0.23 mg/kg), Mubo (0.13±0.23 mg/kg), Oyun (0.13±0.23 mg/kg), Olaolu (0.13±0.23 mg/kg), Eroomo (0.13±0.23 mg/kg) and Okeodo (0.13±0.23 mg/kg), so also were Ojagboro (0.40±0.40 mg/kg), Coca cola (0.40±0.40 mg/kg) and Isale Aluko (0.40±0.40 mg/kg) (Table 50). Pb in the roots of the accession in the first dry season season (2015). between sites ranged between 0.00±0.00 mg/kg and 3.20±1.29 mg/kg with the Control site having the lowest concentratiom and the highest obtained from the accession of Olaolu (Table 50). Pb in the roots of the accession of the Control site was lower than the other sites. Pb in the roots of the accession of Budo Egba, Budo Abio, Mubo, Olaolu, Eroomo and Okeodo, Odoore and the Control site ((1.07±0.23 mg/kg) were statistically the same, so also were Coca cola (3.07±0.83 mg/kg) and Isale Aluko (3.20±1.39 mg/kg) (Table 50).

Pb in the shoots of accession NG/AO/11/08/039 of *Amaranthus hybridus* in the first dry season season (2015) was ranged between 0.27±0.23 mg/kg and 0.53±0.23 mg/kg with the lowest recorded in the Control site and the highest in Coca-cola accession (Table 50). The Pb in the shoot of the Control site was lower than the other sites (Table 50). Accession of Otte, Coca cola and Isale Aluko had the same concentration of Pb concentration the shoots (0.53±0.23 mg/kg), so also were Olaolu (0.40±0.00 mg/kg) and Okeodo (0.40±0.00 mg/kg) and the accession of Eroomo (0.27±0.23 mg/kg), Odoore (0.27±0.23 mg/kg) and Isale Aluko (0.27±0.23 mg/kg) (Table 50). The range of Pb in the roots of the accession was between 2.20 ±1.70 mg/kg and 4.13 ±2.72 mg/kg with the lowest recorded in the Control site and the highest in the accession of Mubo (Table 50). The Pb concentration of the accession in root of the Control site was lower than the other sites (Table 50).

The range of the Pb in the roots of the accession was between 2.27±1.01 mg/kg and 6.13±0.01 mg/kg with the lowest in the accession of the Control site and the highest in Coca cola (Table 50). The Control site had the lowest concentration of Pb in the root than the other sites. No significant differences in the mean concentration of Pb in the roots in the accession of Mubo (3.07±0.23 mg/kg) and Odoore (3.07±0.23 mg/kg) were recorded. Accession NG/AA/03/11/010 of the three *Amaranthus hybridus* accessions had the highest Pb concentration in the shoots followed by NG/AO/11/08/039 and lowest in accession NGBO125. The range of the Pb in the roots of the accession was between 2.27±1.01 mg/kg and 6.13±0.01 mg/kg with the lowest in the accession of the Control site and the highest in Coca cola (Table 50). The Control site had the lowest concentration of Pb in the root than the other sites. No significant differences in the mean concentration of Pb in the roots in the accession of Mubo (3.07±0.23 mg/kg) and Odoore (3.07±0.23 mg/kg) were recorded.

Table 49: Copper concentration (mg/kg) partitioning in the vegetable accessions second rainy season (2017).

	Amarathus hybrid dus						*Corchorus olitorius*			
Site	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.13±0.23^{d}	4.13±1.22^{bc}	0.40±0.40^{b}	7.07±0.23^{a}	0.53±0.23^{c}	4.27±1.15^{ab}	0.40±0.00^{a}	4.13±1.15^{b}	0.31±0.11^{h}	5.33±1.26^{b}
Budo Egba	0.13±0.17^{d}	4.00±1.83^{bc}	0.40±0.00^{b}	4.53±0.83^{c}	0.27±0.23^{e}	3.47±0.46^{bcd}	0.13±0.23^{c}	4.07±0.31^{b}	0.67±0.23^{e}	4.00±1.06^{cd}
Budo Abio	0.27±0.23^{c}	2.27±0.46^{de}	0.40±0.40^{b}	3.33±0.23^{d}	0.53±0.23^{c}	1.87±0.23^{de}	0.13±0.23^{c}	2.00±0.00^{de}	0.67±0.23^{e}	3.00±0.72^{e}
Mubo	0.27±0.23^{c}	4.53±1.15^{b}	0.27±0.23^{c}	6.00±1.83^{b}	0.27±0.23^{e}	3.47±1.97^{bc}	0.27±0.23^{b}	4.27±1.29^{ab}	0.29±0.20^{h}	6.00±1.06^{ab}
Oyun	0.40±0.00^{b}	2.93±0.46^{de}	0.27±0.23^{c}	2.60±0.53^{de}	0.67±0.23^{b}	1.73±0.92^{def}	0.13±0.23^{c}	3.73±1.40^{bc}	0.40±0.40^{g}	4.07±0.42^{cd}
Ojagbooro	0.50±0.26^{ab}	3.27±1.47^{cd}	0.27±0.46^{c}	2.93±2.66^{de}	0.40±0.00^{d}	3.47±1.51^{bc}	0.40±0.40^{a}	3.20±1.74^{bc}	0.53±0.23^{f}	3.73±2.20^{cde}
Olaolu	0.40±0.00^{b}	5.33±0.61^{a}	0.40±0.00^{b}	6.73±0.76^{ab}	0.80±0.00^{a}	4.40±1.06^{abc}	0.27±0.23^{b}	4.13±0.46^{b}	1.20±0.80^{a}	6.27±0.61^{ab}
Eroomo	0.25±0.00^{d}	4.33±0.81^{bc}	0.13±0.23^{d}	6.00±1.60^{b}	0.53±0.23^{c}	4.53±0.83^{a}	0.27±0.46^{b}	4.37±1.62^{ab}	0.53±0.46^{f}	5.33±1.01^{b}
Okeodo	0.40±0.00^{b}	4.27±0.83^{bc}	0.13±0.23	3.20±2.80^{d}	0.80±0.00^{a}	3.20±1.06^{bcd}	0.40±0.40^{a}	4.67±0.61^{a}	0.68±0.26^{e}	4.67±1.85^{bc}
Cocacola	0.27±0.23^{c}	3.73±1.22^{c}	0.53±0.23^{a}	5.60±1.74^{b}	0.27±0.23^{e}	2.40±1.20^{cd}	0.40±0.40^{a}	4.27±0.83^{b}	0.72±0.18^{d}	6.40±0.69^{a}
Isale Aluko	0.40±0.40^{b}	3.20±2.88^{cd}	0.13±0.23^{d}	5.73±1.62^{b}	0.40±0.00^{d}	4.13±1.85^{ab}	0.27±0.23^{b}	1.87±1.15^{de} f	0.27±0.23^{h}	1.87±1.1^{5e}
Odoore	0.53±0.23^{a}	3.20±0.69^{d}	0.40±0.00^{b}	4.53±0.83^{c}	0.67±0.23^{b}	2.20±0.80^{def}	0.12±0.00^{c}	2.67±0.83^{cd}	0.80±0.69^{c}	3.47±1.29^{de}
Botanical garden(control site)	0.40±0.40^{b}	1.07±0.23^{e}	0.13±0.23	1.87±0.23^{e}	0.40±0.40^{d}	1.20±0.69^{ef}	0.27±0.23^{b}	1.07±0.46^{f}	0.93±1.01^{b}	1.47±1.01^{f}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO (2011). Recommended Safe limit of Cu = 40.00mgkg^{-1}. Cu=copper

Accession NG/AA/03/11/010 of the three *Amaranthus hybridus* accessions had the highest Pb concentration in the shoots followed by NG/AO/11/08/039 and lowest in accession NGBO125 (Table 50). Lead concentration in the shoots of the three *Amaranthus hybridus* accessions recorded the lowest concentration in the Control site (Table 50). Pb content in shoots of the accessions were relatively high in Mubo, Oyun, Ojagboro, Okeodo,Coca cola and Isale Aluko which could be due to the proximity of the sites to the road, mechanic workshops, dumpsites, the use of fertilizer, agro chemical products, herbicides and industrial activities (Table 50). Pb concentration in the shoots of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season season (2015) ranged between 0.10±0.00 mg/kg and 0.93 ± 0.61 mg/kg with the lowest recorded in Control site and the highest in Ojagboro (Table 50).

The Pb content in the shoot of the Control site was lower than the other sites (Table 50). *Corchorus olitorius* accession NG/OA/Jun/09/002 had the same statistical concentrations of Pb as accession of Budo Egba (0.13±0.23 mg/kg), Budo Abio, Mubo, Oyun, Olaolu Eroomo and Okeodo (0.40±0.00 mg/kg). Pb in the roots of the accession ranged between 0.93±0.23 mg/kg and 4.00 ±0.40 mg/kg with the lowest obtained in the Control site and the highest in Coca cola (Table 50). The Pb concentration in the root of the accession of the Control site was lower than the other sites. No significant difference in the Pb concentration in the roots of the accession of the Control site and Odoore (Table 50). The same statistical concentration of Pb in the roots of the accession in Mubo and Olaolu (2.00±0.80 mg/kg), so also were Ojagboro (3.20±1.60 mg/kg), and Isale Aluko (3.20±0.69 mg/kg). Accession NG/OA/04/010 of *Corchorus olitorius* recorded a range of Pb in the shoots between 0.40±0.00mg/kg and 0.93±0.23 mg/kg in the first dry season season (2015) with the lowest obtained in the accession of the Control site and the highest in Ojagboro site (Table 50). Pb content in the shoots were statistically the same in accession in Otte, Budo Egba, Budo Abio, Mubo, Oyun, Olaolu, Okeodo and Odoore (0.53±0.23 mg/kg), so also were Ojagboro Eroomo (0.40±0.40 mg/kg), and Isale Aluko (0.43±0.23 mg/kg) (Table 50).

The range of Pb concentration in the roots of *Corchorus olitorius* accession NG/OA/04/010 was between 0.80±0.40 mg/kg and 3.60±1.74 mg/kg with the lowest obtained from the accession of the Control site and the highest in Coca cola (Table 50). The root of the accession of the Control site had lower Pb concentration in the shoot than the other sites (Table 50). Same statistical values of Pb content were recorded in the roots of the accession in Olaolu (2.53±1.06 mg/kg) and Okeodo (2.53±1.29 mg/kg), so also were the accession of Ojagboro (2.93±0.92 mg/kg) and Isale Aluko (2.93±1.51 mg/kg). Pb content was higher in the shoots of *Corchorus olitorious than Amaranthus hybridus* (Table 50). The result showed that all the shoots of *Amaranthus hybridus* accession NG/AA/03/11/010 were Pb free because their values were lower than the WHO/FAO (2011) recommended safe limit for Pb in vegetables (0.30 mg/kg) except for the shoots of Ojagboro (0.40±0.00 mg/kg), Coca cola (0.40±0.40 mg/kg) and Odoore (0.27±0.23 mg/kg) that were polluted with Pb since their valus were above the WHO/FAO (2011) recommended safe limit for Pb in vegetables (0.30 mg/kg), therefore, not fit for consumption.

However, though the roots not consumed all the roots were all polluted with Pb because their values were all very high and above the recommended safe limit (Table 50). It was also found that the shoots and roots of *Amaranthus hybridus* accession NG/AO//11/08/039 were all polluted with Pb because they contain very high Pb content above the recommended safe limit and therefore, not fit for consumption. The result result further suggested that all the shoots of *Amaranthus hybridus* accession NGBO 125 were all fit for consumption except for the shoots of Ojagboro (0.67±0.23 mg/kg), Coca cola (0.56±0.06 mg/kg) and Isale Aluko (0.40±0.40 mg/kg) that were Pb polluted since their values were higher than the safe limit, therefore, suggested not fit for consumption while all the roots of the accession were all highly polluted with Pb (Table 50). All the shoots and roots of the two accessions of *Corchorous olitorius* in all the sites were except for the shoot of *Corchorous olitorius* accession NG/OA/jun/09/002 in the Control site that was free of Pb pollution (0.13±0.23 mg/kg) because the value was below the safe limit (Table 50). Generally, the Pb content in the roots were greater than the shoots suggesting the vegetables accumulate Pb in their roots but exclude some from the shoots (Table 50).

Table 51 shows the Lead concentration in shoots and roots of the vegetable accessions in the second dry season (2016). The range of Lead in the shoots of *Amaranthus hybridus* NG/AA/03/11/010 in the second dry season (2016) was between 0.50±0.25 mg/kg and

3.72±2.73 mg/kg with the lowest content obtained from the shoot of the accession of the Control site and the highest in the accession of Mubo. Pb content in the shoot of the accession of the Control site (0.50±0.25 mg/kg) was lower than the other sites (Table 51). Lead content in the shoots of the accession of the Control site (0.50±0.25 mg/kg) and Odoore (0.50±0.43 mg/kg) were statistically the same. No significant difference was recorded in the Pb content in the shoots of the accession of Budo Egba (2.55±1.80 mg/kg) and Ojagboro (2.56±1.15 mg/kg). Budo Abio (1.45±0.75 mg/kg) and Olaolu(1.43±0.05 mg/kg) had the same Pb content in their shoots. Pb content in the shoots of the accession of Oyun (1.50±1.95 mg/kg) and Isale Aluko (1.58±1.89 mg/kg) were statistically the same (Table 50).

Pb content in the roots of the accession (*Amaranthus hybridus* NG/AA/03/11/010) in the second dry season (2016) ranged between 0.60±0.14 mg/ kg and 3.48±3.26 mg/ kg with the lowest content recorded in the root of the accession in the Odoore while the highest was obtained in the root of the accession in Mubo (Table 51). The root of the accession of the Control site (0.67±0.14 mg/kg) had lower Pb content than the other sites except for Odoore (0.60±0.14 mg/kg). Pb content in the roots of the accession in the Control site (0.67±0.14 mg/kg) and Odoore (0.60±0.14 mg/kg), so also were Otte (2.87±1.88 mg/kg) and Budo Egba (2.83±2.27 mg/kg). The shoots of the accession in Coca cola (1.58±1.13 mg/kg) and Isale Aluko (1.57±1.26 mg/kg) were statistically the same, so also were Olaolu (1.84±1.30 mg/kg) and Okeodo (1.80±1. 72 mg/kg) were statistically the same (Table 51). Pb content in the shoots of the accession of *Amaranthus hybridus* NG/AO/11/08/039 range between 0.42±0.14 mg//mg and 3.67±2.74 mg/kg with the lowest Pb content obtained in the shoot of the accession of the Control site and the highest from the accession of Mubo (Table 51). Pb content in the shoot of the accession of the Control site was lower than the other sites (Table 51). No significant difference in the Pb content in the shoots of the accession in Otte (2.42±1.66 mg/kg) and Budo Egba (2.48±1.07 mg/kg), so also were Budo Abio (1.00±0.38 mg/kg) and Eroomo (1.00±0.66 mg/kg), so also were Oyun (1.56±2.31 mg/kg) and Isale Aluko (1.50±2.10 mg/kg), so also were Olaolu (1.38±1.04 mg/kg) and Okeodo (1.33±1.28 mg/kg) were recorded (Table 51).

The concentration of Pb content in the roots of the accession ranged between 0.67±0.52 mg/kg and 4.00±3.73 mg/kg with the highest content obtained in the accession of Mubo and the lowest in the accession of Odoore (Table 51). The root of the accession of the Control site

(0.92±0.29 mg/kg) had lower Pb content than the other roots of the accession except the root of the accession of Odoore (0.67±0.52 mg/kg). Pb content in the roots of Otte (2.92±2.13 mg/kg) and Budo Abio (2.92 ±1.98 mg/kg) were statistically the same, so also were the roots of accession of Olaolu(1.67±1.26 mg/kg) and Isale Aluko (1.67±1.83 mg/kg), so also were Okeodo (1.75±1.50 mg/kg) and Coca cola (1.75±1.75 mg/kg) accession (Table 51). The range of the Pb content in the shoots of *Amaranthus hybridus* accession NGBO125 was between 0.30±0.18 mg/kg and 2.32±1.84 mg/ kg(Table 51). The highest Pb content was recorded in the shoot of the accession of Budo Egba while the lowest was obtained from the shoot of the accession of Control site. Pb content in the shoots of the Control site was lower than the other sites (Table 51).

Table 50: Lead concentration (mg/kg) in the vegetable Accessions *(Amaranthus hybridus* and *Corchorus olitorius)* first dry season (2015).

	Amarathus hybrid dus						*Corchorus olitorius*			
Site	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.13±0.23^{c}	1.67±1.50^{b}	0.53±0.23^{a}	2.53±0.92^{cd}	0.00±0.00^{e}	2.67±0.46^{ef}	0.33±0.17^{c}	2.67±0.83^{bc}	0.53±0.23^{b}	2.67±0.61^{bcde}
Budo Egba	0.13±0.23^{c}	1.07±0.23^{c}	0.40±0.00^{b}	2.40±0.80^{cde}	0.13±0.23^{d}e	3.73±0.61^{d}	0.40±0.00^{c}	1.87±0.83^{d}	0.53±0.23^{b}	2.13±0.23^{cde}
Budo Abio	0.13±0.23^{c}	1.07±0.23^{c}	0.40±0.00^{b}	2.27±0.23^{de}	0.00±0.00^{e}	2.80±0.40^{ef}	0.40±0.00^{c}	1.60±0.69^{e}	0.53±0.23^{b}	1.60±0.40^{ef}
Mubo	0.13±0.23^{c}	1.07±0.23^{c}	0.40±0.00	4.13±2.72^{a}	0.00±0.00^{e}	2.93±1.15^{e}	0.40±0.00	2.00±0.80^{c}	0.53±0.23^{b}	2.80±0.69^{bc}
Oyun	0.13±0.23^{c}	0.67±0.61^{d}	0.40±0.00^{b}	2.67±1.51^{c}	0.00±0.00^{e}	3.07±0.23^{de}	0.40±0.00^{c}	1.73±0.83^{d}	0.53±0.23^{b}	3.20±0.69^{ab}
Ojagbooro	0.40±0.00^{a}	1.33±0.23^{bc}	0.40±0.00^{n}	3.07±1.22^{bc}	0.67±0.23^{a}	5.73±0.61^{ab}	0.93±0.61^{a}	3.20±1.60^{b}	0.93±0.23^{a}	2.93±0.92^{abc}
Olaolu	0.13±0.23^{c}	1.07±0.23^{c}	0.40±0.00^{b}	3.60±1.60^{b}	0.00±0.00^{e}	3.30±0.31^{ef}	0.40±0.00^{c}	2.00±0.80^{c}	0.53±0.23^{b}	2.53±1.29^{bcd}
Eroomo	0.13±0.23^{c}	1.07±0.23^{c}	0.27±0.23^{a}	2.53±0.92^{cd}	0.00±0.00^{e}	4.13±1.01^{c}	0.40±0.00^{c}	1.47±0.61^{de}	0.40±0.40^{c}	2.40±1.44^{bcd}
Okeodo	0.13±0.23^{c}	1.07±0.23^{c}	0.40±0.00^{b}	2.40±1.06^{cde}	0.00±0.00^{e}	3.60±0.40^{d}	0.40±0.00^{c}	2.13±0.83^{c}	0.53±0.23^{b}	2.53±0.60^{1bcd}
Cocacola	0.40±0.40^{a}	3.57±0.83^{ab}	0.53±0.23^{a}	2.67±0.83^{c}	0.53±0.06^{b}	6.13±0.61^{a}	0.67±0.46^{b}	4.00±0.40^{a}	0.80±0.00^{ab}	3.60±1.74^{a}
Isale Aluko	0.40±0.00^{a}	3.20±1.39^{a}	0.53±0.23^{a}	2.80±0.80^{c}	0.40±0.40^{c}	5.33±1.89^{b}	0.53±0.23^{bc}	3.20±0.69^{b}	0.43±0.23^{c}	2.93±1.51^{abc}
Odoore	0.27±0.23^{b}	1.07±0.23^{c}	0.27±0.23^{c}	2.27±1.22^{de}	0.00±0.00^{e}	3.07±0.23^{de}	0.27±0.23^{de}	1.33±0.61^{def}	0.53±0.23^{b}	1.20±1.39^{ef}
Botanical garden(control site)	0.00±0.00^{d}	1.07±0.23^{c}	0.27±0.23^{c}	2.20±1.70^{e}	0.00±0.00^{e}	2.27±1.01^{g}	0.13±0.23^{e}	0.93±0.23^{f}	0.40±0.00^{c}	0.80±0.40^{f}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO(2011). Recommended Safe limit of of Pb = 0.30 mgkg-$^{-1}$

No significant differences in the Pb content in the shoots of the accession of Budo Abio (0.75±0.90 mg/kg) and Ojagboro (0.75±0.50 mg/kg), so also were Otte (1.95±1.60 mg/kg) and Okeodo (1.93±0.87 mg/kg) (Table 51). Content of Pb in the roots of the accession (NGBO125*)* was in the range of 0.63±0.57 mg/kg with the lowest Pb content from the root of the accession of Odoore and the highest in the root of the accession of Budo Abio (Table 51). Pb content in the roots of the accession of the Control site (0.67±0.63 mg/kg) was lowber than the other roots except for the root of the accession of Odoore (0.63±0.57 mg/kg), so also were the accession of Olaolu (1.40±1.21 mg/kg), Eroomo (1.49±1.16 mg/kg) and Isale Aluko (1.42±1.59 mg/kg). The range of Lead in the shoots of *Corchorous olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016) was between 0.33±0.14 mg/kg and 2.50±2.84 mg/kg with the lowest content obtained in the shoot of the accession in the Control site and the highest in the shoot of the accession in Mubo (Table 51). Pb content in the shoot of the accession of the Control site was lower than the shoots of the accession of the other sites (Table 51). There were no significant differences in the Pb content of the shoots of the accession of the Control site (0.33±0.14 mg/kg) and Odoore(0.39±0.25 mg/kg), so also were Budo Abio (0.75±0.50 mg/kg) and Olaolu (0.75±0.66 mg/kg), so also were Oyun (1.00±1.30 mg/kg), Okeodo (1.00±1.52 mg/kg), Coca cola (1.08±1.23 mg/kg) and Isale Aluko(1.08±1.23 mg/kg) (Table 51).

Pb content in the roots of the accession (*Corchorous olitorius* accession NG/OA/Jun/09/002*)* in the second dry season (2016) ranged beween 0.75±0.50 mg/kg and 2.33±1.81 mg/kg with the lowest Pb content in the root of the accession in the Control site and the highest content in the accession in Coca cola (Table 51). Pb content in the root of the accession of the Control site was lower than the Pb content in the roots of the accession of other sites (Table 51). The root of the accession of the Control site (0.75±0.66 mg/kg) and the accession of Odoore (0.75±0.50 mg/kg) had the same Pb content. There were no significant differences in the Pb content of the roots of the accession of Otte (2.05±1.21 mg/kg), Budo Abio (2.08±1.53 mg/kg), Mubo (2.00±2.05 mg/kg) and Ojagboro (2.08±1.76 mg/kg) (Table 51). Accession of Olaolu (1.42±1.01 mg/kg) and Isale Aluko (1.46±1.56 mg/kg) had the same statisitical Pb content.

Pb content in the shoots of *Corchorous olitorius* accession NG/OA/04/010 in the second dry season (2016) ranged between 0.29±0.05 mg/kg and 2.33±1.66 mg/kg (Table 51). The lowest Pb content was obtained in the shoots of the accession of the Control site while the highest was recorded in the shoot of the accession of Mubo (Table 51). Pb content in the shoot of the accession of the Control site was lower than the other sites (Table 51).There were no statistical differences between the Pb content in the shoots of Budo Abio (0.92±0.27 mg/kg) and Okeodo (0.92±0.58 mg/kg), so also were Budo Egba (1.83±1.38 mg/kg) and Ojagboro (2.00±0.90 mg/kg) (Table 51).

The range of Pb in the roots of the accession in the second dry season (2016) was between 0.52±0.03 mg/kg and 2.58±1.89 mg/kg with the lowest content in the accession in the Control site and the highest in the root of the accession of Mubo (Table 51). Pb content in the root of the accession of the Control site was lower than the other sites (Table 51). Pb content of the root of the accession in the Control site was the same as the accession of Odoore. There were no significant differences in the Pb content of the roots of the accession of Budo Abio, Oyun, Ojagboro and Okeodo (Table 51). Accession with the lowest Pb content in the shoots was NG/AO/11/08/039 while the roots of the accession NG/AA/03/11/010 had the highest Pb content followed by NGBO125 and lastly NG/AO/11/08/039 (Table 51).

Furthermore, Pb content in the shoots were higher in *Corchorous olitorius* accession NG/OA/04/010 than in the accession *Corchorous olitorius* NG/OA/Jun/09/002 while higher Pb content were recorded in the roots of *Corchorous olitorius* accession NG/OA/Jun/09/002 than *Corchorous olitorius* accession NG/OA/04/010. The result indicated that both the shoots and the roots all had Pb concontration beyond the safe limit (0.30 mg/kg), therefore were all polluted with Pb and suggested unsuitable for consumption (Table 51). Table 52 shows the Lead concentration (mg/kg) in the shoots and roots of the vegetable accessions in the first rainy season (2016). The Lead content in the shoots of *Amaranthus hybridus* accession NG/AA/03/11/010 was ranged between 0.33±0.14 mg/kg and 5.92±0.28 mg/kg with the lowest recorded in the accession of the Control site and the highest in the accession in Coca cola (Table 52). Lead content in the shoot of the accession in the Control site was lower than the other sites (Table 52).

Pb content in the shoots of accession in Mubo and Ojagboro were statistically the same. Pb content in the roots of *Amaranthus hybridus* accession NG/AA/03/11/010 in the first rainy season (2016) was in the range of 0.42±0.13 mg/kg and 5.33±0.14 mg/kg with the lowest obtained in the accession in Budo Abio and the highest in the accession of Ojagboro (Table 52). Pb content in the root in the Control site 2.08±0.12 mg/kg was lower than the other sites except Budo Abio 0.42±0.13 mg/kg. Pb content in the roots of the accession of Eroomo and Odoore were statistically the same (Table 52). Pb content in the shoots of *Amaranthus hybridus* accession NG/AO/11/08/039 was ranged between 0.42±0.28 mg/kg and 5.58±0.12 mg/kg with the lowest obtained in the accession of Budo Abio and the highest in the accession of Coca cola (Table 52). Pb content in the shoots of the accession in Otte, Okeodo and Isale Aluko were statistically the same (Table 53), so also were the shoots in Budo Egba, Mubo and Oyun (Table 52).

Pb content in the roots of *Amaranthus hybridus* accession NG/AO/11/08/039 in the first rainy season (2016) ranged between 0.50±0.00 mg/kg and 3.67±0.14mg/kg with the lowest in the accession in Budo Abio and the highest in the accession in Ojagboro (Table 50). Pb content in the root of accession NG/AO/11/08/039 of the Control site was lower (0.67±0.13 mg/kg) than the other sites except for Budo Abio (0.50±0.00 mg/kg) (Table 52). Pb content in the shoot of *Amaranthus hybridus* accession NGBO125 was in the range of 0.58±0.14 mg/kg and 5.67±0.22 mg/kg with the lowest obtained in the accession in Control site and the highest in the accession in Coca cola (Table 52).

Pb content in the shoot of the accession in the Control site was lower than the other sites (Table 52). The shoot of the accession (NGBO125) in Otte and Oyun had the same Pb concentration. Pb content in the roots of the accession *Amaranthus hybridus* NGBO125 ranged between 0.92±0.29 mg/kg and 4.67±0.11 mg/ kg with the lowest obtained in the root of accession in Control site and the highest in Okeodo (Table 52). Pb content in the root of the accession of the Control site was lower than the other sites. No significant differences in the Pb content in the roots of accession in Otte and Eroomo were recorded, so also were the roots of Budo Abio and Mubo (Table 52). Pb content in the shoots of the three *Amaranthus hybridus* accessions was highest in *Amaranthus hybridus* NGBO125, followed by *Amaranthus hybridus*

NG/AA/03/010. Pb content in the shoots of *Corchorus olitorius* NG/OA/Jun/09/002 in the first rainy season was in the range of 0.50±0.00 mg/kg and 3.83±0.17 mg/kg with the lowest obtained in the shoot of the accession of Budo Abio and the highest in the shoot of the accession of Coca cola (Table 52). Pb content in the shoot of the accession in the Control site was lower than Pb content in the shoots in the other accession except Budo Abio (Table 52). Pb content in the roots of the accession(*Corchorus olitorius* NG/OA/Jun/09/002) was in the range of 0.33±0.17 mg/kg and 4.17±0.10 mg/kg with the lowest in the root of the accession of Control site and the highest in the root of the accession of Budo Egba (Table 52). Pb content in the root of of the accession of the Control site was lower than the other sites (Table 52).

Pb content in the shoots of *Corchorus olitorius* NG/OA/04/010 in the first rainy season (2016) was in the range of 0.33±0.14 mg/kg and 2.58±0.12 mg/kg with the lowest obtained in the Control site and the highest in the shoot of the accession of Olaolu (Table 52). Pb content in the Control site was lower than all the other sites (Table 52). Pb content in the roots of *Corchorus olitorius* NG/OA/Jun/09/002 in the first rainy season ranged between 0.58±0.22 mg/kg and 4.83±0.17 mg/kg with the lowest obtained in the shoot of the accession in the Control site and the highest in the Control site (Table 52). Pb content in the roots of the accession in Budo Egba and Okeodo were the same, so also were Oyun and Ojagboro, likewise, Olaolu and Isale Aluko (Table 52). The result showed very strong Pb pollution in both the shoots and the roots of all the accessions and sites with all the vegetable accessions having Pb values beyond the safe limit (0.30 mg/kg) (Table 52).

Table 53 presents the lead concentration (mg/kg) in the vegetable Accessions planted the second rainy season (2017). The range of lead concentration in the shoots of *Amarathus hybridus* NG/AA/03/11/010 was between 0.11 ±0.20 mgkg and 0.40±0.40 mg/kg (Table 53). The lead concentration in the shoot of the accession of the Control site was lower than the other sites (Table 53). Accession of Ojagboro, Cocacola and Isale Aluko were statistically the same in the respect of concentration in the shoots (Table 53). Pb concentration in the roots of the accession was in the range of 0.67±0.61 mg/kg and 3.20±1.39 mg/kg with the lowest recorded in the accession of the Control site while the highest was recorded in the accession of Isale Aluko (Table 50). Pb concentration in the shoots of *Amarathus hybridus* accession NG/AO/11/08/039 in the second rainy season (2017) ranged between 0.13 ±0.23 mg/kg and 0.53±0.23 mg/kg with the lowest recorded in the accessions of the Control site while the highest was recorded of Otte. No significant differences were recorded in the Pb concentration in the shoots of the accession of Otte, Coca cola and Isale Aluko, so also were shoots of the accession of sites Budo Egba, Budo Abio, Mubo, Oyun, Ojagboro, Olaolu and Okeodo (Table 53).

Pb concentration in the roots of the accession in the second rainy season (2017) was between 2.27±1.22 mg/kg and 4.13±2.72 mg/kg with the lowest recorded in the accession of the Control site while the highest recorded in the accession of Mubo (Table 53) Accession of the Control site had lower Pb concentration in the root than the other sites. Accession of Otte, Budo Abio and Odoore had the same Pb concentration in the roots (Table 53). There were no significant differences in the Pb concentration of the roots of the accession of Budo Egba and Okeodo. Pb concentration in the shoots of *Amarathus hybridus* accession NGBO125 in the second rainy season (2017) ranged between 0.00±0.00 mg/kg and 0.67±0.23 mg/kg with the (no detectable value) lowest recorded in the accession in the all the sites except Ojagboro, Coca cola and Isale Aluko and the highest in the accession of Ojagboro (Table 53). The Pb concentration in the roots of the acecession in the second rainy season (2017) was between 2.27 ±1.01 mg/kg and 6.13±0.61 mg/kg with the lowest recorded in the accession of the Control site and the highest in the accession of Cocacola (Table 53).

Pb concentration in the root of the accession in the Control site was lower than the accession of the other sites but higher than the recommended safe limit for Pb in vegetables (Table 53). The roots of the accession of Otte, Budo Abio and Olaolu had the same Pb content, so also were the roots of accession of Budo Egba and Okeodo, accession of Mubo and Odoore (Table 53).

The shoots of *Amarathus hybridus* NG/AO/11/08/039 recorded higher Pb concentration than NG/AA/03/11/010 than NGBO125 while the roots of the accession had highest Pb concentration in accession NGBO125 followed by NG/AO/11/08/039 and NG/AA/03/11/010. *Corchorus olitorius* accession NG/OA/Jun/09/002 recorded Pb concentration range in the shoots between 0.13±0.23 mg/kg and 0.93±0.61 mg/kg with the lowest recorded in the accession in the Control site and the highest in the accession in Ojagboro (Table 53). No significant differences were recorded in the Pb concentration in the shoots of the accession in all the sites except for Otte, Ojagboro, Cocacola, Isale Aluko, Odoore and the Control site (Table 53). Accession of Otte and Odoore had the same Pb concentration in the shoots. The concentration of Pb in the roots of the accession (*Corchorus olitorius* NG/OA/Jun/09/002) ranged between 0.93±0.23 mg/kg and 4.00±0.40 mg/kg with the lowest recorded in the root in the Control site and the highest in the accession of Cocacola (Table 53). The accession of the Control site had lower root Pb concentration than the accession of the other sites (Table 53). No significant differences were recorded in the Pb concentration of the roots of the accession of Budo Egba and Oyun. The Pb concentration in the roots of the accession of Mubo, Olaolu and Okeodo were statistically the same, so also were the accession of Ojagboro and Isale Aluko (Table 53). Accession NG/OA/04/010 of *Corchorus olitorius* had the range of Pb concentration in the shoots between 0.13±0.17 mg/kg and 0.93±0.23 mg/kg (Table 53). Pb concentration of the shoot of the Control site had Pb concentration of the shoot lower than the shoots of the accession of the other sites except for Ojagboro, Coca cola and Isale Aluko (Table 53).

The same concentration of Pb in the shoot of accession of Budo Egba, Mubo, Olaolu, Okeodo and Odoore were recorded. No significant differences were recorded in the Pb content of the shoots of accession in Otte and Eroomo. For the Pb concentration in the roots of the accession (*Corchorus olitorius* NG/OA/04/010) the range was recorded between 0.80±0.40 mg/kg and 3.60±1.74 mg/kg with the lowest content recorded in the Control accession and the highest of the Cocacola accession (Table 53). The accession of the Control site had lower content of Pb in the root than the roots of the accession of the other sites but higher than the safe limit. Accession of Budo Abio and Odoore had the same content of Pb in their roots, so also were the accession of Ojagboro and Isale Aluko. No significant differences were recorded in the Pb content of the accession in Olaolu, Eroomo and Okeodo (Table 53). Between the two *Corchorus olitorius* accessions, the shoots and roots of accession NG/OA/04/010 had the higher Pb concentrations than accession NG/OA/Jun/09/002 (Table 53).

It was found that all the shoots of *Amaranthus hybridus* accession NG/AA/03/11/010 were free of Pb pollution except for the accession in Ojagboro, Coca cola and Okeodo that were Pb polluted with their values beyond the safe limit (0.30), the shoots of *Amaranthus hybridus* accession NG/AO/11/08/039 were all polluted with Pb except for the accession in the Odoore (0.27±0.23 mg/kg) and the Control site (0.13±0.23 mg/kg) that had lower values than the safe limit (0.30 mg/kg), the shoots of *Amaranthus hybridus* accession NGBO 125 were all free of Pb pollution except for the accession in Ojagboro (0.67±0.23 mg/kg), Coca cola (0.53±0.06 mg/kg) and Isale Aluko that had Pb content higher than the safe limit, the shoots of *C. olitorious* NG/OA/Jun/09/002 were all polluted with Pb except for the accession in Otte (0.27±0.23 mg/kg), Odoore (0.13±0.23 mg/kg) and the Control site (0.13±0.17 mg/kg) whose values were lower than the safe limit and the shoots of *C olitorious* accession NG/OA/04/010 were all polluted with Pb except for the accession of the Control site(0.13±0.17 mg/kg)

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However, the roots of all the vegetable accessions in all the sites were highly polluted with Pb with their value beyond the WHO/FAO (2011) safe limit for Pb in vegetables (0.30 mg/kg) (Table 53). It was shown in the result that vegetables were most polluted with Pb in the first rainy season (2016). It was found that the vegetables excluded more of Cd and Cu than Pb and the selected heavy metal pollution were observed to exhibit seasonal variation.

Table 51. Lead concentrationin shoots and roots of the vegetable accessions second dry season (2016).

	Amaranthus hybridus						*Corchorous olitorius*			
	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
Site	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	2.17±1.63[c]	2..87±1.88[b]	2.42±1.66[b]	2.92±2.13[b]	1.95±1.60[bc]	2.20±1.66[cd]	1.70±0.96[b]	2.05±1.21[b]	1.83±1.38[bc]	1.92±1.04[bc]
Budo Egba	2.55±1.80[b]	2.83±2.27[b]	2.48±1.97[b]	2.75±1.98[bc]	2.32±1.84[a]	2.59±2.01[bc]	1.42±1.01[bc]	2.17±1.46[b]	2.00±1.39[b]	2.50±1.56[ab]
Budo Abio	1.45±0.75[f]	2.40±1.26c[de]	1.00±0.38[de]	2.92±1.98[b]	0.75±0.90[def]	3.08±0.29[a]	0.75±0.50[de]	2.08±1.53[bc]	0.92±0.29[ef]	1.42±0.29[cd]
Mubo	3.72±2.73[a]	3.48±3.26[a]	3.67±2.74[a]	4.00±3.73[a]	2.08±1.13[b]	2.94±2.13[ab]	2.50±2.84[a]	2.00±2.05[bc]	2.33±1.66[a]	2.58±1.89[a]
Oyun	1.50±1.95[ef]	1.79±2.13[de]	1.58±2.31[cd]	2.08±2.74[cd]	1.50±1.95[cd]	2.30±2.27[bcd]	1.00±1.30[cd]	1.50±1.52[cd]	1.33±1.66[d]	1.50±1.95[cd]
Ojagboro	2.56±1.15[b]	2.72±1.20[bc]	2.17±1.77[bc]	2.25±1.56[c]	1.89±1.54[bcd]	1.81±1.62[de]	1.33±0.95[bcd]	2.08±1.76[bc]	2.00±0.90[b]	1.42±0.29[cd]
Olaolu	1.43±0.55[f]	1.84±1.30[d]	1.38±1.04[d]	1.67±1.26[e]	1.93±0.87[bc]	1.25±1.00[efg]	0.75±0.66[de]	1.42±1.01[d]	0.58±0.38[fg]	1.08±0.29[d]
Eroomo	1.25±0.66[fg]	2.61±1.64[cd]	1.00±0.66[de]	1.83±1.18[d]	0.75±0.50[def]	1.40±1.21[ef]	0.88±0.55[d]	1.14±1.40[de]	0.92±0.58[ef]	2.00±1.30[bc]
Okeodo	1.65±1.67[e]	1.80±1.72[d]	1.33±1.28[d]	1.75±1.50[de]	1.31±0.83[d]	1.49±1.16[ef]	1.00±1.52[cd]	1.63±1.44[c]	1.67±1.42[c]	1.42±0.95[cd]
Cocacola	2.85±1.56[d]	6.77±1.13[e]	1.67±1.18[c]	1.75±1.75[de]	1.58±1.13[cd]	1.75±1.50[def]	1.08±1.04[cd]	2.33±1.81[a]	1.25±0.90[de]	0.75±0.50[ef]
Isale Aluko	1.58±1.89[ef]	1.57±1.26[e]	1.58±2.10[cd]	1.67±1.81[e]	1.00±1.30[de]	1.42±1.59[ef]	1.08±1.23[cd]	1.46±1.56[d]	1.08±1.23[e]	1.08±1.44[d]
Odoore	0.50±0.43[g]	0.60±0.83[f]	0.50±0.43[e]	0.67±0.52[f]	0.45±0.48[ef]	0.63±0.57[fg]	0.39±0.25[e]	0.75±0.66[e]	0.33±0.14[g]	0.67±0.38[f]
Botanical Garden (Control site).	0.50±0. 25 [g]	0.67±0.14[f]	0.42±0.14[e]	0.92±0,29[ef]	0.30±0.18[f]	0.67±0.63[fg]	0.33±0.14[e]	0.75±0.50[e]	0.29±0.05[g]	0.52±0.03[f]

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO (2011). Recommended Safe limit of Pb = 0.30 $mgkg^{-1}$

Table 52: Lead concentration (mg/kg) in the shoots and roots of the vegetable Accessions first rainy season (2016).

Site	*Amaranthus hybridus*						*Corchorus olitorius*			
	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	3.08±0.29^{de}	4.33±0.14^{b}	2.50±0.25^{c}	3.33±0.17^{b}	3.50±0.66^{d}	3.67±0.13^{c}	2.41±0.14^{cd}	2.67±0.23^{c}	1.50±0.25^{d}	4.83±0.12^{a}
Budo Egba	3.59±0.25^{cd}	3.58±0.29^{cd}	2.17±0.52^{d}	2.58±0.12^{e}	4.33±0.38^{c}	3.42±0.18^{d}	3.42±0.13^{bc}	4.17±0.10^{a}	1.58±0.14^{cd}	2.58±0.11^{cd}
Budo Abio	1 .33±0.12^{f}	0.42±0.13^{i}	0.42±0.28^{h}	0.50±0.00^{gh}	0.75±0.00^{g}	1.08±0.14^{h}	0.50±0.00^{g}	0.58±0 .12e^{f}	0.42±0.13^{fg}	2.08±0.14^{ef}
Mubo	2.67±0.14^{e}	2.27± 0.13^{g}	2.42±0.14^{c}	1.83±0.12^{f}	1.33±0.38^{f}	1.07±0.13^{h}	1.33±0.12^{e}	1.03±0.15^{e}	0.58±0.12^{ef}	2.33±0.14^{de}
Oyun	3.25±0.25^{d}	3.67±0.13^{c}	2.17±0.38^{d}	2.75±0.87^{de}	3.50±0.25^{d}	4.33±0.14^{b}	2.50±0.25^{c}	3.33±0.17^{bc}	2.33±0.17^{b}	2.67±0.13^{c}
Ojagboro	2.67±0.14^{e}	5.33±0.14^{a}	2.17±0.13^{d}	3.67±0.14^{a}	2.67±0.14^{ef}	3.17±0.10^{e}	1.50±0.25^{def}	2.42±0.18^{cd}	1.25±0.25^{df}	2.69±0.10^{c}
Olaolu	4.33±0.37^{b}	3.33±0.14^{de}	3.42±0.63^{b}	2.17±0.29^{ef}	4.82±0.29^{b}	2.67±0.13^{f}	3.58±0.38^{b}	1.33±0.14^{d}	2.58±0.12^{a}	2.46±0.11^{d}
Eroomo	2.33±0.12^{ef}	2.67±0.13^{f}	1.50±0.25^{e}	1.67±0.14^{fg}	2.83±0.38^{e}	3.67±0.14^{c}	2.50±0.25^{c}	2.67±0.13^{c}	1.33±0.17^{e}	2.37±0.22^{de}
Okeodo	3.67±0.13^{c}	4.42±0.29^{b}	2.50±0.25^{c}	3.08±0.12^{bc}	4.33±0.17^{c}	4.67±0.11^{a}	2.17±0.13^{d}	3.41±0.29^{b}	1.67±0.13^{c}	2.58±0.12^{cd}
Cocacola	5.92±0.28^{a}	3.42±0.28^{cde}	5.58±0.12^{a}	2.83±0.13^{d}	5.67±0.22^{a}	4.25±0.00^{bc}	3.83±0.38^{a}	3.33±0.14^{bc}	1.50±0.25^{d}	3.33±014^{b}
Isale Aluko	3.00±0.25^{de}	3.02±0.14^{ef}	2.50±0.00^{c}	3.03±0.12^{bc}	3.33±0.38^{de}	2.58±0.12^{g}	2.50±0.25^{c}	2.67±0.12^{c}	2.25±0.25^{bc}	2.42±0.18^{d}
Odoore	0.58±0.38^{g}	2.67±0.13^{f}	0.67±0.13^{g}	2.08±0.14^{ef}	1.33±0.14^{f}	3.25±0.00^{de}	1.17±0.14^{ef}	1.67±0.12^{d}	0.50±0.26^{efg}	1.83±0.21^{e}
Botanical garden(Control site)	0.33±0.14^{h}	2.08±0.12^{h}	1.08±0.12^{f}	0.67±0.13^{g}	0.58±0.14^{h}	0.92±0.29^{i}	0.67±0.14^{f}	0.33±0.17^{f}	0.33±0.14^{g}	0.58±0.22^{f}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO, 2011. Recommended Safe limit of Pb= 0.30mgkg^{-1} . Pb=Lead.

4.10: Metal dynamics (bioaccumulation coefficient and transfer factor of selected heavy metals in the vegetables accessions).

Table 54 shows the Bioaccumulation Coefficient of Cadmium in the vegetable accessions (*Amarathus hybridus* and *Corchorus olitorius*) in the dry season season (2015). Bioaccumulation Coefficient of cadmium of *Amarathus hybridus* accession NG/AA/03/11/010 ranged between 0.00±0.00 and 3.05±0.10. The lowest value was recorded in the Control site while the highest was recorded in Otte (Table 54). Cd bioaccumulation Coefficient of the Control site (0.54 ±0.04) was higher than other sites except for Otte, Budo Egba, Budo Abio, Ojagboro, Eroomo and Okeodo. Accession of all the sites were poor Cd accumulators except for the accession of Otte, Budo Egba, Budo Abio, Ojagboro, Eroomo and Okeodo that were hyperaccumulators that had their values higher than 1 (Table 54). Accession of the Control site (0.54 ±0.04) was a good Cd accumulator with the value of higher than 0.5

Amarathus hybridus accession NG/AO/11/08/039 had Cd BAC in the first dry season (2015) ranged between 0.00±0.00 and 3.00 ±0.17 with the lowest in the accession of the Control site and the highest in the accession of Coca cola (Table 54). The Cd BAC of the Control site was higher than other sites except for Budo Egba, Oyun, Ojagboro,Coca cola and Odoore. No Cd was detected in the accession of Otte, Mubo, Olaolu, Eroomo, Okeodo, and Isale Aluko in the first dry season (2015). The accession of Budo Abio and Odoore had the same Cd bioaccumulation coefficient (Table 54). Accession of Budo Egba (2.05 ±0.07) and Odoore (2.05 ±0.10) were statistically the same in the value of their Cd bioaccumulation coefficient, so also were the accession of Oyun (1.00±0.00) and Ojagboro (1.00±0.00).

All the accession were poor Cd accumulator because their values were lower than 0.5 except the accession of Budo Egba, Oyun, Ojagboro, Okeodo and Odoore that were Cd hyperaccumulator with their values greater than 1 and the Control site that was a good Cd accumulator with value greater than 0.5. The range of Cd bioaccumulation coefficient in *Amarathus hybridus* accession NGBO125 in the first dry season (2015) ranged between 0.00±0.00 and 1.00±0.00 with the lowest recorded in the accession of the Control site and the highest in Oyun. Accession of Otte, Budo Abio, Mubo, Ojagboro, Olaolu, Okeodo, Eroomo, Coca cola, Isale Aluko, Odoore and the Control site had no value for Cd bioaccumulation coefficient (Table 54). The result showed that accession of all the sites were poor Cd accumulators except for Budo Egba and Oyun that had values equal to 1, therefore, were accumulators (Table 54).The range of Bioaccumulation Coefficient of Cd in the accession *Corchorus olitorius* NG/OA/Jun/09/002 in the first dry season (2015) was between 0.00±0.00 and 3.10 ±0.20 with the lowest recorded in the Control site and the highest in Coca cola (Table 54). No Cd was detected in the accession in Otte, Budo Egba, Olaolu, Isale Aluko, Odoore and the Control site (Table 54). Accession of Budo Abio, Mubo, Ojagboro and Coca cola were good Cd hyperaccumulator with their values higher than 1 and the accession of Oyun had value greater than 0.5, therefore, a good Cd accumulator while other sites were poor accumulators of Cd.

Bioaccumulation Coefficient of Cd in *Corchorus olitorius* accession NG/OA/04/010 in the first dry season ranged between 0.00±0.00 and 3.05±0.22 with the lowest obtained in the Control site and the highest in Ojagboro (Table 54). Cd BAC in the Control site was lower than other sites except for Olaolu, Eroomo, Isale Aluko and Odoore that had no Cd BAC recorded Table 54). Statistically, the same Cd bioaccumulation were recorded in the accession of Otte (1.00 ±0.15), Mubo (1.00 ±0.19) and Coca cola (1.00 ±0.25), so also were the accession of Ojagboro (3.05 ±0.22) and Okeodo (Table 54). Accession of Otte, Mubo, Oyun, Ojagboro, Okeodo and Coca cola were good Cd hyperaccumulators with their values higher than 1, accession of Budo Egba and Budo Abio had values greater than 0.5,therefore, were good Cd accumulators while the accession of the Control and other sites were poor Cd accumulators (Table 54). It was observed that *Corchorus olitorius* accessions were better accumulator of Cd. *Amaranthus hybridus* accession NG/AA/03/11/010 accumulated Cd most while the least was the accession of NGBO125.

Table 55 shows the Biological Accumulation Coefficient of Cadmium of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second dry season (2016). The Bioaccumulation Coefficient of Cd in *Amaranthus hybridus* accession NG/AA/03/11/010 ranged between 0.10±0.00 and 0.72±0.01 with the highest coefficient recorded in Coca-cola and the lowest with a no detectable value in the Control site suggesting lower Cd bioaccumulation coefficient lower than the first dry season (0.00±0.00 and 3.05±0.10) (2015) (Table 55). Accession of all sites were poor Cd bioaccumulators with values lower than 0.5 except for the accession of Okeodo (0.70±0.01), Coca cola, (0.72±0.01), Isale Aluko (0.59±0.01) and Odoore (0.57±0.01) that had higher values than 0.5 (Table 55). The range of the

Bioaccumulation Coefficent of Cd in *Amaranthus hybridus* accession NG/AO/11/08/039 in the second dry season (2016) was between 0.23±0.00 and 1.25±0.04 with the lowest Cd obtained in the accession of the Control site and the highest in Isale Aluko indicating lower values than the first dry season (0.00±0.00 and 3.00±0.00) (Table 55). Accession of the Control site had lower BAC of Cd than the other sites (Table 55). Accession of all the sites had Cd BAC greater than 0.5, therefore, were good Cd accumulators except for Otte (0.41±0.00) and the Control site (0. 25±0.00) that had values lower than 0.5 that were poor Cd accumulators and the accession of Isale Aluko (1.25±0.04), that was a good Cd hyperaccumulator with value greater than 1 (Table 55).

The Cd BAC in *Amaranthus hybridus* accession NGBO 125 ranged between 0.20±0.00 and 0.80±0.00 in the second dry season suggesting lower Cd bioaccumulation coefficient than the first dry season (0.00±0.00 and 1.00±0.00). The lowest Cd BAC in the accession was recorded in the accession of the Control site while the highest was obtained from the accession of Odoore (Table 55). Accession of the sites were all poor Cd accumulators with values less than 0.5 except for the accession of Eroomo (0.65±0.00), Coca cola (0.50±0.00), Isale Aluko(0.75±0.00) and Odoore (0.80±0.00) that were good Cd accumulators with values higher than 0.5. Bioaccumulation Coefficient of Cd in the *Amaranthus hybridus* accessions was in the order NG/AO/11/08/039 ≥ NG/AA/03/11/010 ≥ NGBO125 (Table 55).

Table 53: Lead concentration (mg/kg) partitioning in the vegetable Accessions in the second rainy season (2017)

	Amarathus hybridus						*Corchorus olitorius*			
Site	NG/AA/03/11/010		NG/AO/11/08/039		NGBO125		NG/OA/Jun/09/002		NG/OA/04/010	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Otte	0.13±0.23^{b}	1.67±1.50^{b}	0.50±0.15^{a}	2.53±0.92^{c}	0.00±0.00^{d}	2.67±0.46^{ef}	0.27±0.23	2.67±0.83^{bc}	0.53±0.23	2.67±0.61^{bcde}
Budo Egba	0.13±0.23^{b}	1.07±0.23^{c}	0.40±0.00^{b}	2.40±0.80^{cd}	0.13±0.23^{c}	3.73±0.61^{d}	0.40±0.00c	1.87±0.83^{d}	0.53±0.23^{b}	2.13±0.23^{cde}
Budo Abio	0.13±0.23^{b}	1.07±0.23^{c}	0.40±0.00^{b}	2.27±0.23^{d}	0.00±0.00^{d}	2.80±0.40^{ef}	0.40±0.00c	1.60±0.69^{e}	0.53±0.23^{b}	1.60±0.40^{ef}
Mubo	0.13±0.23^{b}	1.07±0.23^{c}	0.40±0.00^{b}	4.13±2.72^{a}	0.00±0.00^{d}	2.93±1.15^{e}	0.40±0.00^{c}	2.00±0.80^{c}	0.53±0.23^{b}	2.80±0.69^{bc}
Oyun	0.13±0.23^{b}	1.07±0.23^{c}	0.40±0.00^{b}	2.67±1.51^{c}	0.00±0.00^{d}	3.07±0.23^{de}	0.40±0.00^{c}	1.73±0.83^{d}	0.53±0.23^{b}	3.20±0.69^{ab}
Ojagbooro	0.40±0.00^{a}	1.33±0.23^{bc}	0.40±0.00^{b}	3.07±1.22^{bc}	0.67±0.23^{a}	5.73±0.61a b	0.93±0.61^{a}	3.20±1.60^{b}	0.93±0.07^{a}	2.93±0.92^{abc}
Olaolu	0.13±0.23b	1.07±0.23^{c}	0.40±0.00^{b}	3.60±1.60^{b}	0.00±0.00^{d}	3.30±0.31^{ef}	0.40±0.00^{c}	2.00±0.80^{c}	0.53±0.23^{b}	2.53±1.29^{bcd}
Eroomo	0.13±0.23^{b}	1.07±0.23^{c}	0.53±0.20^{a}	2.53±0.92^{c}	0.00±0.00^{d}	4.13±1.01^{c}	0.40±0.00^{c}	1.47±0.61^{de}	0.40±0.40^{c}	2.40±1.44^{bcd}
Okeodo	0.13±0.23^{b}	1.07±0.23^{c}	0.40±0.00^{b}	2.40±1.06^{cd}	0.00±0.00^{d}	3.60±0.40^{d}	0.40±0.00^{c}	2.13±0.83^{c}	0.53±0.23^{b}	2.53±0.61^{bcd}
Cocacola	0.40±0.40^{a}	3.07±0.83^{ab}	0.53±0.23^{a}	2.67±0.83^{c}	0.53±0.06^{ab}	6.13±0.61^{a}	0.67±0.46^{ab}	4.00±0.40^{a}	0.80±0.00^{ab}	3.60±1.74^{a}
Isale Aluko	0.40±0.00^{a}	3.20±1.39^{a}	0.53±0.05^{a}	2.80±0.80^{c}	0.40±0.40^{b}	5.33±1.89^{b}	0.53±0.23^{bc}	3.20±0.69^{b}	0.93±0.23^{a}	2.93±1.51^{abc}
Odoore	0.27±0.23^{ab}	1.07±0.23^{c}	0.27±0.23^{bc}	2.27±1.22^{d}	0.00±0.00^{d}	3.07±0.23^{de}	0.13±0.23^{c}	1.33±0.61^{def}	0.53±0.23^{b}	1.20±1.39^{ef}
Botanical garden(control site)	0.07±0.10^{c}	0.67±0.61^{d}	0.13±0.23^{c}	2.27±1.85^{d}	0.00±0.00^{d}	2.27±1.01^{g}	0.13±0.17^{c}	0.93±0.23^{f}	0.13±0.17^{c}	0.80±0.40^{f}

Values with the same superscript along the column are statistically the same at $p \leq 0.05$. Values represents ±SD. WHO/FAO, 2011. Recommended Safe limit of Pb= 0.30mgkg^{-1} . Pb=Lead.

Cd Bioaccumulation Coefficient of the *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016) ranged between 0.00±0.00 and 0.67±0.05. The BAC of the accession of the Control site was 0.00±0.00 and the highest in Isale Aluko. Only the accession of Isale Aluko (0.67±0.05) and Odoore (0.55±0.00) were good accumulators of Cd while others were poor Cd conductors. It was shown that Cd accumulation was lower in second dry season than in the first dry season (0.00±0.00) and (3.10±0.20) suggesting that more Cd were accumulated in the second dry season than in the first dry season (2005).

The range of the Cd Bioaccumulation Coefficient of *Corchorus olitorius* accession NG/OA/OA/04/010 in the second dry season was between 0.15±0.05 and 0.55±0.00 with the lowest obtained in the Control site while the highest was obtained from Isale Aluko (Table 55). The accession were all poor Cd conductor with values lower than 0.5 except for the accession of Isale Aluko (0.55±0.00) that was a good Cd accumulator. *Amaranthus hybridus* accession were better Cd accumulators than *Corchorus olitorius* accession.The result showed that Cd bioaccumulation coefficient in the vegetable accessions were higher in the first dry dry season (2015) than in the second dry season (2016). This could be due to the change in the soil moisture, pH and organic content that could have enhanced heavy metal movement from soil to the plant.

Table 56 shows the Bioaccumulation Coefficient of Cadmium in the vegetable accessions (*Amarathus hybridus* and *Corchorus olitorius*) in the first rainy season (2016) (Table 56). Bioaccumulation Coefficient of cadmium in all the *Amarathus hybridus* accessions and *Corchorus olitorius* accessions were not detectable.

Table 54 : Bioaccumulation coefficient of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the first dry season (2015)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	3.05±0.10[a]	0.00±0.00[f]	0.00±0.00	0.00±0.00[e]	1.00±0.15[c]
Budo Egba	0.38±0.07[f]	2.05±0.07[b]	1.00±0.00[a]	0.00±0.00[e]	0.83±0.13[cd]
Budo Abio	1.45±0.05[c]	0.25±0.05[ef]	0.00±0.00[c]	2.00±0.07[c]	0.63±0.07[d]
Mubo	0.85±0.17[d]	0.00±0.00[f]	0.00±0.00[c]	1.00±0.00[d]	1.00±0.19[c]
Oyun	0.48±0.08[ef]	1.00±0.10[c]	1.00±0.00[a]	0.61±0.14[ce]	2.05±0.08[b]
Ojagbooro	0.45±0.05[ef]	1.00±0.05[c]	0.00±0.00[v]	2.05±0.15[b]	3.05±0.22[a]
Olaolu	0.00±0.00[g]	0.00±0.00[f]	0.00±0.00[c]	0.00±0.00[d]	0.00±0.00[d]
Eroomo	2.06±0.00[b]	0.00±0.00[f]	0.00±0.00[c]	0.45±0.06[d]	0.00±0.00[d]
Okeodo	0.95±0.10[cd]	0.00±0.00[f]	0.42±0.17[b]	0.48±0.17[e]	3.05±0.05[a]
Cocacola	0.58±0.12[e]	3.00±0.00[a]	0.00±0.00[c]	3.10±0.20[a]	1.00±0.25[c]
Isale Aluko	0.00±0.00[g]	0.00±0.00[f]	0.00±0.00[c]	0.00±0.00[e]	0.00±0.00[e]
Odoore	0.00±0.00[g]	2.05±0.10[b]	0.00±0.00[d]	0.00±0.00[e]	0.00±0.00[e]
Botanical garden(control site)	0.50±0.02[d]	0.42±0.12[e]	0.00±0.00[c]	0.00±0.00[e]	0.42±0.15[g]

Values with the same superscrips along the same colomn are the same at p ≤0.05. Values represent mean±SD.

BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥1 implies good hyperaccumulator of metal

Table 55 : Bioaccumulation coefficient of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second dry season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.21 ± 0.00^{ef}	0.41 ± 0.01^{e}	0.26 ± 0.01^{f}	0.20 ± 0.00^{c}	0.22±0.00b
Budo Egba	0.27 ± 0.00^{f}	0.53 ± 0.01^{d}	0.20 ± 0.00^{f}	0.23 ± 0.01^{c}	0.25 ± 0.00^{b}
Budo Abio	0.00 ± 0.00^{ef}	0.80 ± 0.01^{b}	0.25 ± 0.00^{f}	0.15 ± 0.00^{d}	0.23 ± 0.00^{b}
Mubo	0.38 ± 0.01^{cd}	0.62 ± 0.01^{cd}	0.35 ± 0.01^{e}	0.16 ± 0.00^{d}	0.27 ± 0.00^{b}
Oyun	0.34 ± 0.01^{cd}	0.71 ± 0.01^{c}	0.36±0.00e	0.20 ± 0.00^{c}	0.24 ± 0.00^{c}
Ojagbooro	0.44 ± 0.01^{c}	0.84 ± 0.01^{b}	0.30 ± 0.00^{e}	0.28 ± 0.00^{c}	0.25 ± 0.00^{b}
Olaolu	0.50 ± 0.00^{b}	0.70 ± 0.00^{c}	0.33 ± 0.01^{e}	0.12 ± 0.00^{d}	0.25 ± 0.00^{b}
Eroomo	0.37 ± 0.00^{cd}	0.65 ± 0.01^{cd}	0.65 ± 0.00^{c}	0.22 ± 0.00^{c}	0.20 ± 0.00^{b}
Okeodo	0.70 ± 0.00^{a}	0.70 ± 0.00^{c}	0.20 ± 0.00^{c}	0.05 ± 0.00^{bc}	0.18 ± 0.00^{c}
Cocacola	0.72 ± 0.01^{a}	0.64 ± 0.01^{cd}	0.50 ± 0.00^{d}	0.13 ± 0.00^{d}	0.25 ± 0.00^{b}
Isale Aluko	0.55 ± 0.04^{b}	1.23 ± 0.02^{a}	0.75 ± 0.01^{b}	0.67 ± 0.00^{a}	0.45 ± 0.00^{a}
Odoore	0.55 ± 0.01^{b}	0.52 ± 0.00^{d}	0.80 ± 0.00^{a}	0.55 ± 0.00^{b}	0.20 ± 0.00^{b}
Botanical garden(control site)	0.35 ± 0.00^{f}	0.24 ± 0.03^{f}	0.20 ± 0.00^{f}	0.00 ± 0.00^{a}	0.08 ± 0.00^{d}

Values with the same superscrips along the same colomn are the same at $p \leq 0.05$. Values represent mean±SD.

BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥1 implies good hyperaccumulator of metal.

Table 56 : Bioaccumulation coefficient of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* first rainy season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{bc}$
Budo Egba	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{bc}$
Budo Abio	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{c}$
Mubo	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{bc}$
Oyun	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{b}$
Ojagbooro	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	0.00±0.00a
Olaolu	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{b}$
Eroomo	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{c}$
Okeodo	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$
Cocacola	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{b}$
Isale Aluko	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	0.00±0.00
Odoore	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{c}$
Botanical garden(control site)	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{a}$	$0.00±0.00^{d}$

Values with the same superscrips along the same colomn are the same at p ≤0.05. Values represent mean±SD. BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulato rofmetal BAC ≥1 implies good hyperaccumulator of metal.

Table 57 shows Bioaccumulation coefficient of cadmium in*Amaranthus hybridus* accession NG/AA/03/11/010 in the second rainy season (2017) was in the range of 0.00±0.00 and 0.63±0.01 with the lowest cadmium bioaccumulation of the accession obtained in the accession of the Budo Abio while the highest was in the accession of Coca cola (Table 57). Biaccumulation of Cd was lower in the accession of the Control site was lower than the other sites except Budo Abio (Table 57). The result indicated that accession of all the sites were poor Cd accumulators because their values were less than 0.5 except for the accession of Coca cola and Isale Aluko that were good Cd accumulators because values were higher than 0.5 (Table 57). Bioaccumulation Coefficient of cadmium in *Amaranthus hybridus* accession NG/AO/11/08/039 in the second rainy season (2017) ranged between 0.18±0.02 and 0.85±0.04 with the lowest obtained in the accession of the Control site and the highest in the accession of Isale Aluko. Accession of the Control site and Odoore had the same statistical Cd bioaccumulation Cooefficient. Accession of Budo Egba, Mubo, Oyun, Ojagboro and Coca cola had the same Cd bioaccumulation coefficient (Table 57). It was shown that accession of Otte and Isale Aluko were good Cd accumulators (0.85±0.04) with values greater than 0.5 while accession of the other sites were poor Cd accumulators.

Amaranthus hybridus accession NGBO125 in the second rainy season (2017) recorded the range of cadmium bioaccumulation coefficient as 0.00±0.00 and 0.50±0.00 with the lowest in the accession of the Control site and the highest in the accession of Oyun. (Table 57). Bioaccumulation coefficient of Cd in the accession of the Control site was lower than the other sites (Table 57). Accession of Oyun (0.50 ±0.00) was a good Cd accumulator with value equal to 0.5 while accession of the other sites were poor Cd accumulators with lower values than 0.5. The range of Cadmium bioaccumulation coefficient in *Corchorous olitorius* accession NG/OA/Jun/09/002 in the second rainy season (2017) was between 0.00 ±0.00 and 0.20±0.00 with the lowest obtained from the accession of the Control site and the highest fron the accession of Budo Egba (Table 54). Cadmium bioaccumulation coefficient in the accession of the Control site was lower than the other sites with no detectable value in the second rainy season (2017) Accession of all the sites were poor Cd accumulors with values lower than 0.5.

Cadmium bioaccumulation factor of the *Corchorous olitorius* accession NG/OA/04/010 in the second rainy season (2017) ranged between 0.04±0.00 and 0.30±0.00 with the lowest cadmium bioaccumulation coefficient obtained in the accession of the Odoore and the highest in the accession of Isale Aluko. The accession of the Control site was lower in the value of Cd bioaccumulation coefficient than the other sites except for Odoore (Table 57). Accession of all sites were poor Cd accumulators with their lower values than 0.5.

The result showed that all the accession of *A. hybridus* accession NG/AA/03/11/010 in the second rainy season (2017) were poor Cd accumulators (BAC≤0.5) except for the accession of Coca cola and Isale Aluko that were good Cd accumulators (BAC≥0.5), *A. hybridus* accession NG/AO/11/08/039 in all the sites in the second rainy season (2017) were all poor Cd accumulators (BAC≤0.5) except for the accession of Otte and the Isale Aluko. *A. hybridus* accession NGBO125 in all the sites were poor Cd accumulators (BAC≤0.5) except for the accession in Oyun that was a good Cd accumulators with their values greater than 0.5. (BAC≥0.5) *Amaranthus hybridus* accession NG/AO/11/08/039 were best accumulators of Cd in the first dry season while *Amaranthus hybridus* access ion NGBO 125 were the least Cd accumulators. All the accession of *Corchorous . olitorious* NG/OA/Jun/09/002 were poor Cd accumulator (BAC≤0.5), so also was the accession of *Corchorous . olitorious* NG/OA/04/010 (Table 57)

Table 57 : Bioaccumulation coefficient of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second rainy season (2017)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	$0.12{\pm}0.04^{e}$	$0.84{\pm}0.03^{a}$	$0.08{\pm}0.01^{d}$	$0.10{\pm}0.02^{b}$	$0.11{\pm}0.03^{c}$
Budo Egba	$0.27{\pm}0.09^{d}$	$0.45{\pm}0.02^{b}$	$0.10{\pm}0.02^{bc}$	$0.20{\pm}0.01^{a}$	$0.20{\pm}0.00^{b}$
Budo Abio	$0.00{\pm}0.00^{f}$	$0.33{\pm}0.03^{bc}$	$0.08{\pm}0.00^{d}$	$0.10{\pm}0.01^{b}$	$0.19{\pm}0.03^{bc}$
Mubo	$0.29{\pm}0.01^{d}$	$0.47{\pm}0.02^{b}$	$0.07{\pm}0.03^{cd}$	$0.03{\pm}0.01^{b}$	$0.10{\pm}0.01^{c}$
Oyun	$0.16{\pm}0.04^{e}$	$0.47{\pm}0.00^{b}$	$0.50{\pm}0.02^{a}$	$0.10{\pm}0.00^{b}$	$0.12{\pm}0.02^{c}$
Ojagbooro	$0.44{\pm}0.03^{c}$	$0.46{\pm}0.00^{b}$	$0.10{\pm}0.00^{bc}$	$0.10{\pm}0.00^{b}$	$0.21{\pm}0.03^{b}$
Olaolu	$0.28{\pm}0.04^{bc}$	$0.30{\pm}0.01^{bc}$	$0.10{\pm}0.00^{bc}$	$0.03{\pm}0.00^{bc}$	$0.10{\pm}0.03^{e}$
Eroomo	$0.20{\pm}0.03^{c}$	$0.15{\pm}0.02^{c}$	$0.18{\pm}0.00^{b}$	$0.20{\pm}0.00^{a}$	$0.10{\pm}0.00^{c}$
Okeodo	$0.36{\pm}0.05^{ab}$	$0.36{\pm}0.02^{bc}$	$0.00{\pm}0.00^{c}$	$0.10{\pm}0.01^{b}$	$0.10{\pm}0.00^{e}$
Cocacola	$0.63{\pm}0.02^{a}$	$0.48{\pm}0.06^{b}$	$0.11{\pm}0.05^{ac}$	$0.20{\pm}0.00^{a}$	$0.14{\pm}0.03^{d}$
Isale Aluko	$0.57{\pm}0.01^{b}$	$0.85{\pm}0.04^{a}$	$0.10{\pm}0.00^{bc}$	$0.03{\pm}0.02^{c}$	$0.30{\pm}0.00^{a}$
Odoore	$0.44{\pm}0.02^{e}$	$0.18{\pm}0.04^{e}$	$0.10{\pm}0.01^{bc}$	$0.10{\pm}0.01^{b}$	$0.06{\pm}0.02^{d}$
Botanical garden(control site)	$0.10{\pm}0.04^{ef}$	$0.16{\pm}0.02^{f}$	$0.00{\pm}0.00^{c}$	$0.00{\pm}0.00^{d}$	$0.01{\pm}0.00^{d}$

Values with the same superscrips along the same colomn are the same at p ≤0.05. Values represent mean±SD. BAC ≤0.5 implies poor metal accumulator

, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥1 implies good hyperaccumulator of metal

Table 58 shows the Bioaccumulation co-efficient Copper in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius* in the first dry season (2015). The range of the Bioaccumulation Index of copper of the *Amaranthus hybridus* accession NG/AA/03/11/010 was 0.31±0.00 and 1.40±0.03 with the lowest recorded in the accession of the Control site and the highest was recorded in Isale Aluko. BAC of copper of the accession of the Control site was lower than the other sites (Table 58).Accession of Otte and Mubo had the same statistical value of Cd BAC, so also were the accession of Budo Egba and Olaolu; and Okeodo and Coca cola (Table 58). All the accession were good Cu accumulators because their values were higher than 0.5 except for the accession of Eroomo (0.42±0.01) and the Control site (0.31±0.00) that were poor Cu accumulators due to their low values than 0.5 (Table 58)

The range of BAC of copper in *Amaranthus hybridus* accession NG/AO/11/08/039 in the first dry season (2015) was between 0.28±0.01 and 1.07±0.05. The accession of the Control site (0.47±0.00) had lower Cu bioaccumulation coefficient lower than the other sites except for Budo Egba(0.26±0.00), Mubo(0.35±0.01), Olaolu (0.42±0.00) and Okeodo (0.45±0.00) (Table 58).It was observed that this accession were a poor Cu accumulators with their values less than 0.5 except for the accession of Budo Abio(0.53±0.00), Ojagboro(0.62±0.05) and Erromo (0.85±0.01) that were good accumulators of Cu since they recorded values of Cu BAC higher than 0.5. Bioaccumulation Coefficient of copper of *Amaranthus hybridus* accession NGBO 125 accession ranged between 0.24±0.03 and 0.92±0.02 with the lowest in the accession of Okeodo and the highest in Isale Aluko (Table 58). BAC of copper of the Control site was lower than the other sites except Budo Egba(0.32±0.01), Oyun(0.36±0.01), Olaolu(0.45±0.0), and Okeodo(0.24±0.03) (Table 58). The result indicated that the accession were good Cu accumulators except for the accession of Budo Egba(0.28±0.01), Oyun(0.28±0.01), Olaolu(0.28±0.01) Bioaccumulation Coefficient of copper in the three accession was NG/AA/03/11/010 ≥ NGBO125 ≥ NG/AO/11/08/039 (Table 58).

The Bioaccumulation coefficient of copper in *Corchorus olitorius accession* NG/OA/Jun/09/002 in the first dry season (2015) ranged between 0.21±0.00 and 0.76±0.05 with the lowest obtained from the accession of the Control site and the highest from Eroomo (Table 55). Accession of Otte, Budo Egba, Mubo, Oyun and Coca colaa had the same Cu BAC, so also were Budo Abio and Eroomo (Table 58).

All the accession were good Cu accumulators due to their values higher than 0.5 except for the accession of Olaolu (0.42±0.00), Okeodo(0.36±0.00) and the Control site(0.21±0.00) that poorly accumulated Cu with their lower walues than 0.5. Accession NG/OA/04/010 of *Corchorus olitorius* recorded a range of Cu bioaccumulation coefficient between 0.31±0.00 and 0.84±0.02 with the lowest in the accession of Okeodo and the highest in Isale Aluko (Table 58). The same statistical BAC of Cu was obtained in the accession of the Control site, and Okeodo, so also were the accession of Budo Abio, Mubo, Ojagboro, Eroomo and Odoore (Table 58). Accession of Otte and Coca cola had the same Cu BAC. No significant differences in the Cu BAC were recorded between the accession of Budo Egba and Olaolu (Table 58). Accession in all the sites had Cu BAC greater 0.5 except the accession of Oyun (0.48±0.01), Okeodo (0.31±0.00) and the Control site (0.33±0.00), this suggested that accession in all the sites were good Cu accumulators except foe the accession in Oyun, Okeodo and Coca cola that were poor accumulators of Cu (Table 58).

Table 59 shows the Copper Bioaccumulation coefficient of the vegetable accessions in the second dry season (2016).The range of Copper bioaccumulation in *Amaranthus hybridus* accession NG/AA/03/11/010 in the second dry season (2016) was between 0.60±0.05 and 3.04±0.11 with the lowest obtained in the accession of Budo Abio and the highest Cu bioaccumulation coefficient in the accession of Eroomo (Table 59). Cu bioaccumulation coefficient in the accession in the Control site was lower than the other accession (Table 59). There were no significant differences in the Cu bioaccumulation coefficient of the accession in Mubo, Olaolu and Okeodo, so also were the accession Coca cola and Isale Aluko (Table 59). The accession in all the site were hyper accumulators of Cu since their values were greater than 1 except for the accession of Odoore and the Control site that were good Cu accumulators becase their values were greater than 0.5 but less than 1(Table 59). Bioaccumulation coefficient of copper in *Amaranthus hybridus* accession NG/AO/11/08/039 in the second dry season (2016). was in the range of 0.48±0.02 and 1.54±0.05 with the lowest obtained in the accession in Control site and the highest from the accession of Ojagboro (Table 59). Only the accession in the Control site was a poor Cu accumulator with value less than 0.5, accession in Otte, B udo Egba, Budo Abio, Oyun, Olaolu, Eroomo and Odoore were good accumulators of Cu with BAC less than 0.5

but accession in Mubo, Ojagboro, Okeodo. Coca cola and Isale Aluko were hyper accumulators of Cu with their Cu BAC greater than 1 (Table 59).

Bioaccumulation coefficient of copper in *Amaranthus hybridus* accession NGBO125 ranged between 0.65±0.01 and 3.30±0.06 (Table 56). The accession in the Control site had the lowest copper bioaccumulation coefficient and Oyun had the highest. Accession in the Control site had lower Cu bioaccumulation coefficient higher than the other sites (Table 56). It was observed that the accession in all the sites were hyper accumulators of Cu with greater values than 1 except for the Control accession that had Cu BAC greater than 0.5 indicating that accession in the Control site was a good Cu accumulator (Table 59).

The range of copper bioaccumulation coefficicent in *Corchorous olitorius* accession NG/OA/Jun/09/002 was between 0.15±0.02 and 0.83±0.02 with the lowest obtained fron the accession of Coca cola area and the highest in the accession of Otte (Table 59). Cu bioaccumulation coefficient of the accession of the Control site was higher than the other sites except Otte, the result suggested that the accession in all the sites were good Cu accumulators with Cu BAC greater than 0.5 (Table 59). The range of the copper bioaccumulation coefficient of *Corchorous olitorius* accession NG/OA/04/010 was 0.16±0.01 and 0.80 ±0.05 with the lowest recorded in the accession of Isale Aluko and the highest in the accession of Budo Egba. Bioaccumulation of copper in the accession of the Control site was higher than the other sites except Budo Egba (Table 59).

The result showed that the accession were all poor accumulators of Cu with all the sites recording values less than 0.5 except for the accession of Otte, Budo Egba and Mubo that recorded Cu BAC greater than 0.5, therefore, were good Cu accumulators (Table 59). Furthermore, the result also showed that *Amaranthus hybridus accessi*ons were better accumulators of Cu than the accessions of *Corchorous olitorius*. Accession of *Amaranthus hybridus* NGBO125 in all the sites were observed to be hyper accumulators of Cu except the accession of the Control site, inferring that, the accession was the best Cu accumulator of the three accessions of *Amaranthus hybridus* while accession NG/AO/11/08/039 was the least Cu accumulator.

Table 58: Bioaccumulation coefficient of Copper in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* first dry season (2015)

`	*Amaranthus hybridus*			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.73±0.04[bcd]	0.45±0.00[c]	0.69±0.00[b]	0.53 ±0.01[cd]	0.75±0.01[b]
Budo Egba	0.66±0.01[cde]	0.26±0.00[ef]	0.32±0.01[e]	0.54 ±0.01[d]	0.62±0.01[bc]
Budo Abio	0.82±0.01[bc]	0.53±0.00[cd]	0.84±0.00[ab]	0.69 ±0.00[c]	0.55±0.00[c]
Mubo	0.77±0.00[bcd]	0.35±0.00[e]	0.52±0.00[cd]	0.57 ±0.00[c]	0.59±0.01[c]
Oyun	1.34±0.02[ab]	0.46±0.03[d]	0.36±0.01[ab]	0.50 ±0.01[c]	0.48±0.01[d]
Ojagbooro	0.92±0.03[b]	0.62±0.05[c]	0.57±0.02[cd]	0.60 ±0.01[b]	0.58±0.02[c]
Olaolu	0.62±0.02[cde]	0.42±0.00[d]	0.55±0.00[d]	0.42 ±0.00[c]	0.67±0.01[b]
Eroomo	0.42±0.01[def]	0.85±0.09[b]	0.63±0.00[d]	0.66 ±0.03[ab]	0.59±0.01[c]
Okeodo	0.52±0.01[de]	0.45±0.00[d]	0.24±0.03[d]	0.36 ±0.00[d]	0.31±0.00[e]
Cocacola	0.54±0.01[de]	0.48±0.01[d]	0.63±0.01[b]	0.56 ±0.00 [c]	0.75±0.01[b]
Isale Aluko	1.40±0.03[a]	1.07±0.05[a]	0.92±0.02[a]	0.74 ±0.01[c]	0.84±0.02[a]
Odoore	0.86±0.03[bc]	0.71±0.01[bc]	0.61±0.01[b]	0.80 ±0.02[a]	0.57±0.02 [c]
Botani cal garden(control site)	0.31±0.00[d]	0.47±0.00[d]	0.50±0.01[cd]	0.21± 0.00[c]	0.33±0.00[d]

Values with the same alphabet along the colomn are the same at p ≥0.05. Values represent mean±SD. BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥1 implies good hyperaccumulator of metal.

Table 59 Copper Bioaccumulation Coefficient and Transfer factor of the vegetable accessions in the second dry season (2016)

	Amaranthus hybridus			*Corchorous olitorius*	
	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Site					
Otte	1.22±0.06^{ab}	0.54±0.02^{bc}	1.41±0.03^{c}	0.86±0.05^{b}	0.56±0.05^{cd}
Budo Egba	1.86±0.07^{bc}	0.55±0.04 ^{c}	2.29±0.03^{bc}	0.54±0.00^{b}	0.82±0.07^{c}
Budo Abio	0.86±0.01^{b}	0.57±0.04^{c}	1.08±0.04^{d}	0.60±0.01^{bc}	0.46±0.04^{b}
Mubo	1.53±0.03^{ab}	1.13±0.05^{c}	1.00±0.08^{c}	0.53±0.04^{bc}	0.72±0.05^{b}
Oyun	2.11±0.10^{b}	0.92±0.03^{b}	3.30±0.06^{bc}	0.55±0.00^{bc}	0.35±0.03^{a}
Ojagboro	1.91±0.13^{a}	1.55±0.04^{c}	1.18±0.05^{a}	0.72±0.04^{a}	0.29±0.02^{bc}
Olaolu	1.51±0.05^{c}	0.92±0.03^{d}	1.40±0.02^{c}	0.55±0.03^{bc}	0.35±0.04c^{d}
Eroomo	3.04±0.14^{b}	0.77±0.05^{c}	1.20±0.01^{d}	0.68±0.04^{b}	0.25±0.00^{b}
Okeodo	1.53±0.03^{b}	1.01±0.03^{c}	1.14±0.02^{c}	0.53±0.05^{b}	0.38±0.04^{b}
Cocacola	1.94±0.02	1.01±0.02^{b}	1.80±0.07^{d}	0.70±0.03b^{c}	0.45±0.02^{cd}
Isale Aluko	0.74±0.03^{b}	1.24±0.05^{c}	1.20±0.03^{d}	0.62±0.03^{c}	0.49±0.01^{d}
Odoore	0.97±0.01^{b}	0.69±0.03	1.03±0.06^{cd}	0.59±0.02b^{c}	0.30±0.01^{b}
Botanical Garden (Control site).	0.60±0.05^{b}	0.48±0.02^{a}	0.64±0.03^{bcd}	0.50±0.03^{b}	0.37±0.01^{b}

Values with the same alphabet along the colomn are the same at $p \geq 0.05$. Values represent mean±SD. BAC ≤ 0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥ 1 implies good hyperaccumulator of metal.

Table 60 presents the Bioaccumulation Coefficient of Copper in the vegetable accessions (*Amarathus hybridus accessions* and *Corchorus olitorius accessions*) in the first rainy season (2016). The range of the Bioaccumulation Coefficient of Cu of *Amarathus hybridus* accession NG/AA/03/11/010 was between 0.62±0.00 and 2.37±0.04 with the lowest in the accession of the Control site and the highest in the accession of Budo Egba (Table 60). Accession of the Control site had lower Bioaccumulation Coefficient of Cu than the accession of the other sites (Table 60). Accession in all the sites were good Cu accumulators with Cu BAC higher than 0.5 except for Budo Egba, Mubo Ojagboro and Isale Aluko that had Cu BAC greater than 1, were therefore, good hyper accumulators of Cu (Table 60).

Bioaccumulation Coefficient of Cu of *Amarathus hybridus* accession NG/AO/11/08/039 in the first rainy season (2016) ranged between 0.50±0.00 and 0.81 ± 0.17 with the lowest BAC Cu recorded in the accession of Odoore while the highest was recorded in the accession of Oyun. Cu BAC of the Control site was lower than the accession of the other sites except the accession in Odoore (Table 60). Accession in all the sites were good Cu accumulators with their values greater than 0.5 but less than 1 (Table 60). Bioaccumulation Coefficient of copper in the *Amarathus hybridus* accession NGBO 125 was between the range of 0.85±0.15 and 3.25±0.15 with the lowest recorded in the accession in Coca cola and the highest in Mubo. BAC of Cu of the Control site was lower than the other sites except for Coca cola (Table 60). Accession of most sites were higher than 1 (good hyperaccumulator) except for the accession of Coca cola and the Control site that had values lower than 1 but greater than 0.5 (good accumulators) (Table 60). BAC of copper between accessions was NGBO125 ≥ NG/AA/03/11/010 ≥ NG/AO/11/08/039

The Bioaccumulation Coefficient of copper of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first rainy season (2016) ranged between 0.53±0.00 and 0.95 ± 0.15 with the lowest obtained from Eroomo and the highest from the accession Ojagboro (Table 60). Accession of all the sites were good Cu accumulators with values higher than 0.5 (Table 60). Bioaccumulation of copper of *Corchorus olitorius* accession NG/OA/04/010 was ranged between 0.43±0.11 and 1.23±0.12 with the lowest obtained in the accession of the Control site and the highest in the accession of Mubo (Table 60). BAC of Cu of the accession of the Control site was lower than other sites (Table 60). Accession of Otte, Mubo, Ojagboro and Isale Aluko were hyper accumulators with Cu BAC higher than 1, Budo Egba, Oyun, Olaolu and Okeodo were good accumulator of Cu while the accession of Budo Abio, Eroomo, Odoore and the Control site were poor Cu accumulators with Cu BAC lower than 0.5 (Table 60). *Corchorus olitorius* accession NG/OA/04/010 recorded higher Cu BAC between sites than *Corchorus olitorius* accession NG/OA/Jun/09/002 but less than *Amaranthus hybridus* accessions. Table 61 presents the Bioaccumulation Coefficient of Copper of the vegetable accessions (*Amaranthus hybridus* accessions and *Corchorus olitorius accessions*) in the second rainy season (2017).

Bioaccumulation coefficient of copper of the vegetable accession *Amaranthus hybridus* accession NG/AA/03/11/010 in the second rainy season (2017) ranged between 0.57±0.04 and 1.85±0.05 with the lowest copper bioaccumulation coefficient obtained in Coca cola and the highest in the accession of Mubo (Table 61). Cu BAC in the accession of the Control site was higher than the accession of the other sites except Otte, Budo Abio, Ojagboro, Erromo and Isale Aluko. Accession of Mubo (1.85±0.05), Ojagboro (1.83±0.17) and Eroomo (1.80±0.00) had the same bioaccumulated Cu, so also were the accession of Coca cola (0.52±0.04) and Olaolu (0.59±0.05) (Table 61). Accession of the sites in the second rainy season (2017) were all good Cu accumulator with their values higher than 0.5 except for Mubo, Ojagboro and Eroomo that were good Cu hyperaccumulators with values greater than 1 (Table 61).

Bioaccumulation coefficient of copper in the accession *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) ranged between 0.60±0.00 and 0.95±0.15 with the lowest obtained in the accession of Coca cola and the highest in the accession of Ojagboro (Table 61). Cu BAC of the accession of the Control site was lower than the other sites except Cocacola and Olaolu. Accession of Otte (0.74±0.08) and Budo Egba (0.79±0.07) had the same statistical value of Cu BAC, so also were the accession of Budo Abio (0.85±0.05), Oyun(0.85±0.00), Ojagboro (0.89±0.05), Erooomo (0.85±0.05) and Odoore (0.89±0.14) (Table 61). Accession of the sites were good Cu accumulators with values less than 0.5 (Table 61). Bioaccumulation coefficient of Cu of the accession *Amaranthus hybridus* NGBO125 in the second rainy season (2017) ranged between 0.62±0.11 and 1.20±0.10 with the lowest in the Control site and the highest in Eroomo. Cu BAC of the Control site was lower than the other sites (Table 61).Accession of the sites were good Cu accumulators with values greater than 0.5 except for the accession of Otte, Budo Egba and Eroomo that had values greater than 1, therefore, were Cu hyperaccumulators. Comparing the Cu BAC of the *Amaranthus hybridus* accessions, NG/AA/03/11/010 ≥ *NGBO125* ≥ NG/AO/11/08/039 *(*Table 61). Bioaccumulation coefficient of copper of the accession of *Corchorus olitorius accession* NG/OA/Jun/09/002 in the second rainy season (2017)ranged between 0.45±0.05 and 0.62±0.12 with the lowest obtained in the accession of Coca cola and the highest in the accession of Mubo (Table 61). Cu BAC of the Control site was lower than the accession of the other sites except Coca cola (Table 61). Accession of all the sites were good Cu accumulators with their values greater than 0.5 except for the accession of the Control site, Olaolu and Coca cola that were poor Cu accumulators with values less than 0.5 (Table 61). Bioaccumulation coefficient of copper of *Corchorus olitorius* accession NG/OA/04/010 in the second rainy season (2017) ranged between 0.52±0.00 and 0.74±0.13 with the lowest obtained in the accession of the Control site and the highest in the accession of Isale Aluko (Table 61). Bioaccumulation coefficient of Cu in the Control site was lower than the other sites(Table 61). Accession in all the site were good Cu accumulators with values greater than 0.5 (Table 61).

Table 62 shows the range of bioaccumulation coefficient of lead in *Amarathus hybridus* accession NG/AA/03/11/010 in the first dry season was between 0.00 ±0.00 and 0.28±0.05 with the lowest value in the accession of the Control site and the highest in Ojagboro. Pb bioaccumulation coeffiecient of the Control site was no detectable (Table 62). Accession of all the sites were lower than 0.5, therefore, were all poor Pb accumulators (Table 62). The range of bioaccumulation coefficient of Pb in *Amarathus hybridus* accession NG/AO/11/08/039 was between 0.09 ±0.01 and 0.20±0.05 (Table 62). BAC of Pb of the accession of the Control site was lower than the other sites while the highest was obtained in the accession of Isale Aluko. Accession of all the sites had Pb bioaccumulation coefficient lower than 0.5, therefore, were all poor Pb bioaccumulators (Table 62). The range of bioaccumulation coefficient of Pb of the accession *Amarathus hybridus* accession NGBO 125 was between 0.00±0.00 and 0.10 ±0.01. The BAC of Pb of the accession of the Control site was non detectable. Accession of all the sites had a non detectable Pb BAC except the accession of Budo Egba, Ojagboro, Coca cola and Isale Aluko, therefore, were all poor Pb bioaccumulators (Table 62).

Table 60: Mean±SD Bioaccumulation Coefficient of Copper in Vegetable Accessions in the first rainy season (2016)

	Amaranthus hybridus			*Corchorous olitorious*	
	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.84±0.22^{de}	0.65±0.00^{c}	1.12±0.13^{c}	0.70±0.12^{c}	1.15±0.15^{b}
Budo Egba	2.37±0.34^{a}	0.72±0.00^{c}	1.45±0.13^{c}	0.63±0.01^{d}	0.50±0.00^{c}
Budo Abio	0.75±0.16b^{e}	0.62±0.01c	1.28±0.03^{c}	0.57±0.01^{e}	0.46±0.02^{a}
Mubo	2.20±0.00^{b}	0.76±0.00^{b}	3.25±0.01^{a}	0.66±0.01^{d}	1.23±0.12^{a}
Oyun	0.95±0.17^{d}	0.81±0.17^{a}	1.39±0.01^{c}	0.73±0.01^{c}	0.60±0.00^{bc}
Ojagbooro	1.95±0.00^{bc}	0.75±0.00^{b}	2.12±0.02^{b}	0.95±0.15^{a}	1.14±0.21^{b}
Olaolu	0.70±0.00^{e}	0.58±0.00^{d}	1.18±0.03^{c}	0.77±0.21^{c}	0.59±0.02^{c}
Eroomo	0.84±0.12^{de}	0.66±0.00^{c}	1.12±0.01^{c}	0.53±0.00 ^{e}	0.44±0.15^{d}
Okeodo	0.59±0.00^{fg}	0.59±0.00^{d}	1.25±0.03^{c}	0.55±0.05^{e}	0.55±0.10^{c}
Cocacola	0.67±0.00^{c}	0.67±0.00^{c}	0.85±0.02^{d}	0.89±0.11^{b}	0.51±0.11^{c}
Isale Aluko	1.30±0.00^{c}	0.73±0.00^{b}	1.30±0.01^{c}	0.84±0.11 ^{b}	1.14±0.21^{b}
Odoore	0.50±0.00^{g}	0.50±0.00^{d}	1.05±0.02^{c}	0.64±0.00^{d}	0.48±0.12^{d}
Botanical garden)controlsite	0.62±0.04^{ef}	0.56±0.04^{d}	0.63±0.02^{d}	0.55±0.07^{e}	0.43±0.02^{d}

Values with the same alphabet along the colomn are the same at p $\leq$0.05. Values represent mean±SD. BAC $\leq$0.5 implies poor metal accumulator, BAC $\geq$ 0.5 implies good bioaccumulatorof metal BAC $\geq$1 implies good hyperaccumulator of metal.

Table 61: Bioaccumulation Coefficient of Copper second rainy season (2017)

Site	*Amaranthus hybridus*			*Corchorous olitorious*	
	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/ 002	NG/OA/04/010
Otte	0.75±0.22^{e}	0.74±0.08^{c}	1.10±0.10^{ab}	0.56±0.12^{b}	0.65±0.15^{b}
Budo Egba	0.87±0.34^{d}	0.79±0.07^{c}	1.02±0.13^{ab}	0.53±0.01^{b}	0.61±0.00^{b}
Budo Abio	0.75±0.16^{e}	0.85±0.14^{b}	0.88±0.14^{c}	0.57±0.01^{b}	0.59±0.12^{c}
Mubo	1.85±0.05^{a}	0.76±0.00^{c}	0.91±0.11^{b}	0.62±0.12^{a}	0.70±0.12^{ab}
Oyun	0.95±0.17^{c}	0.85±0.00^{b}	0.85±0.00^{c}	0.51±0.01^{b}	0.60±0.00^{b}
Ojagbooro	1.35±0.00^{b}	0.89±0.05^{b}	0.70±0.10^{d}	0.59±0.15^{b}	0.64±0.21^{b}
Olaolu	0.52±0.00^{g}	0.63±0.00^{d}	0.80±0.00^{c}	0.49±0.21^{c}	0.69±0.02^{b}
Eroomo	1.80±0.00^{a}	0.66±0.00^{d}	1.20±0.10^{a}	0.53±0.00^{b}	0.54±0.15^{c}
Okeodo	0.69±0.00^{ef}	0.59±0.00^{e}	0.71±0.03^{d}	0.50±0.05^{e}	0.55±0.10^{c}
Cocacola	0.55±0.00^{fg}	0.60±0.00^{c}	0.85±0.02^{c}	0.45±0.05^{c}	0.50±0.11^{c}
Isale Aluko	0.83±0.17^{d}	0.95±0.15^{a}	0.89±0.01^{c}	0.60±0.11^{ab}	0.74±0.13^{a}
Odoore	0.70±0.00^{e}	0.89±0.14^{b}	0.75±0.02^{d}	0.59±0.00^{b}	0.48±0.12^{d}
Botanical garden)controlsite	0.57±0.01^{fg}	0.62±0.04^{d}	0.62±0.11^{e}	0.46±0.07^{c}	0.52±0.00^{d}

Values with the same alphabet along the colomn are the same at $p \leq 0.05$. Values represent mean±SD. BAC ≤ 0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥ 1 implies good hyperaccumulator of metal.

The range of the bioaccumulation coefficient of Pb of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season (2015) was between 0.04±0.01 and 0.29±0.03 with the lowest Pb bioaccumulation coefficient in the accession of the C\ontrol site and the highest in Ojagboro (Table 62). The BAC of accession of the Control site was lower than the other sites (Table 62). No significant differences were recorded in the BAC of Pb of accession of sites Otte, Budo Egba, Budo Abio, Mubo, Oyun, Ojagboro, Olaolu and Eroomo, so also were the accession of Okeodo, Coca cola and Isale Aluko (Table 62). Accession of Odoore was comparatively lower in the Pb BAC than the other sites except for the Control site (Table 62). Accession of all the sites had lower values than 0.5, were therefore, por Pb bioaccumulators.

The range of Pb Bioaccumulation Coefficient of the *Corchorus olitorius* accession NG/OA/04/010 in the first dry season (2015) was between 0.14±0.02 and 0.61±0.06 with the lowest recorded in the accession of the Control site and the highest in Otte. Bioaccumulation coefficient of Pb in *Corchorus olitorius* accession NG/OA/04/010 of the Control site was lower than the other sites (Table 62). Accession of Budo Egba, Olaolu, Okeodo and Coca cola had the same statistical Pb bioaccumulation coefficient, so also were Budo Abio, Ojagboro and Isale Aluko (Table 62). No significant differences were recorded in the BAC of Pb in the accession of Mubo and Oyun. The accession of the sites all had Pb BAC. less 0.5 except for the accession of Otte (0.61±0.06) that had Pb BAC higher than 0.5, therefore, was a good Pb bioaccumulator.

BAC of Pb was NG/OA/04/010 greater than NG/OA/Jun/09/002 (Table 62). Table 63 presents the Bioaccumulation coefficient of Lead in the vegetable accessions in the second dry season (2016) was between 0.20±0.02 and 1.07±0.06 with the lowest in the Control site and the highest in the accession of Mubo (Table 62). Bioaccumulation coefficient of Lead in the accession of the Control site was lower than the other sites. Lead bioaccumulation coefficient of the accession of Otte, Olaolu and Coca cola were statistically the same (Table 63). No significant differences were recorded in the Pb bioaccumulation coefficient in the accession of Budo Egba, Ojagboro and Okeodo, so also were the accession of Oyun and Odoore, likewise, Mubo and Isale Aluko (Table 63).

Table 62: Bioaccumulation Coefficient and Transfer Factor of Lead in the vegetable accession in the first dry season (2015).

	Amaranthus hybridus			*Corchorus olitorious*	
SITE	NG/AA/03/11/010	NG/AO/11/08/039	NBGO125	NG/AO/jun/09.002	NG/OA/04/010
Otte	0.07±0.02[c]	0.20±0.02[a]	0.00±0.00[cd]	0.27±0.02[a]	0.61±0.06[a]
Budo Egba	0.11±0.02[b]	0.17±0.02[ab]	0.03±0.01[b]	0.20±0.02[b]	0.44±0.01[b]
Budo Abio	0.12±0.01[b]	0.14±0.01[b]	0.00±0.00[b]	0.22±0.01[b]	0.28±0.05[cd]
Mubo	0.10±0.01[b]	0.11±0.01[b]	0.00±0.00[b]	0.19±0.03[b]	0.17±0.01[d]
Oyun	0.17±0.03[ab]	0.13±0.02[b]	0.00±0.00[b]	0.21±0.03[b]	0.17±0.02[de]
Ojagbooro	0.28±0.04[a]	0.11±0.01[b]	0.10±0.02[a]	0.26±0.03[a]	0.32±0.02[c]
Olaolu	0.11±0.02[b]	0.10±0.01[b]	0.00±0.00[b]	0.19±0.01[b]	0.21±0.01[d]
Eroomo	0.10±0.01[b]	0.18±0.01[ab]	0.00±0.00[b]	0.20±0.04[b]	0.15±0.01[e]
Okeodo	0.10±0.02[b]	0.17±0..01[a] b	0.00±0.00[b]	0.15±0.03[bc]	0.19±001[d]
Cocacola	0.23±0.02[ab]	0.19±0.02[ab]	0.07±0.01[a]	0.16±0.02[bc]	0.32±0.02[c]
Isale Aluko	0.12±0.01[b]	0.20±0.05[a]	0.08±0.01[a]	0.20±0.02[b]	0.15±0.02[e]
Odoore	0.12±0.02[b]	0.11±0.01[b]	0.00±0.00[b]	0.10±0.02[bcd]	0.25±0.01[cd]
Botanical garden)control site	0.00±0.00[d]	0.09±0.01[b]	0.00±0.00[b]	0.04±0.01[d]	0.14±0.01[e]

Values with thsame alphabet along the colomn are the same at p ≤0.05. Values represent mean±SD. BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulator of metal BAC ≥1 implies good hyperaccumulator of metal

Bioaccumulation coefficient of Lead in *Amaranthus hybridus* accession NG/AO/11/08/039 in second dry season (2016) was in the range of 0.33±0.04 and 0.94±0.03. The lowest BAC Pb was obtained in the accession of the Control site and the highest in the accession of Cocacola. Accession of the Control site had lower Pb BAC than the other sites (Table 63). Accession of Budo Egba, Mubo, Coca cola and Isale had the same statistical BAC of Pb, so also were the accession of Ojagboro and Eroono. Accession of Oyun, Olaolu and Odoore had the same values of Pb BAC (Table 63). Accession of all the sites were good Pb accumulators with their Pb BAC higher than 0.5 (Table 63).

The range of Pb bioaccumulation coefficient in the accession of *Amaranthus hybridus* NGBO125 in second dry season (2016) was between 0.21±0.04 and 1.52±0.05 with the lowest recorded in the accession of the Control site and the highest in the accession of Olaolu (Table 63). Pb bioaccumulation coefficient of the accession of the Control site was lower than the other sites. Pb BAC of the accession of Otte, Budo Egba, Okeodo and Coca cola were statistically the same, so also were the accession of Mubo, Oyun, Isale Aluko and Odoore (Table 63). Accession of all the sites were lower than 0.5, therefore were good Pb bioaccumulators except for the accession of Ojagboro and Olaolu that were good Pb hyperbioaccumulators with values greater than 1 and the accession of the Control site that was a poor Pb bioaccumulator(BAC≤0.5). Pb bioaccumulation in the accessions of *Amaranthus hybridus* was in the order *Amaranthus hybridus* NG/AA/03/11/010 ≥ *Amaranthus hybridus* NGBO125≥ NG/AO/11/08/039 (Table 63).

Pb bioaccumulation in the accession of *Corchorus olitorius* accession NG/OA/Jun/09/002 ranged in second dry season (2016) between 0.34±0.04 and 1.24±0.02. The lowest obtained from the accession of the Control site and the highest from the accession of Mubo. Pb bioaccumulation coefficient of the accession of the Control site was lower than the sites (Table 63). Accession of Budo Egba, Oyun, Ojagboro and Okeodo had the same statistical Pb bioaccumulation coefficient (Table 63). Accession of all the sites were good Pb bioaccumulators (BAC ≥0.5) except for the accession of Mubo that was good Pb hyperaccumulator(BAV≥1) and the accession of Budo Abio and the Control site that were poor Pb bioaccumulators (BAC≤0.5) (Table 63). Bioaccumulation coefficient of Pb in *Corchorous olitorius* accession NG/OA/04/010 ranged between 0.45±0.04 and 1.62±0.05 with the lowest obtained in the accession of the

Control site and the highest from the accession of Coca cola. Pb bioaccumulation coefficient of the accession of the Control site was lower than the sites (Table 63). Table 64 shows the Bioaccumulation Coefficient of Lead in the vegetable accessions planted in the first rainy season (2016). Bioaccumulaton Coefficient of Pb in *Amarathus hybridus* accession NG/AA/03/11/010 was between 0.08±0.00 and 0.31±0.01 with the lowest in the accession of the Control site and the highest in the accession of Ojagboro (Table 64). The Pb BAC of the accession of the Control site was lower than the Pb BAC of all the accession of the other sites. There were no significant differences in the Pb BAC of accession of all the sites except the accession of Ojagboro and Coca cola (Table 64). Accession of all the sites were poor Pb bioaccumulators (Pb BAC≤0.5). The range of Bioaccumulation Coefficient of *Amarathus hybridus* accession NG/AO/11/08/039 in the first rainy season (2016) was between 0.05±0.00 and 0.21±0.03 with the lowest BAC of Pb recorded in the accession of the Control site and the highest in the accession of Otte . BAC of Pb in the accession of the Control site was lower than the accession of the other sites (Table 64). The Pb BAC of the accession of Budo Egba, Oyun, Olaolu, Okeodo and Isale Aluko were the statistically the same (Table 64). Accession of all the sites were poor Pb bioaccumulators (Table 64).

Bioaccumulation Coefficient of Pb in *Amarathus hybridus* accession NGBO125 ranged between 0.00±0.00 and 0.11±0.03. The accession of all the sites except the accession of sites Budo Egba, Ojagboro, Coca cola and Isale Aluko had a non detectable Pb BAC (Table 64). The accession were all poor Pb accumulators (Pb BAC≤0.5) Bioaccumulation Coefficient was in the order NG/AA/03/11/010 ≥ NG/AO/11/08/039≥ NGBO125 (Table 64). Bioaccumulation Coefficient of Pb in the accession *Corchorus olitorius* NG/OA/Jun/09/002 in the first rainy season (2016) ranged between 0.06±0.01 and 0.28±0.06 with the highest recorded in Ojagboro and the lowest obtained from the accession of the Control site (Table 64). There were no significant differences in the BAC of Pb of the accession of Otte and Odoore, so alo were the accession of Budo Egba, Budo Abio, Mubo, Oyun, Ojagboro, Olaolu and Eroomo (Table 64).

Table 63. Lead Bioaccumulation Coefficient and Transfer factor of the vegetable accessions (*Amaranthus hybridus and Corchorous olitorius) i*n the second dry season (2016).

	Amaranthus hybridus			*Corchorous olitorius*	
SITE	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.76±0.02[c]	0.80±0.05[b]	0.84±0.05[b]	0.81±0.04[b]	0.92±0.05[bc]
BudoEgba	0.90±0.05[b]	0.90±0.05[a]	0.88±0.03[b]	0.62±0.05[bc]	0.78±0.02[cde]
BudoAbio	0.60±0.01[de]	0.43±0.05[c]	0.48±0.02[de]	0.43±0.03[f]	0.64±0.03[de]
Mubo	1.07±0.06[a]	0.90±0.0[a]	0.70±0.04[bc]	1.21±0.05[a]	0.92±0.00[bc]
Oyun	0.84±0.02 [bc]	0.75±0.03[c]	0.63±0.03[bcd]	0.63±0.06[bc]	0.85±0.02[cd]
Ojagboro	0.93±0.04[b]	0.53±0.06[d]	1.02±0.03[ab]	0.62±0.03[bc]	1.43±0.01[ab]
Olaolu	0.73±0.03[c]	0.71±0.09[cd]	1.50±0.06[a]	0.50±0.10[cd]	0.51±0.02[ef]
Eroomo	0.43±0.02[e]	0.53±0.04[sd]	0.52±0.05[de]	0.37±0.02[d]	0.55±0.03[ef]
Okeodo	0.90±0.02[b]	0.93±0.06[b]	0.85±0.05[b]	0.65±0.03[bc]	1.16±0.05[b]
Cocacola	0.75±0.05[c]	0.94±0.03[a]	0.87±0.05[b]	0.93±0.04[ab]	1.62±0.08[a]
IsaleAluko	1.00±0.07[a]	0.90±0.02[a]	0.70±0.00[bc]	0.70±0.06[bc]	0.96±0.06[bc]
Odoore	0.83±0.04[bc]	0.72±0.05[bc]	0.67±0.05[bcd]	0.50±0.00[cd]	0.49±0.38[ef]
BotanicalGarden(Control site).	0.20±0.02[c]	0.33±0.04[d]	0.24±0.01[e]	0.34±0.04[d]	0.45±0.04[ff]

Values with the same alphabet along the colomn are the same at p ≤0.05. Values represent mean±SD. BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥1 implies good hyperaccumulator of metal.

Accession of Okeodo, Coca cola and Isale Aluko had the same statistical BAC of Pb. Accession of all the sites were poor Pb accumulators (Pb BAC≤0.5). Bioaccumulation Coefficient of Pb in *Corchorus olitorius* accession NG/OA/04/010 in the first rainy season (2016) ranged between 0.12±0.05 and 0.44±0.03 with the lowest recorded in the accession of the Control site and the highest in the accession of Olaolu. Accession of Otte, Budo Egba, Budo Abio, Mubo, Oyun had no significant differences in the Bioaccumulation Coefficient of Pb at $p \leq 0.01$. Bio accumulation of Pb in the accession of Ojagboro, Olaolu and Isale Aluko were statistically the same, so also were the accession of Otte, Budo Abio, Budo Abio, Mubo, Oyun, Eroomo,and Okeodo (Table 64). Accession in the sites were all poor Pb bioaccumulators in the first rainy season (2016). Pb bioaccumulation in the accession of *Corchorus olitorius* NG/OA/04/010 was higher than *Corchorus olitorius* accession NG/OA/Jun/09/002 (Tablen 64). Accessions of *Amarathus hybridus* accumulated less Pb than the asscessions of *Corchorus olitorius* in the first rainy season (2016).

Table 65 presents the Bioaccumulation Coefficient of Lead of vegetable Accessions in the second rainy season (2017). Bioaccumulation Coefficient of Pb in the accession *Amaranthus hybridus* NG/AA/03/11/010 was between 0.22±0.03 and 1.70±0.05 with the lowest obtained in the accession of the Control site and the highest in the accession of Coca cola (Table 65). Accession of the Control site had lower Pb bioaccumulation coefficient than the other sites. There were no significant differences in the Pb BAC of the accession of Otte and Budo Abio, so also were the accession of Oyun, Eroomo and Okeodo, so also were Budo Egba and Mubo (Table 65). Accession of the sites were good Pb bioaccumulators (Pb BAC≥0.5) except for the accession of Ojagboro and Coca cola that were good Pb hyperaccumulators (Pb BAC≥1) and the Control site that was a poor Pb bioaccumulator with Pb BAC less than 0.5(Table 65). Bioaccumulation coefficient of Pb in the *Amaranthus hybridus* accession NG/AO/11/08/039 was between 0.30±0.01 and 1.95±0.04 with the lowest obtained in the accession of the Control site and the highest from the accession of Coca cola (Table 65). Pb bioaccumulation of the accession of the Control site was lower than the other sites except Odoore (Table 65).

No significant differences in the Pb bioaccumulation of the accession of Otte and Oyun, so also were the accession of Budo Egba, Budo Abio, Okeodo and Isale Aluko. Accession of Ojagboro had the same Pb BAC with the accession of Olaolu (Table 65). Bioaccumulation of Pb in *Amaranthus hybridus* accession NGBO125 in the second rainy season (2017) was in the range of 0.42 ±0.01 and 1.81±0.03 with the lowest recorded in the accession of the Control site and the highest in the accession of Olaolu (Table 65). Pb Bioaccumulation coefficient of the Control site was lower than the other sites (Table 65). BAC of Pb of the accession of Otte and Olaolu were statistically the same (Table 65). Oyun and Ojagboro recorded same statistical Pb BAC in the bsecond rainy season (2017) (Table 65). Bioaccumulation Coefficient of Pb of the *Amaranthus hybridus acc*ession was in the order NGBO125≥NG/AO/11/08/039≥ NG/AA/03/11/010. (Table 65). Pb bioaccumulation coefficient of the *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second rainy (2017) ranged between 0.50±0.01 and 2.65±0.11 with the lowest obtained in the accession of the Control site and the highest in Olaolu (Table 65). Pb BAC of the accession of the Control site was lower than the other sites (Table 65). Accession of Otte, Okeodo and Isale Aluko were statistically the same. Accession of Otte and Budo Egba had the same Pb bioaccumulation coefficient (Table 65). Accession of all the sites were good Pb bioaccumulators (Pb BAC≥0.5) except for the accession of Mubo, Ojagboro, Olaolu and Coca cola that were good Pb hyperaccumulators(Pb BAC ≥1) and the Control site was a poor Pb bioaccumulator with value lower than 0.5 (Table 65). The range of Pb bioaccumulation coefficient of *Corchorus olitorius* NG/OA/04/010 accession in the second rainy was ranged berween 0.17±0.03 and 1.01±0.05 with the lowest obtained from the accession of the Control site and the highest from the accession of Olaolu (Table 65).

Bioaccumulation of Pb in the accession of the Control site was lower than the other sites (Table 65). Accession of Mubo and Odoore had the same statistical Pb BAC, so were the accession of Budo Egba and Okeodo (Table 65). There were no statistical differences in the Pb BAC of the accession in Olaolu and Isale Aluko. Accession of all the sites were good Pb bioaccumulators (Pb BAC ≥0.5) except for the accession of Olaolu that was a good Pb hyperaccumulator (Pb BAC≥1) and the accession of Otte, Budo Abio, Mubo, Ojagboro, Odoore and the Control site that were poor Pb bioaccumulators with values lower than 0.5 (Table 65).

Table 64: Bioaccumulation Coefficient Lead of vegetable Accessions (*Amarathus hybridus and Corchorus olitorius*) in the first rainy season (2016).

	Amarathus hybridus				*Corchorus olitorius*
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.10 ± 0.01^{b}	0.23 ± 0.01^{a}	0.00 ± 0.00^{b}	0.14 ± 0.02^{bc}	0.20 ± 0.01^{c}
Budo Egba	0.11 ± 0.03^{b}	0.17 ± 0.02^{ab}	0.03 ± 0.03^{b}	0.21 ± 0.07^{ab}	0.25 ± 0.02^{bc}
Budo Abio	0.09 ± 0.02^{b}	0.11 ± 0.01^{b}	0.00 ± 0.00^{b}	0.25 ± 0.01^{ab}	0.21 ± 0.00^{c}
Mubo	0.12 ± 0.00^{b}	0.10 ± 0.00^{b}	0.00 ± 0.00^{b}	0.20 ± 0.02^{b}	0.19 ± 0.01^{c}
Oyun	0.12 ± 0.01^{b}	0.15 ± 0.01^{ab}	0.11 ± 0.03^{a}	0.23 ± 0.01^{ab}	0.21 ± 0.01^{c}
Ojagbooro	0.31 ± 0.01^{a}	0.20 ± 0.02^{ab}	0.00 ± 0.00^{b}	0.29 ± 0.02^{a}	0.32 ± 0.01^{b}
Olaolu	0.12 ± 0.00^{b}	0.17 ± 0.01^{ab}	0.00 ± 0.00^{b}	0.20 ± 0.01^{b}	0.44 ± 0.03^{a}
Eroomo	0.10 ± 0.01^{b}	0.13 ± 0.01^{b}	0.00 ± 0.00^{b}	0.27 ± 0.03^{a}	0.17 ± 0.01^{cd}
Okeodo	0.12 ± 0.02	0.17 ± 0.01^{ab}	0.09 ± 0.00^{ab}	0.19 ± 0.03^{b}	0.33 ± 0.01^{b}
Cocacola	0.25 ± 0.02^{ab}	0.21 ± 0.03^{a}	0.08 ± 0.02^{ab}	0.25 ± 0.03^{ab}	0.22 ± 0.01^{c}
Isale Aluko	0.13 ± 0.01^{b}	0.19 ± 0.02^{ab}	0.00 ± 0.02^{b}	0.17 ± 0.00^{bc}	0.32 ± 0.00^{b}
Odoore	0.12 ± 0.03^{b}	0.12 ± 0.01^{b}	0.00 ± 0.00^{b}	0.10 ± 0.01^{bc}	0.17 ± 0.00^{cd}
Botanical garden(control site)	0.08 ± 0.00^{b}	0.05 ± 0.00^{c}	0.00 ± 0.00^{b}	0.06 ± 0.01^{a}	0.12 ± 0.05^{d}

Values with the same alphabet along the colomn are the same at $p\leq0.05$. Values represent mean±SD. BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥1 implies good hyperaccumulator of metal.

4.11: Metal dynamics (transfer factor of selected heavy metals in the vegetable accessions). The Transfer Factor of Cd of the accession (*Amaranthus hybridus* accession NG/AA/03/11/010 in the first dry season (2015) (Table 66) ranged between 0.10±0.02 and 0.73±0.02 with the lowest factor in the Control ste and the highest in Ojagboro. Accession of the Control site had Cd Transfer factor lower than all the sites. Accession of Otte, Budo-Egba, Mubo, Oyun, Ojagboro and Olaolu (Table 66). Accession of the sites had low Cd transfer factor with value lower than 0.5 except for the accession Oyun and Okeodo that had higher value than 0.5 (Table 66).

Cadmium transfer factor in *Amaranthus hybridus* accession NG/AO/11/08/039 in the first dry season (2015) ranged between 0.02±0.01 and 0.10±0.01 with the lowest recorded in the accession of the Control site and the highest in Budo Egba. Accession of the Control site had lower Transfer Factor of Cd than the other sites (Table 66). Accession of all the sites had low Cd transfer rate with values lower than than 0.5 (Table 66). Transfer Factor of Cd in the accession (*Amaranthus hybridus* accession NGBO 125) ranged between 0.01±0.00 and 0.09±0.01 (Table 51). Lowest Transfer Factor of Cd was recorded in the Control site while the highest was obtained in the accession of Otte. Transfer Factor of cadmium in the accession of the Control site was lower than the other sites (Table 66).

The range of the Transfer Factor of cadmium of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season (2015) was between 0.03±0.01 and 0.17±0.01 with the lowest value in the Control site and the highest in Budo-Egba (Table 66). TF of the accession in the Control site had lower value than the other sites. Transfer Factor of the accession of Otte, Budo Egba and Odoore were significantly the same . No significant differences were recorded of the TF of the accession of Budo Abio, Oyun ,Olaolu ,Coca-cola and Isale Aluko (Table 66). Accession in all the sites had Cd transfer rate lower tan 0.5. Cd Transfer Factor of the *Corchorus olitorius* accession NG/OA/04/010 ranged between 0.03±0.00 and 0.17±0.01 with the lowest recorded in Control site and the highest in Budo-Egba. Tf of Cd in the accession of the Control site was lower than the other sites (Table 66).

Table 67 shows the cadmium Transfer factor of the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second dry season (2016).

Table 65 Bioaccumulation Coefficient of Lead of vegetable Accessions Second rainy (2017).

Site	*Amaranthus hybridus*			*Corchorus olitorius*	
	NG/AA/03/11/010	NG/AO/11/08 /039	NGBO125	NG/OA/Jun/09/0 02	NG/OA/04/010
Otte	0.71±0.01[de]	0.70±0.03[de]	0.92±0.02[c]	0.88±0.05[d]	0.30±0.03[ef]
Budo Egba	1.00±0.04[abc]	0.81±0.02[d]	1.28±0.01[b]	0.82±0.01[d]	0.60±0.02[de]
Budo Abio	0.77±0.01[de]	0.80±0.04[d]	0.65±0.00[de]	0.56±0.05[ef]	0.23±0.03[efg]
Mubo	1.15±0.05[ab]	1.29±0.05[bc]	1.25±0.01[b]	1.27±0.03b	0.43±0.03[e]
Oyun	0.87±0.01[d]	0.78±0.03[d]	0.80±0.02[cd]	0.75±0.01[de]	0.85±0.01[c]
Ojagboro	0.52±0.01[ef]	1.58±0.01[b]	0.85±0.01[cd]	1.15±0.01[bc]	0.45±0.01[ef]
Olaolu	1.30±0.01[b]	1.55±0.01[b]	1.81±0.03[a]	2.65±0.11[a]	1.01±0.05[a]
Eroomo	0.89±0.01[d]	0.90±0.01[c]	0.71±0.08[d]	0.65±0.01[e]	0.55±0.01[e]
Okeodo	0.80±0.01[d]	0.80±0.01[d]	0.94±0.01[c]	0.95±0.01[cd]	0.67±0.01[de]
Cocacola	1.70±0.05[a]	1.95±0.04[a]	1.30±0.07[b]	1.14±0.01[bc]	0.75±0.01[cd]
Isale Aluko	0.98±0.01[c]	0.80±0.03d	1.27±0.04[b]	0.96±0.01[d]	0.91±0.03[ab]
Odoore	0.62±0.03[e]	0.87±0.01[d]	0.60±0.01[c]	0.60±0.01[ef]	0.21±0.05[f]
Botanical garden(Control site)	0.22±0.01f	0.32±0.01[e]	0.42±0.01[bc]	0.48±0.03[f]	0.17±0.03[f]

Values with the same alphabet along the colomn are the same at p ≤0.05. Values represent mean±SD. BAC ≤0.5 implies poor metal accumulator, BAC ≥ 0.5 implies good bioaccumulatorof metal BAC ≥1 implies good hyperaccumulator of metal.

Transfer factor of cadmium in the accession (*Amaranthus hybridus accession* NG/AA/03/11/010*)* in the second dry season (2016) was in the range of 0.09±0.07 and 0.60±0.28 with the lowest obtained in the accession of Odoore and the highest in the accession of Isale Aluko. Cd transfer factor in the accession of the Control site was lower than the other sites except for the accession of Odoore (Table 67). There were no significant differences in the cadmium transfer factor in the accession of Otte, Budo Egba, Oyun, Ojagboro and Coca cola. The accession of Budo Abio and Mubo had the same Cd transfer factor (Table 67). Accession of the sites had low Cd transfer rate potential (0.5) except for the accession of Mubo and Isale Aluko that had high Cd transfer rate potential with Cd TF greater than 0.5, therefore, were good phytostabilizer of Cd.

Transfer factor of cadmium in the *Amaranthus hybridus* accession in the second dry season (2016) ranged between 0.02±0.03 and 0.49±0.16. The lowest cadmium transfer factor was recorded in the accession of the Odoore while the highest was recorded in the accession of Mubo (Table 67). Transfer factor of cadmium in the accession of the Control site was lower than the other site except the accession of Odoore. There were significant differences in the transfer factor of Cd of the accession of Budo Egba, Budo Abio, Mubo and Ojagboro, so also were the accession of Otte, Coca cola and Isale Aluko (Table 67). It was found that the accession of all the sites were poor phytostabilizer of Cd with values lower than 0.5 (Table 67). Cd transfer factor of *Amaranthus hybridus* accession NGBO125 accession was ranged between 0.07 ±0.02 and 0.47± 0.09 with the lowest in the accession of the Control site and the highest in Otte accession (Table 67). No significant differences were recorded in the Cd TF of accession in Otte, Budo Egba, Budo Abio, Mubo and Okeodo, so also were the accession of Oyun, Ojagboro and Coca cola. Accession of all the sites were poor Cd phytostabilizer because their values were less than 0.5. Transfer factor of cadmium in the accession *Corchorous olitorius* NG/OA/Jun/09/002 in the second dry season was in the range of 0.08±0.07 and 0.71±0.03. The lowest Cd transfer factor was recorded in the accession of the Control site and the highest was obtained from the accession of Mubo (Table 67).

Table 66: Transfer Factor of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the first dry season (2015).

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.23±0.01[a]	0.08±0.01[ab]	0.10±0.01[a]	0.15±0.02[ab]	0.12±0.02[b]
Budo Egba	0.29±0.01[ab]	0.10±0.01[a]	0.09±0.01[ab]	0.17±0.01[a]	0.17±0.01[a]
Budo Abio	0.11±0.02+[bc]	0.05±0.01[bc]	0.04±0.01[c]	0.07±0.02[c]	0.10±0.01[b]
Mubo	0.20±0.01[bc]	0.05±0.01[bc]	0.04±0.01[c]	0.10±0.00[bc]	0.09±0.01[bc]
Oyun	0.50±0.05[a]	0.07±0.01[ab]	0.03±0.01[c]	0.09±0.01[bc]	0.13±0.01[b]
Ojagbooro	0.73±0.02[ab]	0.09±0.01[ab]	0.06±0.01[bc]	0.12±0.02[b]	0.13±0.01[b]
Olaolu	0.40±0.02b	0.05±0.01[bc]	0.03±0.01[c]	0.07±0.01[c]	0.11±0.01[b]
Eroomo	0.22±0.01[c]	0.03±0.01[b]	0.01±0.00[c]	0.06±0.01[c]	0.05±0.00[c]
Okeodo	0.52±0.02[c]	0.03±0.01[b]	0.05±0.00[bc]	0.04±0.01[d]	0.08±0.00[bc]
Cocacola	0.20±0.01[bc]	0.07±0.01[ab]	0.06±0.01[bc]	0.09±0.01[bc]	0.12±0.02[b]
Isale Aluko	0.20±0.01[bc]	0.04±0.01[b]	0.06±0.01[bc]	0.07±0.01[c]	0.07±0.01[bc]
Odoore	0.30±0.01[b]	0.03±0.01[c]	0.02±0.01[d]	0.16±0.02[a]	0.04±0.00[c]
Botanical garden(control site)	0.10±0.01[bc]	0.02±0.01[b]	0.08±0.01[ab]	0.03±0.01[d]	0.03±0.01[c]

TF≥ 0.5 implies good bioaccumulator of metal, TF>1.0–Goodphytostabilizer of metal. TF = Transfer Factor. Pb=Lead

Transfer factor of cadmium in the accession of the Control site was lower than the other sites. Accession of Otte, Oyun, Ojagboro, and Coca cola were statistically the same in the Cd transfer factor, so also were the accession of Budo Egba, Budo Abio, Olaolu and Isale Aluko (Table 67). Accession of the sites were all less than 0.5, therefore, were poor phytostabilizer of Cd except for the accession of Budo Egba, Budo Abio, Mubo, Olaolu and Isale Aluko that were good Cd phytostabilizers with values greater than 0.5 (Table 67). Transfer factor of Cd of the *Corchorous olitorius* NG/OA/04/010 accession in the second dry season (2016) ranged between 0.18±0.01 and 0.77±0.02 with the lowest obtained from the accession of the Control site and the highest from the accession of Oyun. Cd transfer factor of the accession of the Control site was lower than all the other sites (Table 67). Accession of Otte and Budo Egba had the same cadmium transfer factor (Table 67). Accession of Otte and Budo Egba were statistically the same in their Cd TF, so also were the accession in Oyun and Olaolu, likewise, Mubo, Ojagboro, Eroomo and Okeodo (Table 67). Accession of Odoore and the Control site had the same Cd transfer factor (Table 67). Accession of the sites had high Cd transfer potential rate with values greater than 0.5 therefore, were good Cd phytostabilizers except for the accession of Otte, Budo Egba, Budo Abio, Odoore and the Control site (Table 67).

Table 68 shows the range of cadmium transfer factor in *Amarathus hybridus* accession NG/AA/03/11/010 in the first rainy season (2016) was between 0.02±0.00 and 0.11±0.01. Cd transfer factor of the accession of the Control site was lower than the other sites (Table 68). Accessions of the sites were all poor Cd phytostabilizer with their values less than 0.5 (Table 68). Cd transfer factor in *Amarathus hybridus* accession NG/AO/11/08/039 was between 0.02±0.01 and 0.11±0.04 with the lowest in the accession of the Control site and the highest in Otte (Table 68). The result indicated that the accession of all the sites had poor Cd transfer rate with values less than 0.5, therefore, were poor phytostabilizer of Cd (Table 68). Transfer Factor of *Amarathus hybridus* accession NGBO 125 in the first rainy season (2016) ranged between 0.01 ± 0.00 and 0.10 ±0.01 with the the lowest value in the Control accession and the highest in Otte.(Table 68). It was indicated that the accession of all the sites had poor Cd transfer rate with values less than 0.5, therefore, were poor phytostabilizer of Cd (Table 68).

Transfer Factor of cadmium in *Corchorus olitorius* accession NG/OA/Jun/09/002 accession in the first rainy season (2016) ranged between 0.03±0.00 and 0.17±0.01 with the lowest in accession of the Control site and the highest in Budo Egba (Table 68). Accession of all the sites had TF of Cd less than 0.5, therefore were poor phytostabilizer of Cd because of their low Cd transfer rate potential (Table 68). *Corchorus olitorius* accession NG/OA/04/010 recorded the range of Cd transfer factor of 0.0 0±0.00 and 0.17±0.0.01. Accession of the Control site had 0.0 0±0.00 transfer facor of Cd . Accession of the other sites had TF of Cd less 0.5 (Table 68). It was shown in the result that Cd transfer in all the vegetable accession was so poor because all the accessions had Cd transfer rate lower than 0.5, therefore , all the accessions were poor Cd stabilizer (Table 68).

Table 69 shows the Tansfer factor of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second rainy season (2017). No Cd was detected in any of the vegetable accessions in the second rainy season (2017). Table 70 presents the Cu Transfer Factor in *Amaranthus hybridus* accession NG/AA/03/11/010 in the first dry season (2015) ranged between 0.02±0.01 and 0.24±0.03 with the lowest in the accession of the Control site and the highest in Ojagboro (Table 70). The TF of copper of the accession of the Control site was lower than the other sites (Table 70). There were no significant differences in the TF of Cu in Otte, Olaolu, Eroomo and Okeodo, so also were the accession of of Oyun and Odoore. Accession of the sites had Cu transfer factor lower than 0.5, therefore,had low Cu transfer rate potential and were poor Cu phytostabilizer (Table 70). Copper Transfer Factor in *Amaranthus hybridus* accession NG/AO/11/08/039 in the first dry season (2015) ranged between 0.02±0.01 and 0.27±0.01 with the lowest recorded in the accession of the Control site and the highest in Oyun (Table 70). Copper Transfer Factor of the accession in the Control site was lower than the other sites (Table 70). The accession of Oyun and Ojagboro recorded relatively higher Cu TF than the other sites (Table 70). Accession of all the sites had low copper transfer rate and low copper potential with TF less than 0.5, therefore, were all Cu phytostabilizers (Table 70). Transfer Factor of copper of *Amaranthus hybridus* accession NGBO 125 in the first dry season (2015) ranged between 0.02±0.00 and 0.23±0.02. The TF of copper of the Control site was lower than the sites (Table 70).

Table 67: Tansfer factor of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second dry season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	$0.40{\pm}0.02^{bc}$	$0.38{\pm}0.22^{b}$	$0.47{\pm}0.09^{a}$	$0.44{\pm}0.02^{c}$	$0.47{\pm}0.03^{c}$
Budo Egba	$0.42{\pm}0.02^{bc}$	$0.47{\pm}0.29^{a}$	$0.46{\pm}0.06^{a}$	$0.51{\pm}0.01^{b}$	$0.41{\pm}0.01^{c}$
Budo Abio	$0.33{\pm}0.02^{cd}$	$0.48{\pm}0.40^{a}$	$0.43{\pm}0.05^{a}$	$0.57{\pm}0.06^{b}$	$0.36{\pm}0.04^{cd}$
Mubo	$0.55{\pm}0.22^{b}$	$0.49{\pm}0.16^{a}$	$0.37{\pm}0.09^{b}$	$0.71{\pm}0.03^{a}$	$0.53{\pm}0.03^{bc}$
Oyun	$0.44{\pm}0.41^{bc}$	$0.29{\pm}0.28^{bc}$	$0.26{\pm}0.04^{bc}$	$0.42{\pm}0.09^{c}$	$0.77{\pm}0.02^{a}$
Ojagbooro	$0.47{\pm}0.07^{bc}$	$0.41{\pm}0.06^{ab}$	$0.29{\pm}0.60^{bc}$	$0.43{\pm}0.10^{c}$	$0.50{\pm}0.02^{bc}$
Olaolu	$0.25{\pm}0.08^{c}$	$0.18{\pm}0.06^{c}$	$0.16{\pm}0.05^{c}$	$0.51{\pm}0.15^{b}$	$0.74{\pm}0.03^{a}$
Eroomo	$0.09{\pm}0.08^{d}$	$0.09{\pm}0.04^{de}$	$0.04{\pm}0.04^{e}$	$0.12{\pm}0.21^{e}$	$0.52{\pm}0.04^{bc}$
Okeodo	$0.19{\pm}0.06^{cd}$	$0.15{\pm}0.05^{cd}$	$0.33{\pm}0.09^{b}$	$0.31{\pm}0.10^{cd}$	$0.53{\pm}0.03^{bc}$
Cocacola	$0.40{\pm}0.09^{bc}$	$0.35{\pm}0.08^{b}$	$0.26{\pm}0.05^{bc}$	$0.47{\pm}0.13^{bc}$	$0.64{\pm}0.03^{b}$
Isale Aluko	$0.60{\pm}0.28^{a}$	$0.35{\pm}0.31^{b}$	$0.42{\pm}0.08^{a}$	$0.55{\pm}0.09^{b}$	$0.69{\pm}0.02^{b}$
Odoore	$0.09{\pm}0.07^{d}$	$0.02{\pm}0.03^{f}$	$0.12{\pm}0.02^{cde}$	$0.20{\pm}0.08^{d}$	$0.18{\pm}0.01^{ef}$
Botanical garden(control site)	$0.09{\pm}0.15^{d}$	$0.06{\pm}0.10^{ef}$	$0.07{\pm}0.02^{e}$	$0.08{\pm}0.07^{e}$	$0.16{\pm}0.27^{f}$

Values with the same ame superscript along the same column are statistically the same at $p \leq .0.05$. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Table 68: Tansfer factor of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the first rainy season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.11 ± 0.01^{a}	0.08 ± 0.01^{ab}	0.10 ± 0.01^{a}	0.15 ± 0.02^{ab}	0.12 ± 0.02^{b}
Budo Egba	0.08 ± 0.01^{ab}	0.10 ± 0.01^{a}	0.09 ± 0.01^{ab}	0.17 ± 0.01^{a}	0.17 ± 0.01^{a}
Budo Abio	0.04 ± 0.01^{b}	0.05 ± 0.01^{bc}	0.04 ± 0.01^{c}	0.07 ± 0.02^{c}	0.03 ± 0.01^{c}
Mubo	0.05 ± 0.01^{bc}	0.05 ± 0.01^{b}c	0.04 ± 0.01^{c}	0.10 ± 0.00^{bc}	0.09 ± 0.01^{bc}
Oyun	0.10 ± 0.02^{ab}	0.07 ± 0.01^{ab}	0.03 ± 0.01^{c}	0.09 ± 0.01^{bc}	0.13 ± 0.01^{b}
Ojagbooro	0.07 ± 0.02^{ab}	0.09 ± 0.01^{ab}	0.06 ± 0.01^{bc}	0.12 ± 0.02^{b}	0.13 ± 0.01^{b}
Olaolu	0.04±0.01c	0.05 ± 0.01^{b}	0.03 ± 0.01^{c}	0.07 ± 0.01^{c}	0.11 ± 0.01^{b}
Eroomo	0.04±0.01c	0.03 ± 0.01^{b}	0.02 ± 0.00^{c}	0.06 ± 0.01^{c}	0.05 ± 0.00^{c}
Okeodo	0.03 ± 0.01^{c}	0.03 ± 0.01^{b}	0.05 ± 0.00^{bc}	0.04 ± 0.01^{d}	0.08 ± 0.00^{bc}
Cocacola	0.05 ± 0.01^{bc}	0.07 ± 0.01^{ab}	0.08 ± 0.01^{bc}	0.09 ± 0.01^{bc}	0.12 ± 0.02^{b}
Isale Aluko	0.05 ± 0.01^{bc}	0.04 ± 0.01^{b}	0.06 ± 0.01^{bc}	0.07 ± 0.01^{c}	0.07 ± 0.01^{bc}
Odoore	0.02 ± 0.01^{d}	0.03 ± 0.01^{c}	0.04 ± 0.01^{c}	0.16 ± 0.02^{ab}	0.04 ± 0.00^{c}
Botanical garden(control site)	0.04 ± 0.01^{bc}	0.02 ± 0.00^{bc}	0.01±0.00ab	0.03 ± 0.00^{d}	0.00 ± 0.00^{c}

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Table 69: Tansfer factor of Cadmium in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second rainy season (2017).

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Budo Egba	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Budo Abio	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Mubo	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Oyun	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Ojagbooro	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Olaolu	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Eroomo	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Okeodo	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Cocacola	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Isale Aluko	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Odoore	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
Botanical garden(control site)	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Table 70: Tansfer factor of Copper in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the first dry season (2015)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	$0.04{\pm}0.01^{d}$	$0.05{\pm}0.01^{e}$	$0.03{\pm}0.01^{d}$	$0.05{\pm}0.01^{c}$	$0.06{\pm}0.01^{c}$
Budo Egba	$0.09{\pm}0.00^{b}$	$0.10{\pm}0.01^{c}$	0.13 ± 0.02^{b}	$0.06{\pm}0.01^{c}$	0.10 ± 0.02^{bc}
Budo Abio	$0.02{\pm}0.01^{d}$	$0.03{\pm}0.00^{e}$	$0.02{\pm}0.00^{d}$	$0.01{\pm}0.00^{d}$	$0.02{\pm}0.01^{c}$
Mubo	$0.07{\pm}0.01^{c}$	$0.07{\pm}0.00^{e}$	$0.05{\pm}0.02^{cd}$	$0.01{\pm}0.00^{d}$	$0.09{\pm}0.01^{bc}$
Oyun	$0.11{\pm}0.01^{b}$	$0.27{\pm}0.01^{a}$	$0.23{\pm}0.02^{a}$	$0.11{\pm}0.01^{b}$	$0.21{\pm}0.02^{a}$
Ojagbooro	$0.24{\pm}0.03^{a}$	$0.19{\pm}0.01^{b}$	$0.21{\pm}0.04^{a}$	$0.14{\pm}0.01^{a}$	$0.23{\pm}0.02^{a}$
Olaolu	$0.04{\pm}0.01^{d}$	$0.05{\pm}0.01^{d}$	$0.02{\pm}0.00^{d}$	$0.03{\pm}0.00^{cd}$	$0.04{\pm}0.01^{c}$
Eroomo	$0.04{\pm}0.01^{d}$	$0.03{\pm}0.01^{e}$	$0.04{\pm}0.01^{cd}$	$0.03{\pm}0.01^{cd}$	$0.04{\pm}0.01^{c}$
Okeodo	$0.04{\pm}0.01^{d}$	$0.03{\pm}0.00^{e}$	$0.06{\pm}0.01^{cd}$	$0.03{\pm}0.00^{cd}$	$0.04{\pm}0.01^{c}$
Cocacola	$0.06{\pm}0.00^{d}$	$0.06{\pm}0.01^{bd}$	$0.15{\pm}0.03^{b}$	$0.03{\pm}0.01^{cd}$	$0.04{\pm}0.01^{c}$
Isale Aluko	$0.04{\pm}0.01^{d}$	$0.05{\pm}0.01^{bd}$	$0.10{\pm}0.02^{bc}$	$0.04{\pm}0.01^{cd}$	$0.04{\pm}0.01^{c}$
Odoore	$0.11{\pm}0.02^{b}$	$0.06{\pm}0.01^{bd}$	$0.11{\pm}0.01^{bc}$	$0.07{\pm}0.01^{c}$	$0.12{\pm}0.02^{bc}$
Botanical garden(control site)	$0.02{\pm}0.00^{d}$	$0.02{\pm}0.01^{c}$	$0.02{\pm}0.00^{d}$	$0.01{\pm}0.00^{d}$	$0.02{\pm}0.00^{c}$

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

All Cu TF of the accession of the sites recorded TF less than 0.5, therefore, were of low Copper transfer rate and poor Cu phytostabilizers. (Table 70). Copper Transfer Factor in *Amaranthus hybridus* accession NG/AO/11/08/039 was slightly than NG/AA/03/11/010 and NGBO 125. The result shows that all the *Amaranthus hybridus* accessions in the first dry season (2015) had low Cu transfer rate potential, were therefore, poor Cu stabilizer. The range of the copper Transfer Factor in the *Corchorus olitorius accession* NG/OA/Jun/09/002 in the first dry season (2015) was between 0.01±0.00 and 0.14 ±0.01 with lowest in the accession of the Control site and the highest in Ojagboro (Table 70). No significant differences were recorded in the Transfer Factor of the accession of the Okeodo, Eroomo, Coca-cola and Isale-Aluko. Same statistical values of Cu Transfer Factor were recorded in the accession of Budo-Abio, Mubo and Okeodo (Table 70). No significant differences in the copper TF in the accession of Otte, Budo Abio and Odoore. Accession of all the sites were poor Cu phytostabilizers since thay had transfer factor values lower than 0.5 (Table 70).

Cu transfer factor in *Corchorus olitorius* accession NG/OA/04/010 in the first dry season (2015) ranged between 0.02±0.00 and 0.23±0.02 with the lowest in the accession of the Control site and the highest in Ojagboro. The accession of the Control site had lower TF of copper than other sites (Table 70). Accession of Oyun and Ojagboro had relatively higher Cu TF (Table 70). *Corchorus olitorius* NG/OA/04/010 had higher Cu Transfer factor values than *Corchorus olitorius* NG/OA/Jun/09/002 (Table 70). The result indicated low Cu transfer rate potential of the accession in the first dry season, therefore, accession in all sites were poor Cu phytostabilizers (Table 70). Table 71 presents the Transfer factor of copper in the *Amaranthu hybridus* accession NG/AA/03/11/010 in the second dry season (2016) ranged between 0.23±0.04 and 0.66±0.17 with the lowest in the accession of Odoore and thehighest in Ojagboro (Table 71). The accession of the Control site had Cu transfer factor lower than the accession of the other sites except the accession of Odoore. There were no significant differences in the Cu transfer factor in the accession of the Control site, Mubo and Olaolu, so also were the accession of Otte, Oyun and Okeodo (Table 71).Cu TF of accession Budo Egba, Budo Abio and Ojagboro were statistically tha same, so also were the accession of Eroomo, Coca cola and Isale Aluko (Table 71).

Accession of the site had Cu TF lower than 0.5, therefore, had low Cu transfer rate potential except for the accession in Otte, Mubo, Oyun, Okeodo, Odoore and Control site that had values higher than 0.5, therefore had high Cu transfer rate potential. Cu transfer factor of *Amaranthus hybridus* accession NG/AO/11/08/039 in the second dry season (2016) ranged between 0.32±0.01 and 1.36±0.21 with the lowest in the accession of Odoore and the highest in Coca cola. Cu transfer factor in the accession of the Control site was higher than the other sites except Budo Egba, Oyun, Ojagboro,Eroomo,Coca cola and Isale Aluko. There were no significant differences in the Cu transfer factor of the accession of the Control site, Okeodo and Isale Aluko, so also were the accession of Otte, Budo Abio, Mubo, Olaolu and Odoore. likewise the accession of Oyun and Eroomo (Table 71). The result shows that accession of all the sites had Cu TF less than 0.5 except for Budo Egba, Oyun, Ojagboro and Eroomo that had values higher than 0.5, therefore, had higher Cu transfer rate potential, so also was the accession of Coca cola that had value higher than 1, therefore, had high Cu transfer rate potential and was a good Cu phytostabilizer (Table 71).

The range of copper transfer factor in the *Amaranthus hybridus* accession NGBO 125 in the second dry season (2015) was 0.34±0.10 and 0.95±0.10 with the lowest obtained from the accession of Mubo and the highest in the accession of Ojagboro (Table 71). Cu transfer factor of the Control site was lower than the other sites except the accession of Mubo, Eroomo and Odoore. Accession of Otte, Oloaolu and Okeodo were statistically the same in the Cu transfer factor (Table 71). There were no significant differences in the transfer factor of the accession of Budo Egba, Budo Abio, Oyun, Coca cola and Isale Aluko (Table 71). The range of copper transfer factor in the accession between the sites was 0.34±0.10 and 0.95±0.10 with the lowest obtained in the accession of Mubo and the highest in the accession of Ojagboro (Table 71). Cu transfer factor of the Control site accession was lower than the other sites except the accession of Mubo, Eroomo and Odoore. Accession of Otte, Oloaolu and Okeodo were statistically the same in the Cu transfer factor. There were no significant differences in the transfer factor of the accession of Budo Egba, Budo Abio, Oyun, Coca cola and Isale Aluko (Table 71). Accession in the sites had Cu TF lower than 0.5 except for the accession of Budo Egba, Budo Abio, Oyun, Ojagboro, Coca cola and Isale Aluko that had values higher than 0.5, therefore, had high Cu transfer rate potential. *Amaranthus hybridus* accession NG/AO/11/08/039 had the highest Cu transfer rate followed by *Amaranthus hybridus* accession NGBO 125 and the least was *Amaranthus hybridus* accession NG/AA/03/11/010. Cu Transfer factor in the *Corchorous olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016) was ranged between 0.34±0.13 and 0.54±0.16 with the lowest obtained in Odoore and the highest in the Budo Abio (Table 71). Accession of the Control site had lower Cu transfer factor than the other sites except Budo Egba, Mubo, Ojagboro, Olaolu, Isale Aluko and Odoore.

The result showed that accession in all the sites had low Cu transfer rate with values lower than 0.5 except fot the accession of Budo Abio that had value higher than 0.5, therefore, had high Cu transfer rate in the second dry season.(Table 71). Transfer factor of Cu in *Corchorous olitorius* accession NG/OA/04/010 in the second dry season was in the range of 0.28±0.01 and 0.64±0.16 with the lowest was obtained in the accession of Odoore and the highest in Ojagboro. Transfer factor of the Control site accession was higher than the other sites except for Ojagboro (Table 71). Accession of Otte, Budo Abio, Mubo, Olaolou, Eroomom and Isale Aluko had the same statistical value of Cu transfer factor. The result shows that accession of all the sites had low Cu transfer rate potential with values lower than 0.5 except for the accession of Budo Egba that had value higher than 0.5 (Table 71). Accessions of *Amaranthus hybridus* had higher Cu transfer rate potential than the *Corchorus olitorius* accessions (Table 71).

Table 72 presents the Transfer Factor of Cu in *Amaranthus hybridus* accession NG/AA/03/11/010 in the first rainy season (2016) with the range 0.19±0.04 and 0.36 ±0.02 with the lowest in Odoore and the highest in the accession of Ojagboro (Table 72). Transfer Factor of the accession of Cu of the Control site was lower than the accession of the other sites except the accession of Eroomo, Isale Aluko and Odoore. Accession of all the sites had TF of Cu lower 0.5 suggesting low Cu transfer rate potential in the accession (Table 72). The transfer factor of copper of the *Amaranthus hybridus* accession NG/AO/11/08/039 in the first rainy season (2016) ranged bewteen 0.29±0.06 and 0.58±0.08 with the lowest TF Cu recorded in the accession of Oyun and the highest in the accession of Odoore. Transfer Factor of Cu in the accession of the Control site was lower than the accession of the other sites except Otte , Budo Abio and Odoore.

Table 71: Tansfer factor of Copper in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second dry season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	$0.49±0.31^{b}$	$0.39±0.18^{e}$	$0.45±0.04^{bc}$	$0.45±0.23^{ab}$	$0.39±0.10^{c}$
Budo Egba	$0.62±0.19^{ab}$	$0.69±0.19^{c}$	$0.54±0.19^{b}$	$0.41±0.14^{ab}$	$0.50±0.25^{b}$
Budo Abio	$0.66±0.12^{a}$	$0.34±0.09^{e}$	$0.56±0.08^{b}$	$0.54±0.16^{a}$	$0.30±0.06^{cd}$
Mubo	$0.39±0.05^{bc}$	$0.34±0.11^{e}$	$0.34±0.10^{c}$	$0.41±0.17^{ab}$	$0.39±0.20^{c}$
Oyun	$0.42±0.03^{bc}$	$0.52±0.04^{cd}$	$0.52±0.04^{b}$	$0.46±0.26^{ab}$	$0.47±0.06^{bc}$
Ojagbooro	$0.66±0.17^{a}$	$0.91±0.92^{b}$	$0.95±0.10^{a}$	$0.42±0.25^{ab}$	$0.64±0.16^{a}$
Olaolu	$0.39±0.12^{bc}$	$0.35±0.13^{e}$	$0.41±0.30^{bc}$	$0.39±0.16^{b}$	$0.38±0.02^{c}$
Eroomo	$0.57±0.24^{abc}$	$0.51±0.16^{cd}$	$0.36±0.07^{c}$	$0.46±0.12^{ab}$	$0.35±0.04^{c}$
Okeodo	$0.44±0.05^{bc}$	$0.45±0.13^{d}$	$0.44±0.15^{bc}$	$0.46±0.20^{ab}$	$0.40±0.12^{bcd}$
Cocacola	$0.50±0.06^{abc}$	$1.36±0.21^{a}$	$0.55±0.18^{b}$	$0.43±0.08^{ab}$	$0.44±0.09^{b}$c
Isale Aluko	$0.59±0.27^{abc}$	$0.47±0.01^{d}$	$0.50±0.07^{b}$	$0.35±0.19^{b}$	$0.38±0.10^{c}$
Odoore	$0.23±0.04^{c}$	$0.32±0.01^{e}$	$0.36±0.11^{c}$	$0.34±0.13^{b}$	$0.28±0.01^{d}$
Botanical garden(control site)	$0.38±0.06^{bc}$	$0.45±0.07^{d}$	$0.38±0.10^{c}$	$0.43±0.12^{ab}$	$0.53±0.20^{a}$

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Transfer factor of Cu in the accession of the Control site had the same statistical value with accession of Otte and Isale Aluko . No significant differences were recorded in the Cu transfer factor of the accession of Budo Egba, Mubo and Olaolu. Statistically the same values of TF Cu were recorded for accession of Oyun , Ojagboro , Eroomo and Olaolu. Accession of all the site had low Cu transfer rate since their values were lower than 0.5 except for the accession of Budo Abio and Odoore that had high Cu transfer rate potential with values higher than 0.5 (Table 72). The Cu transfer factor of *Amaranthus hybridus* NGBO 125 was in the range of 0.17±0.09 and 0.37±0.06 with the lowest value recorded in the accession of Coca cola and the highest in the accession of Ojagboro (Table 72) . Accession of Otte, Budo Egba and Budo Abio recorded the same statistical values of Cu transfer factor. TF of Cu in the accession of Mubo, Olaolu, Eroomo and Odoore were statistically the same, so also were the accession of Oyun and Cocacola (Table 72). Accession of the sites had low Cu transfer rate potential. Cu TF in *Amaranthus hybridus* accessions was in the order NG/AO/11/08/039 ≥ NG/AA/03/11/010 ≥ NGBO125 (Table 72). Copper transfer factor in the *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first rainy season (2016) ranged between 0.14± 0.09 and 0.49 ±0.06 with the lowest recorded in the accession of Isale Aluko and the highest in the accession of Okeodo. Accession of the Control site had higher Transfer factor than the accession of the other sites except Oyun and Okeodo . Accession of Otte, Mubo, Olaolu and Eroomo recorded significantly same transfer factor of copper (Table 72).

The result indicated low Cu transfer rate potential of the accession. No significant differences in the transfer factor of the accession of Budo Abio, Budo Egba, Ojagboro, Cocacola, Isale Aluko, Odoore and the Control site. Copper transfer factor of *Corchorus olitorius* accession NG/OA/04/010 ranged between 0.03±0.01 and 0.18±0.02 with then lowest factor obtained in the accession of Olaolu and the highest from the accession of Coca cola (Table 72). Cu transfer factor of the accession of the Control site was lower than the other sites except for the accession of Budo Abio, Olaolu, Isale Aluko and Odoore (Table 72). *Corchorus olitorius* accession NG/OA/Jun/09/002 had higher Cu transfer factor than *Corchorus olitorius* accession (Table 72). Accessions of *Amaranthus hybridus* had slightly higher values of Cu TF than the accessions of *Corchorus olitorius* (Table 72).

Table 73 shows Transfer factor of copper in the *Amaranthus hybridus* accession NG/AA/03/11/010 the second rainy season (2017) was in the range of 0.04±0.01 and 0.39±0.10 with the lowest copper transfer factor obtained in the accession of Eroomo and the highest in the accession of Mubo. Transfer factor of copper of the accession of Control site was higher than the transfer factor of copper of the accession of the other sites except the accession of Budo Abio, Mubo and Isale Aluko. Cu transfer factor of the accession of Otte, Oyun, Ojagboro, Okeodo and Cocacola were the statistically the same (Table 73). Cu TF of the accession in all sites had values lower than 0.5, therefore, had low Cu transfer rate potential (73).

Copper transfer factor in *Amaranthus hybridus* accession NG/AO/11/08/039 in the second rainy season ranged between 0.10±0.05 and 0.24±0.03 with the lowest in the accession of Budo Abio and the highest in the accession of Mubo (Table 73). Cu transfer factor in the Control site was higher than the other sites except for Mubo and Olaolu. Cu TF of Budo Abio, Ojagboro, Okeodo and Odoore were statistically the same. Accession in all the sites had low Cu transfer rate potential since their values were lower than 0.5 (Table 73). Cu transfer factor in *Amaranthus hybridus* accession NGBO125 ranged between 0.06±0.01 and 0.33±0.02 with the lowest Cu TF obtained in the accession of Budo Egba and the highest in the accession of Oyun (Table 73). Cu TF of the accession of the Control site was lower than the other sites except Otte and Budo Egba. Low Cu transfer rate was observed in the accession. Comparing the Cu transfer factor of the three accessions of *Amaranthus hybridus*, *Amaranthus hybridus* accession NG/AO/11/08/039 ≥ NG/AA/03/11/010 ≥ NGBO125.

Transfer factor of Cu in *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second rainy season (2017) was in the range of 0.10±0.01 and 0.48±0.12 with the lowest copper transfer factor obtained in the accession of Otte and the highest in the accession of Mubo. TF of Cu of the accession of the Control site was higher than the other sites except for the accession of Budo Abio and Mubo (Table 73). The result shows low Cu transfer rate potential of the accession. Cu Transfer factor of the *Corchorus olitorius* accession NG/OA/04/010 ranged between 0.04±0.01 and 0.29±0.09 with the lowest obtained in the accession of Budo Egba and the highest from the accession of Mubo (Table 73).

Transfer factor of the accession of the Control site was lower than the other sites except Otte and Budo Egba. Accession of the sites had low Cu transfer rate potential (Table 73).

Table 74 presents Transfer factor of Pb in *Amaranthus hybridus* accession NG/AA/03/11/010 in the first dry season was in the range of 0.10±0.02 and 0.73±0.02 with the lowest Pb transfer factor obtained in the accession of the Control while the highest was obtained in the accession of Ojagboro (Table 74). The transfer factor of the accession of the Control site was lower than the other sites (Table 74). No significant differences in the values of TF of Pb in the accession of Otte, Budo Abio and Cocacola were recorded (Table 74).

Accession in the sites had Pb transfer factor lower than 0.5 except for the accession of Ojagboro that had higher Pb TF higher than 0.5, therefore, high Pb transfer rate potential. The *Amaranthus hybridus* accession NG/AO/11/08/039 had the range of transfer factor of Pb between sites as 0.10±0.05 and 0.87±0.03 with the lowest in the accession of Budo Abio and the highest in the accession of Ojagboro. The accession of the Control site had Pb transfer factor lower than other sites except for Otte, Bubo Abio, Mubo, Eroomo and Cocacola (Table 74). Accession of all the site had lower values than 0.5 except for the accession in Ojagboro that had value greater than 0.5. Pb Transfer Factor of *Amaranthus hybridus* accession NGBO 125 was between 0.11±0.05 and 0.64±0.01 with the lowest transfer factor at the accession of Eroomo and the highest Olaolu. Accession of the Control site waslower than the other siites except for Eroomo (Table 74). Accession in the sites were all lower than 0.5, therefore were of low Pb transfer rate potential except for the accession of Okeodo and Coca cola (Table 74).

The transfer Factor of Pb of *Corchorus olitorius* accession NG/OA/Jun/09/002 was between 0.09±0.05 and 0.47±0.01 with the lowest value recorded in the accession of the Control site and the highest in the accession of Ojagboro. Pb TF of the accession of the Control site was higher than all other sites. Accession of the sites all had Pb TF lower than 0.5 (Table 74).

Table 72: Tansfer factor of Copper in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the first rainy season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.28 ± 0.02^{b}	0.48 ± 0.02^{b}	0.29 ± 0.08^{b}	0.28 ± 0.06^{cd}	0.13 ± 0.04^{a}
Budo Egba	0.29 ± 0.07^{b}	0.38 ± 0.02^{c}	0.29 ± 0.04^{b}	0.34 ± 0.03^{c}	0.12 ± 0.03^{a}
Budo Abio	0.34 ± 0.02^{a}	0.52 ± 0.04^{ab}	0.29 ± 0.04^{b}	0.31 ± 0.00^{c}	0.07 ± 0.05^{b}
Mubo	0.24 ± 0.05^{b}	0.36 ± 0.11^{c}	0.21 ± 0.12^{bc}	0.25 ± 0.08^{cd}	0.14 ± 0.02^{a}
Oyun	0.33 ± 0.02^{a}	0.29 ± 0.02^{d}	0.19 ± 0.10^{c}	0.42 ± 0.16^{b}	0.14 ± 0.01^{a}
Ojagbooro	0.36 ± 0.02^{a}	0.30 ± 0.04^{d}	0.37 ± 0.06^{a}	0.34 ± 0.18^{c}	0.16 ± 0.02^{a}
Olaolu	0.25 ± 0.04^{b}	0.35 ± 0.03^{c}	0.23 ± 0.06^{bc}	0.22 ± 0.03^{cd}	0.03 ± 0.01^{b}
Eroomo	0.19 ± 0.04^{c}	0.30 ± 0.02^{d}	0.22 ± 0.04^{bc}	0.21 ± 0.03^{cd}	0.11 ± 0.07^{a}
Okeodo	0.36 ± 0.10^{a}	0.29 ± 0.03^{d}	0.34 ± 0.11^{a}	0.49 ± 0.01^{a}	0.12 ± 0.01^{a}
Cocacola	0.23 ± 0.06^{b}	0.41 ± 0.11^{bc}	0.17 ± 0.02^{c}	0.31 ± 0.01^{c}	0.18 ± 0.02^{a}
Isale Aluko	0.21 ± 0.05^{b}	0.45 ± 0.13^{b}	0.32 ± 0.14^{a}	0.14 ± 0.01^{d}	0.06 ± 0.01^{b}
Odoore	0.15 ± 0.02^{c}	0.58 ± 0.04^{a}	0.25 ± 0.10^{bc}	0.34 ± 0.11^{c}	0.05 ± 0.04^{b}
Botanical garden(control site)	0.22±0.03b	0.47 ± 0.13^{b}	0.38 ± 0.11^{a}	0.34 ± 0.12^{c}	0.09 ± 0.04^{b}

Values with the same ame superscript along the same column are statistically the same at $p\leq.0.05$. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Table 73: Tansfer factor of Copper in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second rainy season (2017)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.10 ± 0.01^{c}	0.13 ± 0.01^{bc}	0.09 ± 0.01^{e}	0.10 ± 0.01^{d}	0.07 ± 0.01^{d}
Budo Egba	0.07 ± 0.02^{cd}	0.15 ± 0.01^{b}	0.06 ± 0.01^{e}	0.12 ± 0.01^{d}	0.04 ± 0.01^{d}
Budo Abio	0.19 ± 0.03^{b}	0.10 ± 0.05^{c}	0.12 ± 0.01^{d}	0.33 ± 0.03^{b}	0.20 ± 0.10^{b}
Mubo	0.39 ± 0.10^{a}	0.24 ± 0.03^{a}	0.33 ± 0.02^{b}	0.48 ± 0.12^{a}	0.29 ± 0.09^{a}
Oyun	0.10 ± 0.10^{c}	0.15 ± 0.02^{b}	0.60 ± 0.14^{a}	0.18 ± 0.02^{cd}	0.14 ± 0.10^{c}
Ojagbooro	0.12 ± 0.01^{c}	0.11 ± 0.02^{c}	0.18 ± 0.03^{c}	0.18±0.01cd	0.13 ± 0.02^{c}
Olaolu	0.09 ± 0.01^{cd}	0.16 ± 0.02^{b}	0.13 ± 0.02^{d}	0.16 ± 0.02^{cd}	0.12 ± 0.02^{c}
Eroomo	0.04 ± 0.01^{d}	0.17 ± 0.01^{b}	0.14 ± 0.01^{d}	0.14 ± 0.01^{d}	0.10 ± 0.01^{c}
Okeodo	0.11 ± 002^{c}	0.11 ± 0.01^{c}	0.11 ± 0.01^{de}	0.19 ± 0.01^{c}	0.13 ± 0.02^{c}
Cocacola	0.10 ± 0.01^{c}	0.15 ± 0.02^{b}	0.19 ± 0.01^{c}	0.18 ± 0.01^{cd}	0.09 ± 0.02^{cd}
Isale Aluko	0.21 ± 0.03^{b}	0.21 ± 0.03^{ab}	0.17 ± 0.03^{cd}	0.15 ± 0.03^{c}	0.14 ± 0.02^{c}
Odoore	0.15 ± 0.01^{bc}	0.12 ± 0.01^{c}	0.14 ± 0.01^{d}	0.17 ± 0.02^{cd}	0.13 ± 0.01^{c}
Botanical garden(control site)	0.13 ± 0.01^{c}	0.15 ± 0.04^{b}	$0.11\pm0.01d^{e}$	0.19 ± 0.01^{c}	0.08 ± 0.01^{d}

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Table 74: Tansfer factor of lead in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the first dry season (2015)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.23±0.01^{de}	0.13±0.05^{ef}	0.13±0.01^{ef}	0.16±0.04^{d}	0.19±0.01^{def}
Budo Egba	0.29±0.01^{d}	0.39±0.01^{bc}	0.43±0.01^{c}	0.15±0.02^{d}	0.16±0.14^{def}
Budo Abio	0.11±0.02^{e}	0.10±0.05^{ef}	0.23±0.05^{d}	0.14±0.01^{d}	0.12±0.01^{ef}
Mubo	0.20±0.01^{de}	0.22±0.05^{de}	0.18±0.04^{e}	0.10±0.05^{e}	0.10±0.02^{f}
Oyun	0.41±0.05^{bc}	0.31± 0.02^{bcd}	0.40±0.01^{c}	0.21±0.05^{cd}	0.21±0.04^{def}
Ojagbooro	0.73±0.02^{a}	0.87±0.01^{a}	0.43±0.01^{c}	0.47±0.01^{a}	0.57±0.03^{a}
Olaolu	0.40±0.02^{c}	0.43±0.02^{b}	0.47±0.01b^{c}	0.33±0.03^{b}	0.32±0.01^{bc}
Eroomo	0.22±0.01^{e}	0.18±0.05^{def}	0.11±0.05^{ef}	0.23±0.02^{c}	0.10±0.01^{f}
Okeodo	0.42±0.02^{bc}	0.35±0.02^{bc}	0.64±0.03^{a}	0.31±0.02^{b}	0.34±0.01^{bc}
Cocacola	0.21±0.01^{de}	0.15±0.05^{ef}	0.39±0.02^{c}	0.21±0.02^{cd}	0.10±0.02^{f}
Isale Aluko	0.30±0.01^{d}	0.32±0.02^{bc}	0.53±0.01^{b}	0.26±0.04^{c}	0.27±0.01^{cd}
Odoore	0.30±0.01^{d}	0.33±0.05^{bc}	0.18±0.02^{e}	0.16±0.04^{d}	0.37±0.01^{bc}
Botanical garden(control site)	0.10±0.02^{e}	0.25±0.01^{cd}	0.13±0.03^{ef}	0.09±0.05^{e}	0.09±0.03^{f}

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Pb transfer factor of *Corchorus olitorius* accession NG/OA/04/010 was between 0.09±0.03 and 0.57±0.03 with the lowest value recorded in the accession of the Control site and the highest in the accession of Ojagboro. Accession of the Control site had lower Pb TF than accession of the other sites (Table 74). Accession of all the sites had TF lower than 0.5 except for the accession of Ojagboro that had Pb TF higher than 0.5 therefore, had high Pb transfer rate potential (Table 74). Table 75 shows the Pb transfer factor of *Amaranthus hybridus* accession NG/AA/03/11/010 in the second dry season (2016) was in the range of 0.25±0.00 and 1.00±0.15 with the lowest obtained from the accession of the Control site and the highest in the accession of Coca cola. Pb transfer factor of the accession of the Control site was lower than the other sites (Table 75). Pb transfer factor of the accession of the Control site was statistically the same with the accession of Odoore. Accession of Budo Egba, Mubo, Ojagboro, Oloalu and Eroomo had the same Pb transfer factor, so also were the accession of Oyun and Odoore. Accessionin the sites had Pb TF lower than 0.5, therefore, were of low Pb transfer rate potential except for the accession of Isale Aluko (0.69±0.32) that had Pb TF higher than 0.5 indicating high Pb transfer rate potential and the accession of Coca cola (1.00±0.15) that had Pb TF greater than 1indicating the accession was a good Pb phytostabilizer (Table 75).

Transfer factor of Pb in the accession of *Amaranthus hybridus* accession NG/AO/11/08/039 in the second dry season(2016) had the range of 0.24±0.21 and 0.98±0.19 with the lowest obtained from the accession of the Control site and the highest in the accession of Coca cola. Pb transfer factor of the accession of the Control site was lower than the other sites. There was no significant differences in the Pb transfer factor of the accession of the Control site, Budo Egba, Oyun, Eroomo, Okeodo and Odoore. Accession of Otte, Budo Abio and Mubohad the same Pb TF, so also were the accession of , Ojagboro and Olaolu (Table 75). The range of Pb transfer factor of *Amaranthus hybridus* accession NGBO125 in the second dry season was between 0.23±0.17 and 0.52±0.19 with the lowest obtained in the accession of the Control site and the highest from the accession of Coca cola. Pb transfer factor of the Control site accession was than the other (Table 75). There were no significant differences in the Pb transfer factor of the accession of Budo Egba, Ojagboro, Olaolu and Okeodo, so also were the accession of Otte, Budo Abio, Mubo, Eroomo and Odoore (Table 75).

The range of Pb transfer factor in the *Corchorous olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016) was between 0.23±0.17 and 0.52±0.19 with the lowest in the accession of Okeodo while the highest was obtained in the accession of Isale Aluko. Pb transfer factor of the Control site was lower than the other sites (Table 75). There were no significant differences in the Pb transfer factor of the accession of Budo Egba, Mubo, Oyun, Olaolu, Odoore and the Control site, so also were the accession of Ojagboro and Isale Aluko. Accession of Otte, Budo Abio, Eroomo and Okeodo were statistically the same in the values of Pb TF (Table 75). It was found that accession in all the sites were of low Pb transfer rate potential with values lower than 0.5 except for the accession of Isale Aluko that was of high Pb transfer rate potential with value greater than 0.5 (Table 75). Transfer factor of *Corchorous olitorius* accession NG/OA/04/010 ranged between 0.15±0.14 and 0.52±0.71 with the lowest recorded in the accession of the Control site and the highest in the accession Isale Aluko. The accession of the Control site had a lower Pb transfer factor than the other sites. There were no significant differences in the Pb transfer factor of the accession of Budo Abio, Ojagboro, Eroomo and the Control site, so also were the accession of Budo Egba, Oyun, Olaolu and Okeodo, likewise the accession of Otte, Mubo and Odoore(Table 75). Accession in all the sites were of low Pb transfer rate potential except for the accession of Isale Aluko (0.52±0.71) that was of high Pb transfer rate with Pb TF greater than 0.5(Table 75).

Table 76 Pb transfer factor in *Amarathus hybridus* accession NG/AA/03/11/010 in the first rainy season (2016) ranged between 0.01±0.01 and 0.13±0.03 with the lowest in the Control site and the highest in Coca cola. TF Pb of the Control site was lower than the other sites. No significant differences were recorded in the TF Pb of accession in Budo Abio, Eroomo and Okeodo (Table 76). Pb transfer rate potential of the accession was lower with all values lower than 0.5 (Table 76). Transfer factor of Pb in *Amarathus hybridus* accession NG/AO/11/08/039 was in the range of 0.01±0.00 and 0.25±0.07 with the lowest recorded in the accession of the Control site and the highest in Oyun. The Control site recorded lower TF of Pb than other sites. Pb TF of the accession in Otte, Budo Egba, Eroomo, Okeodo and Cocacola were statistically the same. No significant differences was recorded in the Pb TF in the accession of Budo Abio and Oyun, so also were the accession of Mubo and Odoore. Accession of Olaolu had the same transfer factor of Pb as the accession of Isale Aluko. Accession in all the sites hd low Pb transfer rate potential with values lower than 0.5. The range of the Pb Transfer Factor of *Amarathus hybridus* accession NGBO125 was between 0.04±0.08 and 0.34±0.05 with the lowest recorded in the accession of the Control site and the highest in the accession of Ojagboro. Transfer Factor of Pb in the accession of the Control site was lower than the accession of the other sites (Table 76). There were no significant differences in the Pb TF of the accession in Otte, Budo Abio Eroomo and Okeodo. Accession of Mubo, Olaolu and Odoore had the same Pb TF. Accession of all the sites had Pb transfer factor less than 0.5, therefore, were of low Pb transfer rate potential (Table 76). Pb Transfer factor of the *Amarathus hybridus* accessions was in the order NG/AO/11/08/039 ≥ NGBO125 ≥ NG/AA/03/11/010. Pb transfer factor of the *Corchorus olitorius* NG/OA/Jun/09/002 was in the range of 0.02±0.00 and 0.27±0.05 with the lowest in recorded in the accession of the Control site and the highest in Oyun. The accession of the Control site had lower Pb TF than the accession of the other sites. Accession of Otte, Ojagboro, Cocacola and Isala Aluko were statistically the same in the transfer factor of Pb, so also were the accession of Budo Egba and Odoore (Table 76). No significant differences in the Pb TF in the accession of Budo Abio, Oyun, Erooomo and Isale Aluko were recorded, so also were the accession of Mubo and Olaolu (Table 76).

The *Corchorus olitorius* accession NG/OA/04/010 had Pb transfer factor range between 0.01±0.01 and 0.16±0.03 with the lowest Pb transfer factor recorded in the accession of the Control site and the highest in the accession of Coca cola. Pb transfer factor of the accession of the Control site was lower than the accession of the other sites (Table 76). Accession of Otte, Budo Egba, Eroomo and Cocacola recorded the same Pb transfer factor. No significant differences were recorded in the Pb transfer factor of the accession of Budo Abio, Okeodo and Isale Aluko. The same statistical values of transfer factor were recorded for the accession in Mubo, Oyun, Olaolu, Odoore and the Control site (Table 76). Low Pb transfer rate potential was recorded for the accession with values lower than 0.5 (Table 76). Higher Pb transfer rate potential were recorded in *Corchorus olitorius* accession NG/OA/Jun/09/002 than *Corchorus olitorius* accession NG/OA/04/010. Accessions of *Corchorus olitorius* were of slightly higher Pb rate potential than the *Amaranthus hybridus* accession s (Table 76).

Table 77 shows the Pb Transfer factor in the accession *Amaranthus hybridus* NG/AA/03/11/010 in the second rainy season (2017) was in the range of 0.05±0.02 and 0.21±0.04 with the lowest recorded in the accession of Budo Abio and the highest was obtained in the accession of Mubo (Table 77). Transfer factor of Pb of the accession of the Control site was lower than the other sites except the accession of Budo Abio, Olaolu and Odoore. Transfer factor of Pb of the accession of Otte, Budo Egba, Ojagboro, Okeodo and Isale Aluko were statistically the same. No significant differences in the transfer factor of Pb of the accession in Budo Abio and Olaolu were recorded. Accession in the sites were of poor Pb transfer rate potential (Table 77). Pb Transfer in *Amaranthus hybridus* accession NG/AO/11/08/039 in the second rainy season (2017) ranged between 0.05±0.00 and 0.13±0.01 with the lowest in the accession of the Control site and the highest in Ojagboro. Accession of all the sites were of low Pb transfer rate potential with value lower than 0.5 (Table 77).

Pb Transfer in *Amaranthus hybridus* accession NGBO125 was in the range of 0.02±0.01 and 0.18±0.07 with the lowest obtained in the accession of the Control site and the highest in the accession of Mubo (Table 77). The order of Pb transfer factor of the *Amaranthus hybridus* accessions was NG/AA/03/11/010 greater than NGBO125 greater than NG/AO/11/08/039. Accession of the sites were of low Pb transfer potential (Table 77). Pb Transfer factor of *Corchorus olitorius* accession NG/OA/04/010 in the second rainy season (2017) was ranged 0.06±0.00 and 0.20±0.04 with the lowest transfer factor obtained in the accession of the Control site and the highest in the accession in Mubo (Table 77). Low Pb transfer rate potential was recorded in the accession (Table 77). TF of Pb in *Corchorus olitorius* accession NG/OA/04/010 was greater than *Corchorus olitorius* accession NG/OA/Jun/09/002 (Table 77).

4.12: Proximate composition of the vegetable accessions.

Table 78 shows the proximate composition analysis (nutritional content) of *Amaranthus hybridus* accession NG/AA/03/11/010 in the first dry season (2015). The range of the moisture content in the accession ranged between 6.38±0.02% and 6.86±0.11 % with the lowest moisture content in the accession of Coca cola and the highest in the accession of the Control site. The accession in the Control site had higher moisture content than the accession in the other sites (Table 78). Percentage moisture in accession in Otte and Budo- Abio were statistically the same. No significant differences in the percentage moisture in accession in Budo Egba, Mubo, Ojagboro, Cocacola and Isale Aluko (Table 78). Accession of Oyun and Olaolu recorded same percentage moisture content. The range of the ash content of the accession was between 2.46±0.02 % and 6.44±0.02 % with the lowest recorded in the accession in the Control site and the highest in the accession of Ojagboro. The percentage ash in *Amaranthus hybridus* accession NG/AA/03/11/010 in the Control site lower than the other sites (Table 78). No significant differences in the percentage ash of accession in Mubo, Oyun and Cocacola.

The range of the percentage fat and oil of the accession in the first dry season (2015) was between 3.09±0.02 % and 4.91±0.01 % with the lowest recorded in the accession in Cocacola and the highest in Odoore. Accession in the Control site and Okeodo recorded the same percentage fat and oil (Table 78). Percentage fat and oil of accession in Otte, Budo Egba and Cocacola were statistically the same (Table 78). No significant differences were recorded in the percentage fat and oil in the accession of Budo Abio, Mubo, Oyun, Ojagboro ,Olaolu and Cocacola but statistical differences in the percentage of fat and oil in the accession at $p \leq 0.05$(Table 78). Crude protein of the *Amaranthus hybridus* accession NG/AA/03/11/010 ranged between 10.57±7.06 % and 18.59±6.93 % with the lowest recorded in the accession of Budo Egba and the highest in Eroomo. Percentage crude protein in the accession in the Control site was higher than the accession in other sites except for Eroomo and Odoore (Table 78). Accession in the Control site was statistically the same in the percentage crude protein as the accession in Budo Abio. Accession of Otte , Olaolu and Isale Aluko had the same percentage crude protein, so were accession of Budo-Egba, Ojagboro and Cocacola (Table 78).

Table 75: Tansfer factor of lead in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second dry season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	$0.43±0.03^{c}$	$0.43±0.09^{c}$	$0.32±0.09^{d}$	$0.37±0.08^{b}$	$0.36±0.12^{b}$
Budo Egba	$0.31±0.27^{de}$	$0.29±0.25^{e}$	$0.29±0.25^{de}$	$0.23±0.20^{c}$	$0.19±0.17^{cd}$
Budo Abio	$0.40±0.07^{cd}$	$0.41±0.10^{c}$	$0.30±0.27^{de}$	$0.34±0.16^{b}$	$0.26±0.22^{bc}$
Mubo	$0.38±0.06^{d}$	$0.42±0.06^{c}$	$0.36±0.05^{d}$	$0.24±0.19^{c}$	$0.31±0.04^{bc}$
Oyun	$0.29±0.26^{e}$	$0.28±0.25^{de}$	$0.43±0.50^{c}$	$0.23±0.21^{c}$	$0.17±0.16^{cd}$
Ojagbooro	$0.33±0.29^{de}$	$0.31±0.27^{d}$	$0.25±0.24^{de}$	$0.40±0.10^{ab}$	$0.29±0.04^{bc}$
Olaolu	$0.33±0.30^{de}$	$0.32±0.28^{d}$	$0.25±0.22^{de}$	$0.26±0.23^{c}$	$0.19±0.18^{cd}$
Eroomo	$0.32±0.28^{de}$	$0.27±0.06^{e}$	$0.35±0.36^{d}$	$0.31±0.26^{b}$	$0.25±0.22^{bcd}$
Okeodo	$0.37±0.05^{d}$	$0.29±0.26^{de}$	$0.22±0.20^{de}$	$0.38±0.20^{b}$	$0.19±0.16^{cd}$
Cocacola	$1.00±0.15^{a}$	$0.98±0.19^{a}$	$0.72±0.27^{a}$	$0.42±0.24^{ab}$	$0.49±0.44^{ab}$
Isale Aluko	$0.69±0.32^{b}$	$0.63±0.32^{b}$	$0.56±0.38^{b}$	$0.52±0.19^{a}$	$0.52±0.11^{a}$
Odoore	$0.28±0.25^{e}$	$0.24±0.21^{e}$	$0.36±0.3^{4d}$	$0.27±0.25^{bc}$	$0.33±0.18^{b}$
Botanical garden(control site)	0.25±0.00	$0.23±0.20^{e}$	$0.17±0.19^{e}$	$0.23±0.17^{c}$	$0.15±0.14^{d}$

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Table 76: Tansfer factor of lead in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the first rainy season (2016)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.09 ± 0.02^{ab}	0.11 ± 0.02^{b}	0.11 ± 0.05^{ab}	0.15 ± 0.02^{b}	0.13 ± 0.00^{ab}
Budo Egba	0.06 ± 0.04^{abc}	0.14 ± 0.04^{b}	0.19 ± 0.04^{b}	0.11 ± 0.00^{bc}	0.11 ± 0.02^{ab}
Budo Abio	0.07 ± 0.02^{abc}	0.17 ± 0.07^{ab}	0.12 ± 0.05^{ab}	0.09 ± 0.03^{bcd}	0.08 ± 0.04^{bc}
Mubo	0.01 ± 0.01^{c}	0.07 ± 0.02^{bc}	0.05 ± 0.06^{c}	0.03 ± 0.00^{d}	0.03 ± 0.01^{c}
Oyun	0.02 ± 0.03^{c}	0.25 ± 0.07^{a}	0.11 ± 0.05^{b}	0.08 ± 0.00^{bcd}	0.01 ± 0.01^{c}
Ojagbooro	0.02 ± 0.00^{c}	0.15 ± 0.07^{ab}	0.34 ± 0.05^{a}	0.17 ± 0.07^{b}	0.16 ± 0.03^{a}
Olaolu	0.11 ± 0.04^{ab}	0.04 ± 0.00^{c}	0.27 ± 0.03^{b}	0.27 ± 0.05^{a}	0.03 ± 0.01^{c}
Eroomo	0.06 ± 0.01^{abc}	0.14 ± 0.01^{b}	0.15 ± 0.10^{ab}	0.08 ± 0.00^{bcd}	0.12 ± 0.02^{ab}
Okeodo	0.05 ± 0.02^{abc}	0.12 ± 0.00^{b}	0.16 ± 0.09^{ab}	0.10 ± 0.02^{bc}	0.09 ± 0.05^{bc}
Cocacola	0.13 ± 0.03^{a}	0.12 ± 0.02^{b}	0.23 ± 0.05^{b}	0.15 ± 0.01^{b}	0.14 ± 0.02^{ab}
Isale Aluko	0.03 ± 0.04^{bc}	0.05 ± 0.02^{c}	$0.08\pm0.03b^{c}$	0.17 ± 0.02^{b}	0.05 ± 0.02^{bc}
Odoore	0.03 ± 0.03^{bc}	0.09 ± 0.03^{bc}	0.04 ± 0.08^{c}	0.09 ± 0.03^{bcd}	0.03 ± 0.03^{c}
Botanical garden(control site)	0.01 ± 0.01^{c}	0.01 ± 0.00^{d}	0.04 ± 0.00^{c}	0.02 ± 0.00^{d}	0.02 ± 0.01^{c}

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Table 77: Tansfer factor of lead in the vegetable accessions (*Amaranthus hybridus and Corchorus olitorius)* in the second rainy season (2017)

	Amaranthus hybridus			*Corchorus olitorius*	
Site	NG/AA/03/11/010	NG/AO/11/08/039	NGBO125	NG/OA/Jun/09/002	NG/OA/04/010
Otte	0.15±0.01^{ab}	0.12±0.01^{a}	0.13±0.01^{bc}	0.09±0.01^{b}	0.17±0.01^{ab}
Budo Egba	0.15±0.01^{ab}	0.10±0.01^{ab}	0.14±0.01^{bc}	0.17±0.01^{a}	0.10±0.01^{b}
Budo Abio	0.05±0.02^{c}	0.06±0.00^{b}	0.05±0.02^{c}	0.04±0.02^{c}	0.07±0.02 ^{c}
Mubo	0.21±0.04^{a}	0.13±0.02^{a}	0.18±0.07^{a}	0.11±0.03^{b}	0.20±0.04^{a}
Oyun	0.13±0.01^{b}	0.10±0.03^{ab}	0.16±0.01^{ab}	0.12±0.01^{b}	0.10±0.01^{b}
Ojagbooro	0.18±0.01^{ab}	0.13±0.01^{a}	0.11±0.01^{bc}	0.08±0.01^{b}	0.06±0.01^{c}
Olaolu	0.07±0.01^{c}	0.05±0.01^{b}	0.05±0.00^{c}	0.03±0.00^{c}	0.03±0.00^{c}
Eroomo	0.11±0.01^{b}	0.07±0.01^{ab}	0.15±0.01^{b}	0.11±0.01^{b}	0.10±0.00^{bc}
Okeodo	0.17±0.01^{ab}	0.12±0.01^{a}	0.18±0.01^{a}	0.13±0.01^{b}	0.10±0.01^{bc}
Cocacola	0.11±0.01^{b}	0.09±0.01^{b}	0.14±0.01^{bc}	0.11±0.01^{b}	0.11±0.01^{bc}
Isale Aluko	0.15±0.01^{ab}	0.09±0.00^{b}	0.13±0.00^{bc}	0.07±0.00^{c}	0.06±0.00^{c}
Odoore	0.10±0.01^{bc}	0.05±0.00^{b}	0.06±0.01^{c}	0.06±0.01^{c}	0.07±0.01^{c}
Botanical garden(control site)	0.10±0.01^{bc}	0.05±0.00^{b}	0.02±0.01^{c}	0.05±0.01^{c}	0.01±0.01^{c}

Values with the same ame superscript along the same column are statistically the same at p≤.0.05. Values represent mean±SD. TF<0.5–Low metal transfer rate TF>1.0–Goodphytostabilizer and High metal transfer potemtial

Accession of Mubo and Oyun were statistically the same in the percentage of crude protein. Percentage crude fibre of *Amaranthus hybridus* accession NG/AA/03/11/010 was between 1.63±0.01 and 2.39±0.02 % . The accession in the Control site had lower percentage crude flbre than the accession of the other sites. No significant differences in the percentage crude fibre in the accession of Otte ,Budo Egba, Okeodo and Odoore (Table 78). Accession of Budo Abio, Mubo, Olaolu, Eroomo and Isale Aluko had statistically the same percentage crude fibre (Table 78). The range of percentage carbohydrate of *Amaranthus hybridus* accession NG/AA/03/11/010 ranged between 63.16±0.01 % and 75.30±0.02 % with the lowest value in Ojagboro and the highest in Budo Abio accession. Percentage carbohydrate in accession of the Control site was lower than the accession of other sites except for Budo Abio, Ojagboro and Odoore. No significant differences were recorded in the percentage carbohydrate in the accession in Budo Egba, Oyun, Ojagboro Cocacola, Isale Aluko, Odoore and Control site. Accession of Oyun and Okeodo had the same percentage carbohydrate (Table 78).

Table 79 shows the Proximate Composition of *Amaranthus hybridus* accession NG/AA/03/11/010. The range of the moisture content of *Amaranthus hybridus* accession NG/AA/03/11/010 in second dry season (2016) ranged between 6.46 ±0.01 % and 6.93±0.02 %. The lowest moisture content was obtained in the accession of Ojagboro while the highest in Odoore. The moisture content in the accession of the Control site was higher than the other sites except for the accession of Okeodo and Odoore (Table 79) indicating lower moisture content than in the first dry season (2015). Ash content ranged between 4.05±0.02 % and 5.42±0.01 % with the lowest obtained in the accession of the Control site and the highest in Ojagboro. Ash content of the Control site was lower than the other sites (Table 79). The result showed higher ash content in the accession in the second dry season (2016) than in the first dry season (2015). The fat and oil content in *Amaranthus hybridus* accession NG/AA/03/11/010 rangedbetween 3.80±0.00 % and 4.37±0.00 %. Accession in Ojagboro had the lowest content of fat and oil while the accession in Budo Egba had the highest percentage fat and oil (Table 79).The accession of the Control site had crude fat and oil content higher than the other sites except for the accession of Budo Egba and Odoore suggesting higher crude fat and oil in the accession in the second dry season (2016) than in the first dry season (2015) (Table 79).

Table 78 : Proximate composition analysis(%) of fresh edible vegetable accession (*Amaranthus hybridus* accession NG/AA/03/11/010) first dry season (2015).

SITE	MOISTURE	ASH	FAT AND OIL	CRUDE PROTEIN	CRUDE FIBRE	PERCENTAGE CARBONHYDRATE
Otte	6.40 ± 0.35^{d}	5.23 ± 0.01^{c}	3.19 ± 0.01^{c}	11.66 ± 0.11^{d}	1.64 ± 0.02^{c}	69.80 ± 0.02^{abc}
Budo-Egba	6.75 ± 0.03^{b}	5.19 ± 0.01^{c}	3.33 ± 0.01^{c}	10.57 ± 7.06^{de}	1.66 ± 0.02^{c}	64.37 ± 0.03^{c}
Budo-Abio	6.79 ± 0.04^{b}	3.52 ± 0.02^{e}	3.98 ± 0.01^{bc}	16.49 ± 0.02^{b}	2.39 ± 0.02^{a}	75.30 ± 0.02^{a}
Mubo	6.79 ± 0.01^{b}	5.48 ± 0.02^{bc}	3.85 ± 0.02^{bc}	14.51 ± 0.02^{c}	2.35 ± 0.02^{a}	68.51 ± 0.17^{bc}
Oyun	6.68 ± 0.02^{c}	5.43 ± 0.02^{bc}	3.88 ± 0.03^{bc}	13.69 ± 2.45^{c}	2.29 ± 0.02^{ab}	65.22 ± 0.02^{c}
Ojagboro	6.74 ± 0.02^{b}	6.44 ± 0.02^{a}	3.74 ± 0.01^{bc}	10.73 ± 2.49^{de}	2.07 ± 0.02^{b}	63.16 ± 0.01^{c}
Olaolu	6.64 ± 0.01^{c}	5.22 ± 0.01^{c}	3.80 ± 0.02^{bc}	11.57 ± 0.03^{d}	2.34 ± 0.01^{a}	70.24 ± 0.02^{b}
Eroomo	6.54 ± 0.01^{cd}	2.46 ± 0.02^{f}	4.83 ± 0.02^{ab}	18.59 ± 6.93^{ab}	2.36 ± 0.01^{a}	70.23 ± 0.02^{ab}
Okeodo	6.81 ± 0.01^{a}	4.42 ± 0.02^{d}	4.16 ± 0.02^{b}	15.63 ± 0.06^{bc}	1.68 ± 0.02^{c}	67.33 ± 0.03^{bc}
Coca-cola	6.38 ± 0.02^{d}	5.71 ± 0.02^{bc}	3.09 ± 0.02^{c}	10.67 ± 0.06^{de}	1.80 ± 0.01^{bc}	65.22 ± 0.02^{c}
Isale-Aluko	6.75 ± 0.08^{b}	5.98 ± 0.01^{b}	3.67 ± 0.30^{bc}	11.63 ± 0.06^{d}	2.34 ± 0.02^{a}	65.05 ± 0.01^{c}
Odoore	6.85 ± 0.01^{a}	4.22 ± 0.01^{de}	4.91 ± 0.01^{a}	18.63 ± 0.04^{a}	1.63 ± 0.01^{c}	64.43 ± 0.06^{c}
Botanical garden (Control site)	6.86 ± 0.11^{a}	4.23 ± 0.02^{de}	4.22 ± 0.02^{b}	16.57 ± 0.05^{b}	1.59 ± 0.01^{c}	64.54 ± 0.02^{c}

Values with the same superscript along the same column are statistically the same at $p\leq0.5$. Values are means ± SD.

Crude protein content ranged between 9.58±0.02 % and 21.90±0.01 % with the lowest obtained in the accession of Ojagboro and the highest in the accession of Odoore (Table 79). Percentage crude protein of the Control site was higher than the other sites except for the accession of Odoore (Table 79). It was found that higher crude protein content was observed in the second dry season (2016) than in the first dry season (2015) accession. The range of crude fibre ranged between 1.67±0.01 % and 2.42±0.02 % with the lowest obtained in the accession of the Control site and the highest in Mubo. The accession of the Control site had lower percentage crude fibre than the other sites (Table 79). Higher crude fibre content was observed in the second dry season (2016) than in the first dry season (2015) accession. Carbohydrate content ranged between 62.71±0.01 % and 76.77±0.03 %. Accession of the Control site had lower carbohydrate content than the other sites (Table 79). Carbohydrate content in the second dry season (2016) accession were higher than the first dry season (2015)

Table 80 presents the proximate (nutrional) composition analysis (%) of fresh edible *Amaranthus hybridus* accession NG/OA/04/010 in the first rainy season (2016). The moisture content of *Amaranthus hybridus* accession NG/OA/04/010 ranged between 9.69±0.02% and 9.94±0.03% with the lowest moisture content obtained in the accession in Ojagboro while the highest was obtained in Budo Abio (Table 80).Moisture content of the Control site was higher than the other sites except for Budo Abio. The moisture in the accession in the Control site was statistically the same with the accession in Budo Abio (Table 80). The ash content of *Amaranthus hybridus* accession NG/OA/04/010 in the first rainy season (2016) ranged between of 3.17±0.03% and 3.44±0.01% with the lowest obtained in the accession of the Control site and the highest in Coca cola (Table 80).

The ash content of the Control site was lower than the other sites. Percentage fat and oil content of the accession ranged between 4.27±0.04% and 4.50±0.01% with the lowest obtained in the accession of Coca cola and the highest in Budo Abio. The percentage fat and oil of the accession in the Control site was higher than the other sites except for Budo Abio. Percentage fat and oil of the accession in the Control site was statistically the same with the accession in Budo Abio and Eroomo (Table 80). Percentage crude protein of *Amaranthus hybridus* accession NG/OA/04/010 in the first rainy season (2016) ranged between 14.31±0.01% and 14.46±0.01% with the lowest obtained in the accession in Ojagboro and the highest in the Control site (Table 80).

Table 79 Proximate composition (%) of *Amaranthus hybridus* accession NG/AA/03/11/010 in the second dry season (2016).

Site	Moisture content	Ash Content	Fat and Oli content	Crude protein content	Crude fibre content	Carbohydrate content
Otte	6.81 ± 0.01^{b}	4.16 ± 0.01^{d}	4.28 ± 0.01^{ab}	20.20 ± 0.01^{b}	1.89 ± 0.02^{ef}	65.84 ± 0.01^{c}
Budo Egba	6.79 ± 0.02^{c}	4.14 ± 0.01^{d}	4.37 ± 0.01^{a}	20.25 ± 0.01^{b}	1.89 ± 0.00^{ef}	62.71 ± 0.01^{e}
Budo Abio	6.66 ± 0.02^{d}	4.39 ± 0.01^{c}	4.11 ± 0.01^{b}	12.26 ± 0.02^{c}	2.39 ± 0.02^{b}	76.28 ± 0.02^{ab}
Mubo	6.85 ± 0.01^{b}	5.40 ± 0.01^{a}	3.92 ± 0.00^{bc}	10.11 ± 0.01^{de}	2.42 ± 0.02^{a}	76.42 ± 0.03^{ab}
Oyun	6.76 ± 0.03^{c}	5.39 ± 0.00^{ab}	3.91 ± 0.00^{bc}	10.21 ± 0.01^{d}	2.38 ± 0.01^{b}	76.77 ± 0.03^{a}
Ojagboro	6.46 ± 0.01^{e}	5.42 ± 0.02^{a}	3.80 ± 0.00^{c}	9.58±0.02e	2.36 ± 0.01^{b}	75.83 ± 0.02^{b}
Olaolu	6.71 ± 0.01^{c}	$5.34\pm0.01a^{b}$	3.91 ± 0.00^{bc}	11.15 ± 0.01^{cd}	2.41 ± 0.00^{b}	75.73 ± 0.02^{b}
Eroomo	6.64 ± 0.02^{d}	5.32 ± 0.01^{ab}	3.95 ± 0.00^{bc}	11.24 ± 0.00^{cd}	2.29 ± 0.00^{c}	75.76 ± 0.02^{b}
Okeodo	6.90 ± 0.01^{a}	4.37 ± 0.01^{c}	4.25 ± 0.00^{ab}	21.03 ± 0.06^{ab}	1.72 ± 0.00^{ef}	64.72 ± 0.03^{d}
Cocacola	6.88 ± 0.02^{b}	4.26 ± 0.02^{cd}	4.23 ± 0.01^{ab}	20.67 ± 0.61^{b}	1.91 ± 0.00^{e}	64.73 ± 0.02^{d}
Isale Aluko	6.79 ± 0.02^{c}	5.36 ± 0.03^{ab}	3.90 ± 0.00^{bc}	20.84 ± 0.02^{b}	2.38 ± 0.02^{b}	75.40 ± 0.02^{b}
Odoore	6.93 ± 0.02^{a}	4.09 ± 0.02^{e}	4.31 ± 0.00^{ab}	21.90 ± 0.01^{a}	1.71 ± 0.00^{e}	67.77 ± 0.03^{cde}
Botanical Garden (Control site).	6.87 ± 0.03^{b}	4.05 ± 0.02^{e}	4.28 ± 0.01^{ab}	21.51 ± 0.01^{ab}	1.67 ± 0.01^{f}	66.02 ± 0.02^{cd}

Percentage crude protein in the accession in the Control site was higher than the other sites. There were no significant differences in the percentage crude protein in the accession in the Control site, Budo Abio and Odoore (Table 80). The range of the percentage crude fibre of *Amaranthus hybridus* accession NG/OA/04/010 in the first rainy season (2016) ranged between 2.21±0.01% and 2.46±0.01% with the lowest obtained in the accession of the Control site and the highest in Coca cola (Table 80). Accession of the Control site had lower percentage crude fibre than the other sites. Accession of the Control site had the same statistical percentage crude fibre as the accession of Budo Abio, Eroomo and Odoore. Percentage carbohydrate of the *Amaranthus hybridus* accession NG/OA/04/010 was in the range of 64.21±0.02% and 64.41±0.04% with the lowest obtained in the accession of the Control site and the highest in Coca cola (Table 80). Percentage carbohydrate of the accession of the Control site was lower than the other sites. Statististically, the same percentage carboyhdrate was obtained in the accession in the Control site, Budo Egba, Budo Abio, Mubo, Oyun, Olaolu and Odoore (Table 80).

Table 81 presents the proximate composition analysis (%) of *Amaranthus hybridus* accession NG/OA/04/010 planted in the second rainy season (2017) . The range of the percentage moisture of the accession ranged between 6.53±0.04 % and 12.04±0.01 % with the lowest recorded in the accession of Coca cola and the highest in Budo Abio. The moisture content in the accession in the Control site was higher than the accession of the other sites except for Budo Abio and Odoore (Table 81). The moisture content of the accession in the Control site was statistically the same with the accession in Odoore. No significant differences were recorded in the moisture content of the accession in Budo Egba, Mubo and Okeodo, so also were the accession of Ojagboro and Olaolu, Coca cola and Isale Aluko (Table 81). It was observed that the percentage moisture in the accession was lower in the second rainy season (2017) than in the first rainy season (2016). The ash content of *Amaranthus hybridus* accession NG/OA/04/010 in the second rainy season (2017) ranged between 1.10±0.02 % and 7.14±0.02 % with the lowest recorded in the accession in the Control site and the highest in Isale Aluko (Table 81). The ash content of the accession in the Control site was lower than the other sites (Table 81).

Table 80: Proximate (nutritional) composition analysis (%) of fresh edible *Amaranthus hybridus* accession NG/OA/04/010 in the first rainy season (2016).

SITE	Moisture content	Ash content	Fat and Oil content	Crude Protein content	Crude Fibre content	Carbohydrate content
Otte	9.74 ± 0.02^{c}	3.33 ± 0.02^{b}	4.32 ± 0.03^{c}	14.37 ± 0.01^{b}	2.42 ± 0.02^{a}	64.25 ± 0.00^{c}
Budo-Egba	9.70 ± 0.02^{c}	3.31 ± 0.00^{b}	4.34 ± 0.03^{c}	14.34 ± 0.01^{b}	2.36 ± 0.01^{b}	64.26 ± 0.00^{c}
Budo-Abio	9.94 ± 0.03^{a}	3.19 ± 0.01^{d}	4.56 ± 0.02^{a}	14.40 ± 0.01^{a}	2.20 ± 0.01^{c}	64.24 ± 0.01^{c}
Mubo	9.82 ± 0.03^{b}	3.27 ± 0.03^{c}	4.45 ± 0.01^{ab}	14.42 ± 0.02^{a}	2.32 ± 0.02^{b}	64.20 ± 0.04^{c}
Oyun	9.87 ± 0.01^{b}	3.22 ± 0.03^{c}	4.48 ± 0.02^{ab}	14.38 ± 0.02^{b}	2.30 ± 0.01^{b}	64.23 ± 0.02^{c}
Ojagboro	9.69 ± 0.02^{d}	3.41 ± 0.03^{b}	4.35 ± 0.04^{c}	14.31 ± 0.01^{b}	2.44 ± 0.01^{a}	64.41 ± 0.04^{a}
Olaolu	9.71 ± 0.02^{d}	3.37 ± 0.02^{ab}	4.35 ± 0.02^{c}	14.35 ± 0.02^{b}	2.36 ± 0.02^{b}	64.29 ± 0.01^{c}
Eroomo	9.84 ± 0.12^{b}	3.18 ± 0.02^{d}	4.50 ± 0.01^{a}	14.41 ± 0.02^{a}	2.22 ± 0.01^{c}	64.37 ± 0.02^{b}
Okeodo	9.81 ± 0.04^{b}	3.30 ± 0.01^{b}	4.40 ± 0.02^{b}	$14..37\pm0.03^{b}$	2.33 ± 0.02^{b}	64.34 ± 0.01^{b}
Coca-cola	9.62 ± 0.08^{d}	3.44 ± 0.01^{a}	4.27 ± 0.04^{d}	14.34 ± 0.01^{b}	2.46 ± 0.01^{a}	64.41 ± 0.02^{a}
Isale-Aluko	9.65 ± 0.02^{d}	3.48 ± 0.02^{a}	4.31 ± 0.04^{c}	14.36 ± 0.01^{b}	2.41 ± 0.01^{a}	64.42 ± 0.03^{a}
Odoore	9.88 ± 0.02^{b}	3.15 ± 0.02^{d}	4.47 ± 0.03^{b}	14.40 ± 0.01^{a}	2.29 ± 0.01^{c}	64.24 ± 0.00^{c}
Botanical garden (Control site)	9.91 ± 0.03^{a}	3.17 ± 0.03^{d}	4.54 ± 0.01^{a}	14.46 ± 0.01^{a}	2.21 ± 0.01^{c}	64.21 ± 0.02^{c}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD

There were no significant differences in the ash contents in the accession in Otte, Olaolu and Okeodo, so also were the accession of Budo Egba and Oyun at $p \leq 0.05$ (Table 81). It was observed that the ash content in the accession was lower in the second rainy season (2017) than in the first rainy season (2016). The fat and oil content of *Amaranthus hybridus* accession NG/OA/04/010 in the second rainy season (2017) ranged between 3.22±0.02 % and 5.83±0.02 % with the lowest recorded in the accession in Coca cola and the highest in Eroomo. The percentage fat and oil in the accession of the Control site was higher than the other sites except for the accession in Oyun, Eroomo and Odoore. There were no significant differences in the fat and oil content in the accession of Otte, Okeodo and the Control site at $p \leq 0.05$ (Table 81). The fat and oil content in *Amaranthus hybridus* accession NG/OA/04/010 in the second rainy season (2016) in Budo Egba, Mubo, Ojagboro, Olaolu and Isale Aluko were statistically the same, so also were the accession in Oyun and Odoore (Table 81). It was found that the percentage crude fat and oil in the accession was lower in the second rainy season (2017) than in the first rainy season (2016). The crude protein in the accession ranged between 10.43±0.06 % and 20.01±6.93 % with the lowest recorded in the accession in Isale Aluko and the highest in Eroomo. Percentage crude protein in the accession in the Control site was higher than the other sites except for the accession of Budo Abio, Eroomo and Odoore (Table 81). Accession in the Control site had the same percentage crude protein as accession in Okeodo (Table 81). Accession in Otte and Mubo had the same statistical percentage crude protein, so also were the accession in Budo Egba, Ojagboro and Coca cola. There were no significant differences in the crude protein in the accession in Budo Abio and Odoore(Table 81).

The result showed that the percentage crude protein in the accession was higher in the second rainy season (2017) than in the first rainy season (2016). The range of the the crude fibre in the accession ranged between 0.93±0.01 % and 2.57±0.01 % with the lowest recorded in the accession of Odoore and the highest in Cocacola. The crude fibre content in the accession in the Control site was lower than the other sites except for Budo Abio, Eroomo and Odoore (Table 81). No significant differences were recorded in the crude fibre content in the Control site and Okeodo. Crude fibre content in the accession in Otte and Mubo were statistically the same (Table

81). No significant differences were recorded in the crude fibre content in the accession in Budo Egba, Oyun, Olaolu and Isale Aluko, so also were the accession in Budo Abio and Odoore (Table 81). The result suggested that the percentagecrude fibre in the accession was lower in the second rainy season (2017) than in the first rainy season (2016). Accession in Ojagboro and Coca cola had the same content of crude fibre (Table 81).

Percentage carbohydrate in *Amaranthus hybridus* accession NG/OA/04/010 in the second rainy season (2017) ranged between 60.00 % and 69.74±0.07 % with the lowest recorded in the accession in Eroomo and the highest in Isale Aluko. The accession in the Conrol site had lower in carbohydrate content than the other sites except for Budo Abio, Eroomo and Odoore (Table 81). The Control site recorded the same carbohydrate content with the accession in Okeodo (Table 81). Percentage carbohydrate in the accession in Otte, Mubo and Oyun were statistically the same, so also were the accession in Budo Egba, Olaolu and Coca cola at $p \leq 0.05$. Accession of Budo Abio, Eroomo and Odoore recorded same stastical carbohydrate content (Table 81). It was observed that the percentage carbohybrate in the accession was higher in the second rainy season (2017) than in the first rainy season (2016).

Table 82 shows proximate Composition (%) of *Amaranthus Amaranthus hybridus* accession NG/AO/11/08/039 in the first dry season (2015). The range of the moisture content of the accession ranged between 6.53±0.02 % and 6.91±0.02 % with the lowest moisture content in the accession of Budo Egba and the highest in Mubo. The accession in the Control site had higher moisture content than the accession in all the sites except for Mubo, Oyun and Eroomo. Percentage moisture of accession in Otte, Budo Egba and Cocacola were statistically the same. No significant differences in the percentage moisture in accession of Budo Abio, Ojagboro, Olaolu and Isale Aluko were recorded (Table 82). The Control site recorded same percentage moisture with the accession in Mubo, Oyun, Eroomo, Okeodo and Odoore. The range of the ash content in the accession ranged between 4.23 ±0.03 % and 5.50 ±0.02 % with the lowest recorded in the accession in Odoore and the highest in Mubo (Table 82). The percentage ash in the accession in the Control site was lower than other sites except for Odoore. Accession in the Control site, Mubo, Oyun, Eroomo, Okeodo and Odoore had same percentage ash. Accession in Budo Abio, Ojagboro, Olaolu and Isale-Aluko had the same ash content. The range of the percentage fat and oil in *Amaranthus hybridus accession* NG/AO/11/08/039 in the first dry season(2015) was between 3.24 ±0.02 % and 4.25 ±0.02% with the lowest recorded in the accession in Otte and the highest in Odoore.

Percentage fat and oil of accession in the Control site was higher than the accession in the other sites except for Odoore (Table 82). Percentage fat and oil of accession in the Control site, Oyun, Ojagboro, Okeodo and Odoore were statistically the same. No significant differences were recorded in the percentage fat and oil in the accession in Budo Egba, Budo Abio, Mubo, Olaolu, Cocacola and Isale Aluko. Crude protein in the accession ranged between 6.42 ± 0.02 % and 18.68 ±0.02 % with the lowest recorded in the accession of Budo Egba and the highest in the accession in Oyun (Table 82). Percentage crude protein in the accession in the Control site was higher than the accession in the other sites except for Oyun (Table 82).

Accession in the Control site had the same percentage crude protein as the accession in Oyun, Ojagboro and Odoore. Accession in Budo Egba, Budo Abio, Mubo, Olaolu, Okeodo and Isale Aluko were statistically the same in the percentage of crude protein. Percentage crude fibre of the accession ranged between 1.35 ±0.02 % and 2.58 ±0.02 % with the lowest percentage fibre recorded in the accession in Budo Egba and the highest in Budo Abio. The accession in the Control site had lower percentage crude flbre than the accession in the other sites except for Budo Egba (Table 82). Accession of Otte, Budo Abio, Odoore and the Control site had no significant differences in the percentage crude fibre. Accession in Otte, Oyun, Ojagboro, Olaolu, Okeodo, Isale Aluko and Control site were statistically the same in the percentage crude fibre. Same percentage crude fibre were recorded in the accession in Budo Abio, Mubo, Eroomo and Cocacola (Table 82)

Table 81 : Proximate composition analysis (%) of fresh edible *Amaranthus hybridus* accession NG/OA/04/010 second rainy season (2016).

SITE	MOISTURE	ASH	fat and oil	CRUDE PROTEIN	CRUDE FIBRE	CARBOHYDRATE Content
Otte	9.43±0.17 cd	3.19±0.01cd	4.21±0.01bc	14.18±0.12c	2.44±0.02b	64.51±0.04bc
Budo-Egba	9.74±0.01c	3.72±0.01bc	3.91±0.01cd	12.12±7.06de	2.09±0.02b**c**	68.00±0.06ab
Budo-Abio	12.04±0.01a	1.38±0.02ef	4.38±0.01b	19.87±0.02ab	1.00 ±0.02d	60.78±0.02d
Mubo	9.79±0.04c	2.64±0.02d	3.85±0.02cd	15.56±0.02c	2.40±0.02b	65.68±0.07bc
Oyun	10.08±0.02bc	3.53±0.02bc	4.88±0.03ab	13.57±2.45cd	2.00±0.02bc	65.28±0.12bc
Ojagboro	8.48±0.02d	5.44±0.02b	3.34±0.01cd	10.91±2.49de	2.52±0.02a	67.53±0.07b
Olaolu	8.78±0.01d	3.17±0.01cd	3.56±0.02cd	13.20±0.03cde	2.06±0.01bc	68.61±0.11ab
Eroomo	10.72±0.01b	2.01±0.02def	5.83±0.02a	20.01±6.93a	1.01±0.01d	60.00±0.07d
Okeodo	9.87±0.01c	3.18±0.02cd	4.16±0.02bc	17.11±0.06b	1.71±0.02c	63.88±0.10c
Coca-cola	6.53±0.04e	7.14±0.02a	3.22±0.02d	11.23±0.06de	2.57±0.01a	68.11±0.19ab
Isale-Aluko	6.75±0.08e	6.98±0.01ab	3.67±0.30cd	10.43±0.06e	2.29±0.02bc	69.74±0.07a
Odoore	11.88±0.01ab	2.38±0.02de	4.91±0.01ab	19.82±0.04ab	0.93±0.01d	60.04±0.06d
Botanical garden (Control site)	11.86±0.11ab	1.10±0.02f	4.22±0.02bc	17.28±0.05b	1.19±0.03c	63.79±0.05c

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD

Crude protein content in the accession ranged between 10.03±0.00 % and 21.55±0.00% with the lowest recorded in the accession in Ojagboro and the highest in the accession in Odoore (Table 83). Crude protein content in the Control site was higher than the other sites except for Odoore (Table 83). It was found that higher content of crude protein was observed in the accession in the second dry season (2016) than in the accession of the first dry season (2015). Crude fibre content in the accession in the second dry season(2016) ranged between 1.67±0.02 % and 2.48±0.06 % with the lowest obtained in the accession in Budo Abio and the highest in the accession in Isale Aluko. Crude fibre content of The range of percentage carbohydrate of the accession in the first dry season (2015) ranged between 64.12 ±0.02 % and 75.20 ±0.02 % with the lowest value recorded in the accession in Okeodo and the highest in Olaolu accession. Percentage carbohydrate of accession in the Control site was lower than the accession of the other sites except for Oyun and Okeodo. No significant differences were recorded in the percentage carbohydrate of the accession in the Control site, Oyun, Ojagboro, Okeodo and Odoore. Accession in Budo Egba, Budo Abio, Olaolu, Cocacola and Isale Aluko had the same percentage of Carbohydrate. Accession of Otte, Mubo and Eroomo recorded statistically the same percentage Carbohydrate (Table 82).

Table 83 shows proximate composition (%) of *Amaranthus hybridus* accession NG/AO/11/08/039 in the second dry season (2016). Moisture content of the accession ranged between 6.73±0.01 % and 6.97±0.03 % with the lowest content in the accession of Ojagboro and the highest in the accession of Odoore. Moisture content of the accession in the Control site was higher than the other sites except for the accession in Budo Abio, Eroomo and Odoore (Table 83). The result suggested higher moisture content in the accession in the second dry season (2016) than in the first dry season (2015). Ash content of the accession ranged between 4.00±0.01 % and 5.55±0.03 % with the lowest obtained in the accession in the Control site and the highest in the accession in Coca cola (Table 83). The ash content in the Control site was lower than the other sites (Table 83). It was observed that ash content in the accession in the second dry season (2016) was lower than in the first dry season (2015). Percentage fat and oil content ranged between 3.86±0.02 % and 4.38±0.01% with the lowest crude fat and oil obtained in the accession of Isale Aluko and the highest in the accession in Odoore

Table 82. Proximate Composition (%) of *Amaranthus Amaranthus hybridus* accession NG/AO/11/08/039 first dry season (2015) .

Site	Moisture content	Ash Content	Fat and Oil content	Crude protein content	Crude fibre content	Carbohydrate content
Otte	6.63±0.01[cd]	4.25 ± 0.02[b]	3.77± 0.01[b]	10. 62 ±0.02[bc]	1.62 ±0.02[b]	64.71 ±0.02[c]
Budo Egba	6.59 ± 0.02[c]	5.42 ±0.03[a]	3.74 ±0.02[b]	6.38 ±0.01[c]	2.35 ±0.01[a]	75 .20 ±0.01[a]
Budo Abio	6.84±0.02[b]	4.30 ±0.02[b]	4.19±0.01a[b]	14.55 ±6.94[b]	1.54 ±0.02[b]	64.56 ±0.02[c]
Mubo	6.86 ±0.01[b]	5.47 ±0.01[a]	3.87 ±0.02[b]	6.54 ±0.02[c]	2.35 ±0.01[a]	74 .92 ±0.02[b]
Oyun	6.94±0.01[a]	5.48±0.02[a]	3.87 ± 0.01[b]	6.59 ±0.01[c]	2.27 ±0.01[ab]	75.17 ±0.01[a]
Ojagboro	6.56±0.01[c]	5.42 ±0.02[a]	3.72 ±0.01[b]	6.66 ±0.01[c]	2.26 ±0.02[ab]	75 .10 ±0.01[a]
Olaolu	6.58±0.02[c]	5.12± 0.02[ab]	3.87 ±0.02[b]	6.52 ±0.01[c]	2.34 ±0.02[a]	75.29 ±0.02[a]
Eroomo	6.79±0.01[bc]	4.38 ±0.01[b]	3.82 ±0.02[b]	6.65 ± 0.01[c]	2.32 ±0.02[a]	75.14 ±0.23[a]
Okeodo	6.59 ±0.01[c]	5.42 ± 0.02[a]	3.85 ±0.02[b]	6.64 ±0.02[c]	2.35 ±0.01[a]	74 .85 ±0.60[b]
Cocacola	6.18 ±0.01[e]	5.41 ± 0.02[a]	3.84 ±0.02[b]	6.58 ±0.02[c]	2.35 ±0.02[a]	75.10 ±0.17[a]
Isale Aluko	6.32 ±0.01[d]	5.41 ±0.02[a]	3.81 ±0.02[b]	6.59 ±0.02[c]	2.39 ±0.01[a]	75.15 ±0.22[a]
Odoore Botanical Garden (Control site).	6.87 ±0.01[b]	4.20 ± 0.01[b]	4.25 ±0.01[a]	18 .57 ±0.04[a]	1.61 ±0.02[b]	64.42 ±0.02[c]

Values with the same superscripts along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

Percentage crude fat and oil in the Control site was higher than the other sites except for the accession in Odoore suggesting higher crude fat and oil content in the second dry season (2016) accession than in the first dry season (2015). the accession in the Control site was lower than the other sites except for the accession of Budo Abio indicating higher crude fibre content in the accession in the second dry season (2016) than in the first dry season (2015) (Table 83) . Carbohydrate content of the accession in the second dry season (2016) ranged between 64.66±0.06 % and 75.58±0.64 % with the lowest in the accession in Budo Abio and the highest in the accession in Isale Aluko (Table 83). Carbohydrate content of the accession in the Control site was lower than the other sites except for Budo Abio showing higher percentage content in the accession in the second dry season (2016) than in the first dry season (2015) (Table 83) (Table 83). It was observed that all the pxomate content of the accession were of higher values in the second dry season (2017) except for the percentage ash of the accession that had lower value in the second dry season(2016) than in the first dry season (2015) (Table 83)

Table 84 shows the proximate (nutritional) composition analysis (%) of fresh edible *Amaranthus hybridus* NG/AO/11/08/039 in the first rainy season (2016). The percentage moisture of the accession was ranged between 9.65±0.01% and 9.99±0.01% with the lowest moisture content in the accession of Isale Aluko and the highest in the accession of the Control site (Table 84). The moisture content of the accession in the Control site was higher than the other sites but statistically the same with the accession in Odoore. The ash ccontent of *Amaranthus hybridus* NG/AO/11/08/039 in the first rainy season (2016) range of 3.15 ± 0.02 % and 3.40±0.01 % with the lowest content obtained in the accession in the Control site and the highest content in the accession in Isale Aluko (Table 84). Percentage ash in the accession in the Control site was lower than the other sites (Table 84). The range of crude fat and oil content in the accession ranged between 4.36±0.02% and 4.59±0.02% with the lowest obtained in the accession in Ojagboro and the highest in the accession in Budo Abio. Percentage crude fat and oil in the accession in the Control site was higher than the other sites except for the accession in Budo Abio, Mubo, Oyun, Eroomo, Okeodo and Odoore (Table 84).

Table 83. Proximate Composition (%) of *Amaranthus Amaranthus hybridus accession* NG/AO/11/08/039 in the second dry season (2016).

Site	Moisture content	Ash Content	Fat and Oil content	Crude protein content	Crude fibre content	Carbohydrate content
Otte	6.78 ± 0.01^{b}	4.18 ± 0.01^{c}	4.29 ± 0.01^{ab}	19.05 ± 0.00^{b}	2.42 ± 0.01^{a}	64.97 ± 0.09^{b}
Budo Egba	6.79 ± 0.03^{b}	5.32 ± 0.02^{b}	4.03 ± 0.01^{b}	10.22 ± 0.00^{c}	2.40 ± 0.04^{a}	75.39 ± 0.03^{a}
Budo Abio	6.92 ± 0.01^{a}	4.28 ± 0.00^{bc}	4.28 ± 0.02^{ab}	11.10 ± 0.00^{bc}	1.67 ± 0.02^{d}	64.66 ± 0.06^{b}
Mubo	6.82 ± 0.15^{ab}	5.41 ± 0.03^{ab}	3.97 ± 0.00^{b}	10.25 ± 0.00^{c}	2.41 ± 0.01^{a}	75.12 ± 0.09^{a}
Oyun	6.77 ± 0.02^{b}	5.41 ± 0.01^{ab}	3.99 ± 0.02^{b}	10.20 ± 0.00^{c}	2.34 ± 0.03^{b}	75.25 ± 0.33^{a}
Ojagboro	6.73 ± 0.01^{b}	5.33 ± 0.02^{b}	3.87 ± 0.01^{bc}	10.03 ± 0.00^{d}	2.32 ± 0.02^{b}	75.20 ± 0.30^{a}
Olaolu	6.75 ± 0.01^{b}	5.38 ± 0.01^{b}	3.98 ± 0.01^{b}	10.11 ± 0.00^{d}	2.48 ± 0.01^{a}	75.18 ± 0.40^{a}
Eroomo	6.89 ± 0.02^{ab}	5.35 ± 0.01^{b}	3.90 ± 0.02^{b}	10.20 ± 0.00^{c}	2.48 ± 0.05^{a}	75.10 ± 0.32^{a}
Okeodo	6.81 ± 0.06^{ab}	5.30 ± 0.04^{b}	3.96 ± 0.01^{b}	10.18 ± 0.00^{cd}	2.47 ± 0.02^{a}	75.16 ± 0.37^{a}
Cocacola	6.94 ± 0.02^{a}	5.55 ± 0.03^{a}	3.90 ± 0.01^{b}	10.02 ± 0.00^{d}	2.41 ± 0.01^{a}	75.48 ± 0.15^{a}
Isale Aluko	6.75 ± 0.03^{b}	5.34 ± 0.00^{b}	3.86 ± 0.02^{bc}	10.17 ± 0.00^{cd}	2.48 ± 0.06^{a}	75.58 ± 0.64^{a}
Odoore	6.97 ± 0.01^{a}	4.11 ± 0.00^{c}	4.38 ± 0.01^{a}	21.55 ± 0.00^{a}	2.17 ± 0.40^{bc}	64.72 ± 0.26^{b}
Botanical Garden (Control site).	6.88 ± 0.02^{ab}	4.00 ± 0.01^{c}	4.36 ± 0.01^{a}	20.89 ± 0.00^{ab}	2.10 ± 0.02^{bc}	64.83 ± 0.18^{b}

Values with the same superscripts along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

Crude protein content in *Amaranthus hybridus* NG/AO/11/08/039 in the first rainy season (2016) ranged between 14.20±0.01% and 14.43±0.02% with the lowest obtained in the accession in Ojagboro and the highest in the accession in the Control site (Table 84).Percentage crude protein of the accession in the Control site was higher than the other sites but statistically the same with the accession in Odoore (Table 84). The range of the crude fibre content of the accession *Amaranthus hybridus* NG/AO/11/08/039 was between 2.10 ±0.01% and 2.38±0.02% with the lowest obtained in the accession in Eroomo and the highest in the accession in Oyun (Table 84). The crude fibre content of the accession in the Control site was lower than the other sites except for the accession in Eroomo. The percentage carbohydrate of the accession ranged between 64.30±0.01% and 64.60±0.00% with the lowest carbohydrate content obtained in the accession in Eroomo and the highest in the accession in Isale Aluko (Table 84). Percentage carbohydrate of the accession in the Control site was lower than the other sites except for the accession in Eroomo but the same with the accession in Odoore (Table 84).

Table 85 shows the proximate composition analysis (%)) of fresh edible *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017). The moisture content of the accession ranged between 9.44 ±0.01 % and 12.05±0.08 % with the lowest content recorded in the accession in Coca cola and the highest in the accession in Budo Abio (Table 85). Moisture content of the accession in the Control site was higher than the other sites except for the accession in Budo Abio, Mubo and Oyun. Accession in the Control site had the same moisture content with the accession in Mubo. No significant differences were recorded in the moisture content in the accession in Budo Egba, Olaolu and Okeodo, so also were the accession in Ojagboro, Cocacola and Isale Aluko. The result showed higher moisture content in the accession in the second rainy season (2017) than in the first rainy season (2016). Ash content of *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) ranged between 1.22 ±0.02 % and 3.97 ± 0.03 % with the lowest content recorded in the accession of the Control site and the highest in the accession of Coca cola (Table 85). The accession in the Control site had a lower ash content than the accession in the other sites. Ash content were statistically the same in the accession in Otte, Budo Egba, Olaolu and Okeodo. No significant differences in the ash content in the accession in Budo Abio and Odoore (Table 85).

Table 84: Proximate (Nutritional) composition analysis (%) of fresh edible *Amaranthus hybridus NG/AO/11/08/039* in the first rainy season (2016).

Site	Moisture content	Ash content	Fat and Oil content	Crude protein content	Crude fibre content	Carbohydrate content
Otte	9.71±0.02^{c}	3.25±0.02^{c}	4.43± 0.02^{b}	14.28±0.02^{c}	2.20±0.01^{b}	64.38±0.01^{c}
Budo-Egba	9.74±0.03^{c}	3.29±0.01^{c}	4.41± 0.01^{b}	14.22±0.01^{c}	2.22±0.01^{b}	64.42±0.02^{b}
Budo-Abio	9.78±0.02^{c}	3.24±0.01^{c}	4.59±0.02^{a}	14.34±0.01^{b}	2.17±0.02^{c}	64.39±0.01^{c}
Mubo	9.73±0.02^{c}	3.30±0.05^{b}	4.54±0.01^{a}	14.25±0.01^{c}	2.35±0.00^{a}	64. 45±0.03^{b}
Oyun	9.75±0.01^{c}	3.33±0.03^{b}	4.57±0.05^{a}	14.26±0.01^{c}	2.38±0.02^{a}	64.41±0.03^{b}
Ojagboro	9.64±0.01^{d}	3.35±0.01^{b}	4.36±0.02^{c}	14.20±0.01^{c}	2.35±0.01^{a}	64.32±0.02^{c}
Olaolu	9.67±0.02^{d}	3.38±0.02^{b}	4.47±0.04^{b}	14.39±0.01^{b}	2.35±0.02^{a}	64.35±0.01^{c}
Eroomo	9.89±0.01^{b}	3.25±0.02^{c}	4.58±0.02^{a}	14.37±0.01^{b}	2.10±0.01^{c}	64.30±0.01^{c}
Okeodo	9.77±0.02^{c}	3.30±0.02^{b}	4.52±0.02^{a}	14.41±0.01^{a}	2.22±0.02^{b}	64.33±0.02^{c}
Coca-cola	9.67±0.01^{d}	3.36±0.02^{b}	4.41±0.02^{b}	14.23±0.02^{c}	2.37±0.02^{a}	64.47±0.03^{b}
Isale-Aluko	9.65±0.01^{d}	3.40±0.01^{a}	4.39±0.01^{c}	14.20±0.01^{c}	2.34±0.01^{a}	64.60±0.00^{a}
Odoore	9.99±0.01^{a}	3.20±0.02^{c}	4.55±0.03^{a}	14.40±0.01^{a}	2.15±0.01^{c}	64.31±0.00^{c}
Botanical garden (Control site)	9.94±0.01^{a}	3.15±0.02^{d}	4.58±0.02^{a}	14.43±0.02^{a}	2.14±0.02^{c}	64.31±0.02^{c}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

Same statistically ash content were recorded in the accession in Mubo and Oyun,. so also were the accession in Ojagboro and Cocacola at $p \leq 0.05$ (Table 85). It was observed that *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) had lower ash content than in the first rainy season (2016). The range of fat and oil content of *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) was between 2.85 ±0.01 % and 4.33 ±0.02 % with the lowest content in the accession in Isale Aluko and the highest in the accession of Odoore. The accession in the Control site had a higher percentage crude fat and oil than the other sites except for Budo Abio and Odoore. Accession in Oyun and the Control site had the same statistical content of crude fat and oil. Accession in Otte, Budo Egba, Mubo, Ojagboro, Olaolu, Eroomo and Okeodo had the same statistical content of crude fat and oil, so also were the accession in Budo Abio and Odoore. Accession in Cocacola and Isale Aluko were statistically the same in the content of crude fat and oil (Table 85). Lower content of crude fat and oil was recorded for *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) than in the first rainy season (2016).

The range of crude protein of *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) was between 7.02±0.04 % and 21.76 ±0.01% with the lowest recorded in the accession in Isale Aluko and the highest in the accession in Odoore. The accession in the Control site, Budo Egba, Olaolu and Okeodo were statistically the same, so also were the accession in Mubo and Oyun. No significant differences were recorded in the crude protein content of the accession in Cocacola and Isale Aluko (Table 85) Significant differences in the crude protein content in the accession was recorded at $p \leq 0.05$ (Table 85). Lower crude protein content was observed in *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) than in the first rainy season (2016). The crude fibre content of *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) ranged between 1.10 ±0.04% and 2.67 ±0.03% with the lowest crude fibre content in the accession in the Control site and the highest in the accession in Ojagboro. Crude fibre content in the accession in the Control site was lower than the other sites (Table 85). The same statistical crude fibre content were recorded in the accession in Otte and Eroomo, so also were the accession in Budo Abio and Odoore (Table 85). No significant differences in the crude fibre content in the accession was recorded in the accession in Olaolu and Okeodo. It was shown in the result that lower crude fibre content was recorded in the accession in the second rainy season (2017) than in first rainy season (2016). The range of the carbohydrate content of *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) was between 60.18 ±0.22% and 75.14 ±0.23% with the lowest carbohydrate content recorded in the accession in Odoore and the highest content in the accession of Eroomo (Table 85). Carboyhdrate content in the accession in the Control site was lower than the accession in the other sites except for the accession of Odoore. No significant differences in the carbohydrate content of the accession in the Control site and the accession in Odoore were recorded. Accession in Budo Egba and Oyun had the same carbohydrate content, so also were the accession in Mubo, Ojagboro, Olaolu, Cocacola and Isale Aluko (Table 85). Higher carbohydrate content in *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy season (2017) was recorded than in the first rainy season (2016).

Table 86 shows the nutritional content (proximate) analysis of *Amaranthus hybridus* accession NGBO125 in the first dry season (2015). The range of moisture content in the accession NGBO 125 in the first dry season (2015) was between 6.53±0.02 % and 6.91±0.02 % with the lowest moisture content in the accession in Budo Egba and the highest in the accession in the Mubo. The accession in the Control site had higher moisture content than the accession of the other sites except for Mubo, Oyun and Eroomo (Table 86). Percentage moisture of accession of Otte, Budo Egba and Cocacola were statistically the same. No significant differences in the percentage moisture of accession in Budo Abio, Ojagboro, Olaolu and Isale Aluko (Table 86). The Control site recorded same percentage moisture with the accession of Mubo, Oyun, Eroomo, Okeodo and Odoore.

The range of the ash content of the accession NGBO 125 in the first dry season (2015) ranged between 4.23 ±0.03 % and 5.50 ±0.02 % with the lowest recorded in the accession in Odoore and the highest in Mubo. The percentage ash in the accession in the Control site was lower than the other sites except for Odoore at $p \leq 0.05$ (Table 86). Accession in Control site, Mubo, Oyun , Eroomo, Okeodo and Odoore had same percentage ash. Accession of Budo Abio, Ojagboro, Olaolu and Isale-Aluko had the same ash content (Table 86).

Table 85 : Proximate composition analysis (%)) of fresh edible *Amaranthus hybridus* NG/AO/11/08/039 in the second rainy (2017).

SITE	MOISTURE	ASH	FAT AND OIL	CRUDE PROTEIN	CRUDE FIBRE	PERCENTAGE CARBONHYDRATE
Otte	10.69±0.01^{c}	2.92 ± 0.02^{b}	3.86± 0.04^{b}	11.79	1.62 ±0.02^{cd}	68.89 ±0.01b^{c}
Budo-Egba	10.11± 0.04^{cd}	2.78 ±0.03^{b}	3.79 ±0.01^{b}	10.11 ±0.04^{d}	2.35 ±0.01^{ab}	70 .69 ±0.11^{abc}
Budo-Abio	12.05±0.08^{a}	1.81 ±0.02^{cd}	4.31 ±0.01a	18.23 ±2.11^{b}	1.30 ±0.02^{d}	61.75 ±0.16^{c}
Mubo	11.34 ±0.01^{bc}	2.33 ±0.02^{bc}	3.96 ±0.01^{b}	8.15 ±0.00^{de}	1.88 ±0.02^{c}	72 .19 ±0.08^{ab}
Oyun	11.72±0.03^{ab}	2.40±0.02^{bc}	4.01 ± 0.05^{ab}	8.21 ±0.03^{de}	1.96 ±0.04^{ab}	71.71±0.06^{abc}
Ojagboro	9.93±0.02^{d}	3.92 ±0.02^{a}	3.88 ±0.02^{b}	7.89 ±0.01^{ef}	2.67 ±0.03^{a}	70 .67 ±0.03^{ab}
Olaolu	10.12±0.03^{cd}	2.90 ± 0.02^{b}	3.95 ±0.02^{b}	10.43 ±0.01^{d}	1.94 ±0.01^{bc}	70.45 ±0.12^{ab}
Eroomo	11.41±0.04^{b}	1.92 ±0.04^{c}	4.12±0.03a^{b}	13.45 ± 0.05^{c}	1.67 ±0.03^{cd}	75.14 ±0.23^{a}
Okeodo	10.02 ±0.03^{cd}	2.88 ± 0.02^{b}	3.95 ±0.02^{b}	10.04 ±0.01^{d}	2.01 ±0.04^{bc}	69 .85 ±0.15^{b}
Coca-cola	9.44 ±0.01^{d}	3.97 ± 0.03^{a}	2.94 ±0.01^{c}	7.11 ±0.03^{f}	2.21 ±0.04^{ab}	74.53 ±0.17^{ab}
Isale-Aluko	9.51 ±0.01^{d}	3.67 ±0.03^{ab}	2.85 ±0.01^{c}	7.02±0.04^{f}	2.30 ±0.00^{ab}	74.59 ±0.05^{ab}
Odoore	10.31 ±0.05^{bc}	1.95 ± 0.01^{cd}	4.33 ±0.02^{a}	21.76 ±0.01^{a}	1.33 ±0.02^{d}	60.18 ±0.22^{c}
Botanical garden (Control site)	11.32 ±0.01^{bc}	1.22 ±0.02^{d}	4.17 ±0.03^{ab}	19.81±0.02^{ab}	1.10 ±0.04^{e}	62 .17 ±0.15^{c}

Values with the same superscripts along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

The range of the percentage fat and oil of *Amaranthus hybridus accession* NGBO125 in the first dry season (2015) was between 3.24 ±0.02% and 4.25 ±0.02% with the lowest recorded in the accession of Otte and the highest in the accession of Odoore (Table 86). Accession of Control site was higher than the accession in the other sites except for Odoore. Percentage fat and oil of accession in the Control site, Oyun, Ojagboro, Okeodo and Odoore were statistically the same (Table 86). No significant differences were recorded in the percentage crude fat and oil of the accession in Budo Egba, Budo Abio, Mubo, Olaolu, Cocacola and Isale Aluko at $p \leq 0.05$ (Table 86). Crude protein in the accession NGBO 125 in the first dry season (2015) ranged between 6.42 ± 0.02 % and 18.68 ±0.02 % with the lowest recorded in the accession in Budo Egba and the highest in the accession of Oyun (Table 86). Percentage crude protein in the accession NGBO 125 in the Control site was higher than the accession in the other sites except for the accession of Oyun (Table 86). Accession of the Control site recorded the same percentage crude protein as the accession in Oyun, Ojagboro and Odoore (Table 86). Accession in Budo Egba, Budo Abio, Mubo ,Olaolu, Okeodo and Isale Aluko were statistically the same in the percentage crude protein.

Percentage crude fibre of the accession NGBO 125 was between 1.35 ±0.02 % and 2.58 ±0.02 % with the lowest percentage fibre recorded in the accession in Budo Egba and the highest in Budo Abio. The accession in the Control site had lower percentage crude flbre than the accession in the other sites except for Budo Egba (Table 86). Accession in Otte, Budo Abio, Odoore and the Control site recorded no significant differences in the percentage fibre at $p \leq 0.05$ (Table 86). Accession in Otte, Oyun, Ojagboro, Olaolu, Okeodo, Isale Aluko and Control site recorded statistically the same percentage crude fibre (Table 86). Same percentage crude fibre were recorded in the accession in Budo Abio, ,Mubo, Eroomo and Cocacola at $p \leq 0.05$. The range of percentage of carbohydrates of accession NGBO 125 was between 64.12 ±0.02% and 75.20 ±0.02 % with the lowest value recorded in the accession in Okeodo and the highest in Olaolu accession (Table 86).

Percentage carbohydrate of accession in the Control site was lower than the accession of the other sites except for that in Oyun and Okeodo. No significant differences were recorded in the percentage carbohydrate of the accession of the Control site, Oyun, Ojagboro, Okeodo and Odoore at $p \leq 0.05$ (Table 86) Accession in Budo Egba, Budo Abio, Olaolu, Cocacola and Isale Aluko had the same percentage carbohydrate statistically. Accession in Otte, Mubo and Eroomo recorded statistically the same percentage carbohydrate. Table 87 presents the proximate composition (%) of *Amaranthus Amaranthus* hybridus accession NGBO125 in the second dry season (2016). Moisture content of the accession ranged between 6.69±0.01 % and 7.05±0.01 % with the lowest obtained in the accession in Ojagboro and the highest in the accession in Mubo (Table 87). The moisture content of the Control site was higher than the other sites. Moisture content in the accession NGBO125 in the second dry season (2016) was of higher values than the first dry season (2015) (Table 87).

The range of ash content of the accession NGBO125 in the second dry season (2016) was between 4.28±0.00 % and 5.54±0.01 % with the lowest of the accession in the Odoore and the highest of the accession in Olaolu suggesting lower values of ash content in the second dry season (2016) than in the first dry season (2015) (Table 87). The ash content of the accession in the Control site was lower than the other site except for Odoore. Percentage crude fat and oil of accession NGBO125 in the second dry season (2016) ranged between 3.87±0.01 % and 4.37±0.01 % with the lowest of the accession in Isale Aluko and the highest in Otte indicating higher crude fat and oil in the second dry season (2016) than the first dry season (2015). The range of the crude protein in the accession NGBO125 in the second dry season (2016) was between 7.28±1.19 % and 11.68±0.13 %. The crude protein content of the accession in the Control site was higher than the other sites except for Budo Abio, Eroomo and Odoore. It was observed that percentage crude protein in the second dry season (2016) was higher than in the first dry season (2015) (Table 87). Crude fibre content of accession NGBO125 in the second dry season (2016) ranged between 1.68±0.05 % and 2.49±0.02 %. The highest crude fibre content was obtained in the accession in Mubo while the lowest in the Control site. The accession of the Control site had lower crude fibre content than the other sites (Table 87). Crude fibre was observed to have higher values in the second dry season (2016) than in the first dry season (2015) (Table 87).

The carbohydrate content of NGBO125 accession ranged between 64.22±0.02 % and 75.29±0.01 %. Accession in Okeodo recorded the lowest carbohydrate content while the accession in Olaolu had the highest content of carbohydrate. Carbohydrate content in the Control site was lower than the other sites except for Oyun, Ojagboro and Okeodo (Table 87). Higher values of carbohydrate were recorded in the NGBO 125 in sites in the second dry season (2016) than in the first dry season (2015) (Table 87). *Amaranthus hybridus* NGBO125 was between the range of 9.34±0.03% and 9.77±0.03% with the lowest moisture content obtained in the accession in Ojagboro and the highest in the accession oin Budo Abio (Table 88). Percentage moisture of *Amaranthus hybridus* accession NGBO125 in the Control site was higher than the other sites except for the accession in Budo Abio and Oyun. Moisture content of the accession in the Control site was statistically the same in the moisture content of the accession in Oyun (Table 88).

Percentage ash of the accession was in the range of 3.05±0.02% and 3.31±0.01% with the lowest ash content recorded in the accession of Budo Abio and the highest in the accession of Ojagboro (Table 88). Ash content of the accession in the Control site was lower than the other sites except for the accession in Budo Abio. Accession of the Control site had the same ash content statistically with the accession in Eroomo and Odoore. The fat and oil content of accession NGBO 125 was ranged between 4.20±0.01% and 4.57±0.01% with the lowest obtained in the accession of Coca cola and the highest in the accession in Odoore (Table 88). Percentage fat and oil of the accession in the Control site was higher than the other sites except for the accession of Budo Abio and Odoore. The crude protein content of accession NGBO 125 was in the range of 14.28±0.02% and 14.51±0.02% with the lowest obtained in the accession in Isale Aluko and the highest in the accession of Eroomo (Table 88). Percentage crude of the accession in the Control site was higher than the other sites except for the accession in Eroomo and Odoore. Accession in the Control site had the same statistical content of crude protein with the accession in Budo Abio, Mubo, Oyun and Okeodo (Table 88). Table 88 presents the proximate (nutritional) composition analysis (%) of fresh edible *Amaranthus hybridus* NGBO125 in the first rainy (2016). The moisture content of the accession Percentage crude fibre of NGBO 125 accession ranged between 2.20±0.01 % and 2.47±0.02 % with the lowest obtained in the accession in Odoore and the highest in the accession in Coca cola (Table 88).

Table 86: Proximate composition analysis (%) of fresh edible *Amaranthus hybridus* accession NGBO125 in the first dry season (2015).

Site	Moisture	Ash	Fat and oil	Crude protein	Crude fibre	Percentage carbonhydrate
Otte	6.58±0.02^{b}	4.28 ±0.02^{b}	3.24 ±0.02^{c}	8.65 ±0.01^{c}	1.73 ±0.01^{b}	71.94±0.02^{ab}
Budo-Egba	6.53 ±0.02^{b}	5.45 ±0.02^{a}	3.92 ± 0.02^{b}	6.42 ± 0.02^{cd}	1.35 ±0.02^{c}	74.93 ±0.03^{a}
Budo-Abio	6.67 ±0.01^{ab}	5.43 ±0.02^{a}	3.86 ±0.02^{b}	6.50 ±0.02^{cd}	2.35±0.01^{a}	75.20 ±0.02^{a}
Mubo	6.91±0.02^{a}	5.50 ±0.02^{a}	3.88±0.02^{b}	6.50 ±0.02^{cd}	2.36 ±0.01^{a}	74.82 ±0.03^{ab}
Oyun	6.86 ± 0.02^{a}	4.26 ±0.01^{b}	4.22±0.02^{a}	18.68 ±0.02^{a}	1.80 ±0.01^{b}	64.20 ±0.02^{b}
Ojagboro	6.63±0.01^{ab}	4.39 ±0.02 ^{b}	4.19 ±0.01^{a}	18.62 ±0.02^{a}	1.68 ± 0.01^{b}	64 .49 ±0.02^{b}
Olaolu	6.62±0.02^{ab}	5.46±0.01^{a}	3.87 ±0.01^{b}	6.55 ±0.42^{cd}	2.05 ±0.02^{b}	75. 12 ±0.02^{a}
Eroomo	6.86 ± 0.02^{a}	5.41 ±0.02^{a}	4.02 ±0.02^{ab}	13.58 ± 0.02^{b}	2.34 ±0.03^{a}	71.03 ±0.02^{ab}
Okeodo	6.84 ±0.01^{a}	4.32±0.01^{b}	4.17 ±0.02^{a}	6.62 ± 0.02^{cd}	1.84 ±0.02^{b}	64.12 ±0.02^{b}
Coca-cola	6.54 ±0.02^{b}	5.44 ± 0.02^{a}	3.82 ±0.02^{b}	10.71 ±0.02^{bc}	2.32 ±0.02^{a}	74.98 ±0.02^{a}
Isale-Aluko	6.72 ±0.02^{ab}	5.05 ±0.56^{ab}	3.84 ±0.02^{b}	6.62 ±0.02^{cd}	1.84 ±0.02^{b}	75.01 ±0.01^{a}
Odoore	6.83 ±0.01^{a}	4.23 ±0.03^{b}	4.25 ±0.02^{a}	18.61 ± 0.02^{a}	2.58 ±0.02^{a}	64.52 ±0.02^{b}
Botanical garden (Control site)	6.85 ±0.01^{a}	4.24 ±0.01^{b}	4.24±0.02^{a}	18.62 ± 0.02^{a}	1.59 ±0.01^{b}	64.43 ±0.04^{b}

Values of superscript with the same alphabet along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD

Table 87. Proximate Composition (%) of *Amaranthus Amaranthus hybridus* accession NGBO125 in the second dry season (2016) .

	Moisture content	Ash Content	Fat and Oil content	Crude protein content	Crude fibre content	Carbohydrate content
Otte	6.71 ± 0.01^{c}	4.43 ± 0.01^{b}	4.37 ± 0.01^{a}	10.63 ± 0.01^{ab}	1.85 ± 0.02^{bc}	64.74 ± 0.01^{c}
Budo Egba	6.82 ± 0.01^{c}	5.47 ± 0.02^{ab}	4.23 ± 0.01^{a}	7.28 ± 1.19^{c}	2.45 ± 0.04^{a}	74.96 ± 0.01^{bc}
Budo Abio	6.79 ± 0.02^{c}	5.52 ± 0.01^{a}	4.02 ± 0.02^{ab}	11.60 ± 0.09^{bc}	2.44 ± 0.03^{a}	74.31 ± 0.01^{bc}
Mubo	7.05 ± 0.01^{a}	5.56 ± 0.01^{a}	3.95 ± 0.04^{b}	7.87 ± 0.02^{bc}	2.49 ± 0.02^{a}	74.92 ± 0.01^{bc}
Oyun	6.96 ± 0.01^{ab}	4.37 ± 0.01^{b}	4.35 ± 0.01^{a}	11.57 ± 0.02^{a}	1.96 ± 0.04^{b}	64.30 ± 0.01^{c}
Ojagboro	6.69 ± 0.01^{c}	4.54 ± 0.03^{b}	4.27 ± 0.02^{a}	10.67 ± 0.01^{ab}	1.87 ± 0.03^{bc}	65.41 ± 0.01^{c}
Olaolu	6.75 ± 0.01^{a}	5.54 ± 0.01^{a}	3.95 ± 0.03^{b}	8.26 ± 0.01^{bc}	2.43 ± 0.01^{a}	75.29 ± 0.01^{a}
Eroomo	7.00 ± 0.01^{a}	5.52 ± 0.02^{a}	3.95 ± 0.03^{b}	11.61 ± 0.03^{a}	2.45 ± 0.02^{a}	75.24 ± 0.01^{a}
Okeodo	6.93 ± 0.06^{ab}	4.53 ± 0.02^{b}	4.26 ± 0.02^{a}	9.31 ± 0.01^{b}	1.95 ± 0.02^{b}	64.22 ± 0.02^{c}
Cocacola	6.86 ± 0.06^{bc}	5.52 ± 0.03^{a}	3.90 ± 0.01^{b}	10.51 ± 0.01^{a}	2.45 ± 0.02^{a}	75.12 ± 0.02^{a}
Isale Aluko	6.88 ± 0.02^{bc}	5.14 ± 0.56^{ab}	3.87 ± 0.01^{c}	7.87 ± 0.02^{c}	$2..41\pm0.02^{a}$	75.14 ± 0.02^{a}
Odoore	6.95 ± 0.02^{ab}	4.28 ± 0.00^{b}	4.36 ± 0.01^{a}	11.68 ± 0.13^{a}	1.69 ± 0.02^{c}	64.63 ± 0.02^{c}
Botanical Garden (Control site).	7.00 ± 0.01^{a}	4.32 ± 0.01^{b}	4.33 ± 0.03^{a}	11.55 ± 0.29^{a}	1.68 ± 0.05^{c}	64.54 ± 0.02^{c}

Values of superscript with the same alphabet along the same column are statistically the same at $p\leq0.05$. Values represent mean±SD

The percentage crude fibre of the accession in the Control site was lower than the other sites except for the accession in odoore. The accession in the Control site had the same percentage crude fibre with the accession in Budo Abio, Eroomo, Okeodo and Odoore statistically (Table 88).The range of carbohydrate content of the accession ranged between 64.29±0.01% and 64.60±0.01% with the lowest carbohydrate content obtained in the accession in Odoore and the highest in the accession in Ojagboro (Table 88). Percentage carbohydrate of the accession in the Control site was statistically the same with the carbohydrate content in the accession in Budo Abio and Eroomo (Table 88). Table 89 shows the proximate composition analysis (%)) of fresh edible *Amaranthus hybridus* accession NGBO125 in the second rainy season (2017). The moisture content of the accession ranged between 8.12±0.03 % and 11.96 ± 0.04 % with the lowest moisture content recorded in the accession in Ojagboro and the highest in the accession in Eroomo. Moisture content of the accession in the Control site was higher than the accession in the other sites except for the accession in Budo Abio, Mubo, Oyun, Eroomo and Odoore (Table 89). Accession in Otte, Okeodo and Cocacola had the same moisture content statistically (Table 89). No significant differences in the moisture content of accession in Budo Egba, Olaolu and the Control site, so also were the accession in Budo Abio, Mubo, Oyun and Odoore (Table 89).

Result showed higher moisture content of accession NGBO 125 in the second rainy season (2017) than innthe first rainy season (2016). The ash content of accession NGBO 125 in the second rainy season (2017) ranged between 1.06 ±0.03 % and 4.11 ±0.06 % with the lowest ash content recorded in the accession in Control site and the highest in the accession in Isale Aluko (Table 89). Accession in the Control site had ash content lowerr than the other sites except for the accession in Odoore. Ash content of the accession in Otte and Olaolu were significantly the same, so also were the accession in Budo Egba, Mubo and Oyun (Table 89). No significant differences were recorded in the ash content of the accession in Budo Abio and Okeodo, so also were the accession in Ojagboro and Coca cola, Eroomo and Odoore (Table 89). Lower ash content values were recorded in accession NGBO125 in the second rainy season (2017) than in the first rainy season (2016).

Table 88: Proximate composition analysis (%)) of fresh edible *Amaranthus hybridus* NGBO125 in the first rainy season (2016).

Site	Moisture	Ash	Fat and Oil	Crude Protein	Crude Fibre	Carbohydrate content
Otte	9.64 ± 0.01^{b}	3.21 ± 0.01^{b}	4.31 ± 0.01^{c}	14.39 ± 0.01^{c}	2.38 ± 0.02^{b}	64.56 ± 0.02^{b}
Budo-Egba	9.60 ± 0.01^{b}	3.25 ± 0.01^{b}	4.27 ± 0.01^{d}	14.36 ± 0.02^{c}	2.30 ± 0.01^{b}	64.55 ± 0.01^{b}
Budo-Abio	9.77 ± 0.03^{a}	3.05 ± 0.02^{d}	4.56 ± 0.02^{a}	14.48 ± 0.01^{b}	2.25 ± 0.02^{c}	64.32 ± 0.02^{c}
Mubo	9.67 ± 0.02^{b}	3.20 ± 0.02^{b}	4.40 ± 0.02^{b}	14.41 ± 0.01^{b}	2.32 ± 0.02^{b}	64.51 ± 0.01^{b}
Oyun	9.70 ± 0.01^{a}	3.28 ± 0.02^{b}	4.46 ± 0.01^{b}	14.38 ± 0.02^{c}	2.30 ± 0.01^{b}	64.47 ± 0.02^{c}
Ojagboro	9.34 ± 0.03^{d}	3.31 ± 0.01^{a}	4.41 ± 0.01^{b}	14.33 ± 0.02^{c}	2.42 ± 0.01^{a}	64.60 ± 0.01^{a}
Olaolu	9.68 ± 0.02^{b}	3.28 ± 0.02^{b}	4.43 ± 0.02^{b}	14.35 ± 0.01^{c}	2.37 ± 0.02^{b}	64.49 ± 0.01^{c}
Eroomo	9.63 ± 0.01^{b}	3.11 ± 0.01^{c}	4.51 ± 0.02^{a}	14.51 ± 0.02^{a}	2.22 ± 0.02^{c}	64.30 ± 0.01^{c}
Okeodo	9.69 ± 0.01^{b}	3.19 ± 0.01^{c}	4.31 ± 0.01^{c}	14.44 ± 0.01^{b}	2.24 ± 0.01^{c}	64.29 ± 0.01^{d}
Coca-cola	9.42 ± 0.03^{c}	3.27 ± 0.03^{b}	4.20 ± 0.01^{d}	14.31 ± 0.02^{c}	2.47 ± 0.02^{a}	64.57 ± 0.01^{b}
Isale-Aluko	9.45 ± 0.02^{c}	3.25 ± 0.01^{b}	4.26 ± 0.02^{d}	14.28 ± 0.02^{d}	2.49 ± 0.01^{a}	64.53 ± 0.02^{b}
Odoore	9.55 ± 0.01^{c}	3.11 ± 0.01^{c}	4.57 ± 0.01^{a}	14.50 ± 0.01^{a}	2.20 ± 0.01^{c}	64.25 ± 0.01^{d}
Botanical garden (Control site)	9.75 ± 0.02^{a}	3.11 ± 0.02^{c}	4.53 ± 0.01^{a}	14.49 ± 0.01^{b}	2.21 ± 0.01^{c}	64.35 ± 0.01^{c}

Value with the same superscrite along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

The fat and oil content of accession NGBO 125 ranged between 3.00 ±0.02 % and 5.40 ±0.05 % with the lowest fat and oil oil content in the accession in Otte and the highest in the accession in Eroomo (Table 89). Accession in the Control site had lower fat and oil content than the accession in the other sites except for the accession in Otte, Budo Egba and Isale Aluko. Accession in the Control site had statistically the same fat and oil content with the accession in Budo Egba and Budo Abio (Table 89). No significant differences in the fat and oil content of the accession in Mubo, Ojagboro, Olaolu, Okeodo and Coca cola were recorded. It was found that lower content of crude fat and oil was recorded in accession NGBO 125 in the second rainy season (2017) than in the first rainy season (2016). Crude protein content in accession NGBO 125 in the second rainy season (2017) ranged between 7.76 ± 0.02 % and 21.04 ± 0.09 % with the lowest crude protein in the accession in Isale Aluko and the highest in Odoore accession showing lower values of crude protein in accession NGBO125 in the second rainy season (2017) than in the first rainy season (2016);

(Table 89). Crude protein of the accession in the Control site was higher than the accession in the other sites except for the accession in Odoore. No significant differences were recorded in the crude protein content in the accession in Otte and Cocacola, so also were the accession in Budo Egba and Okeodo. The crude protein content of the accession in Budo Abio and Mubo were statistically the same, so also were the accession in Oyun and Ojagboro (Table 89). Crude fibre in accession NBGO 125 in the second rainy season (2017) ranged between 1.08 ±0.02 % and 2.61 ± 0.03 % with the lowest in the accession in Odoore and the higest in the accession in Ojagboro suggesting lower crude fibre in accession NGBO125 in the second rainy season (2017) than in the first rainy season (2016). (Table 89). The crude fibre content of the accession in the Control site was lower than the other sites except for the accession of Oyun, Eroomo and Odoore (Table 89). There were significant differences in the crude fibre content of the accession in Budo Egba, Eroomo and Okeodo, so also were the accession in Olaolu and Cocacola at $p \leq 0.05$(Table 89). Carbohydrate content of accession NGBO125 in the second rainy season (2017) ranged between 58.17 ±0.13 % and 73.41 ±0.11 % with the lowest carbohydrate content in the accession in Odoore and the highest in the accession in Budo Abio (Table 89). The carbohydrate content of the accession in the Control site was lower than the accession in the other sites except for the accession in Oyun, Eroomo and Odoore (Table 89).

The carbohydrate content of the accession in Otte, Budo Egba, Mub, Olaolu and Eroomo were statistically the same. So also were the accession in Budo Abio and Isale Aluko, accession in Oyun and Odoore. There were no significant differences in the carbohydrate content in the accession of Ojagboro, Okeodo and Cocacola (Table 89). The result indicated higher carbohydrate content in accession NGBO125 in the second rainy season (2017) than in the first rainy season (2016).

Table 90 shows proximate (nutritional) composition analysis (%)) of fresh edible *Corchorus olitorius* NG/OA/Jun/09/002 in the first dry season (2015) . The range of the moisture content of *Corchorus olitorius* accession NG/OA/Jun/09/002 ranged between 9.69±0.02% and 9.95±0.02% with the lowest obtained in the accession in Ojagboro and the highest in the accession in Odoore (Table 90). The moisture content of the accession in the Control site was higher than the other sites except for the accession in Odoore. The moisture content in the Control site was the same with the accession in Okeodo and Odoore. Percentage ash of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season (2015) ranged between 2.20±0.01% and 2.37±0.02% with the lowest obtained in the accession in Budo Abio and the highest was obtained in the accession in Coca cola (Table 90). Percentage ash of the accession in the Control site was lower than the other sites except for the accession in Budo Abio, Eroomo and Odoore (Table 90). No significant differences in the ash content in the accession of the Control site, Otte, Budo Abio, Mubo, Oyun, Eroomo, Okeodo and Odoore were recorded (Table 90). Accession in Ojagboro, Olaolu, Coca cola and Isale Aluko had the same percentage ash (Table 90). Percentage crude fat and oil ranged between 3.32±0.02% and 3.55±0.01% with the lowest obtained in the accession in Isale Aluko while the highest was obtained in the accession in Budo Abio. The crude fat and oil content in the accession in the Control site was higher than the other sites except for the accession in Budo Abio, Mubo and Eroomo. Percentage crude fat and oil in the accession in Ojagboro, Coca cola and Isale Aluko were statistically the same (Table 90).

Percentage crude protein ranged between 14.65±0.01% and 14.89±0.01% with the lowest obtained in the accession in Ojagboro and the highest in the accession in Budo Abio (Table 90). Percentage crude protein of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the Control site in the first dry season was higher than the other sites except for the accession in

Budo Abio, Eroomo and Odoore. The percentage crude protein in the accession in the Control site was statistically the same with the crude protein in the accession in Budo Abio and Odoore (Table 90).

Percentage crude fibre in the accession (*Corchorus olitorius* NG/OA/Jun/09/002) was ranged between 2.20±0.01% and 2.40±0.01% with the lowest obtained in the accession in Odoore and the highest in the accession in Isale Aluko (Table 90). Percentage crude fibre in the Control site was lower than the other sites except for the accession in Odoore but was statistically the same with the accession in Budo Abio and Odoore (Table 90). Percentage carbohydrate of *Corchorus olitorius* accession NG/OA/Jun/09/002 ranged between 64.72±0.02 % and 65.66±0.01 % with the lowest obtained in the accession in Eroomo and the highest in the in accession in Ojagboro (Table 90). Percentage carbohydrate of the accession in the Control site was lower than the other sites but statistically the same with the accession in Eroomo and Odoore (Table 90). Table 91 shows the proximate composition analysis (%) of fresh edible *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016). The range of the moisture content of the accession was between 8.09 ±0.01 % and 10.21±0.02 %.

The accession in Isale Aluko recorded the lowest moisture content while the accession in Odoore recorded the highest moisture content suggesting higher moisture content than in the accession in the first dry season(2015) (Table 91). The moisture in the Control site had a lower moisture content than the other sites except for the accession in Budo Egba, Okeodo, Cocacola and Isale Aluko. Accession in Otte, Ojagboro and the Control site had the same statistical moisture content (Table 91). No significant differences were recorded in the moisture content of the accessions of Budo Egba and Isale Aluko. The moisture content of the accession in Budo Abio, Mubo, Oyun, Eroomo and Odoore were statistically the same in their moisture content . (Table 91). The ash content of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016) ranged between 1.27±0.05 % and 3.20 ±0.05 % with the lowest ash content recorded in the accession in Eroomo and the highest in the accession in Ojagboro indicating higher ash content in the accession than in the first dry season accession (2015).

Table 89: Proximate composition analysis (%)) of fresh edible *Amaranthus hybridus* NGBO125 in the second rainy season. (2017)

SITE	MOISTURE	ASH	FAT AND OIL	CRUDE PROTEIN	CRUDE FIBRE	PERCENTAGE CARBONHYDRATE
Otte	10.03±0.02^{bc}	2.11 ±0.03^{bc}	3.00 ±0.02^{d}	9.72 ±0.03^{c}	1.50 ±0.02^{de}	72.49±0.12^{ab}
Budo-Egba	10.41 ±0.01^{b}	2.54 ±0.02^{b}	3.74 ± 0.02^{c}	9.37 ± 0.05^{cd}	1.29 ±0.05^{ef}	72.28 ±0.07^{ab}
Budo-Abio	11.05 ±0.05^{ab}	1.66 ±0.04^{c}	3.97 ±0.03^{c}	8.66 ±0.14^{d}	1.10±0.01^{f}	73.41 ±0.11^{a}
Mubo	11.13±0.02^{ab}	2.63 ±0.02^{b}	4.11±0.04^{b}	8.35 ±0.04^{d}	1.99 ±0.14^{c}	71.68 ±0.10^{ab}
Oyun	11.51± 0.04^{ab}	2.44 ±0.01^{b}	4.78±0.02^{ab}	19.80±0.01^{ab}	1.67 ±0.03^{d}	69.33 ±0.19^{b}
Ojagboro	8.12±0.03^{cd}	3.78 ±0.02^{ab}	4.30 ±0.00^{b}	11.12±0.03^{ab}	2.61 ± 0.03^{a}	68 .89 ±0.02^{b}
Olaolu	10.38±0.02^{b}	2.04±0.01^{bc}	4.27 ±0.03^{b}	9.18 ±0.12c^{d}	1.79 ±0.03^{cd}	72. 11 ±0.17^{ab}
Eroomo	11.96 ± 0.04^{a}	1.38 ±0.02^{d}	5.40 ±0.05^{a}	17.28 ± 0.22^{b}	1.15 ±0.07^{ef}	61.14 ±0.10^{ab}
Okeodo	10.11 ±0.05^{bc}	1.77±0.03^{c}	4.26 ±0.00^{b}	10.19±0.11^{cd}	1.24 ±0.09^{ef}	70.76 ±0.19^{b}
Coca-cola	10.02 ±0.03^{bc}	3.91 ± 0.05^{ab}	4.13 ±0.02^{b}	11.06 ±0.04^{c}	1.89 ±0.04^{cd}	68.70 ±0.11^{b}
Isale-Aluko	8.95 ±0.05^{c}	4.11 ±0.06^{a}	3.08 ±0.03^{d}	7.76 ±0.02^{cd}	2.46 ±0.04^{ab}	73.29 ±0.09^{a}
Odoore	11.76 ±0.13^{ab}	1.06 ±0.03^{e}	4.05 ±0.05^{bc}	21.04 ± 0.09^{a}	1.08 ±0.02^{f}	68.17 ±0.13^{b}
Botanical garden (Control site)	10.87 ±0.03^{b}	1.26 ±0.03^{d}	3.96±0.01^{c}	19.94±0.11^{ab}	1.19 ±0.01^{ef}	62.11 ±0.07^{bc}

Value of the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

The ash content of the accession in the Control site was lower than the other sites except for the accession of Budo Abio, Olaolu, Eroomo and Odoore (Table 91). Ash content of the accession in Otte and Mubo, so also were the accession in Budo Egba and Okeodo, likewise in Coca cola and Isale Aluko were sstatistically the same. The crude fat and oil content of the accession in the second dry season (2016) was in the range of 4.03 ±0.03% and 5.33 ±0.11% with the lowest content recorded in the accession in Oyun and highest in the accession in Budo Abio (Table 91).The accession in the Control site had a higher fat and oil content than the accession in the other sites except for the accession in Budo Abio, Mubo, Eroomo and Odoore (Table 91). The crude fat and oil content in the accession in the Control site and the accession in Mubo were statistically the same. The accession in Budo Egba and Odooro, Budo Abio and Eroomo, Oyun, Ojagboro and Olaolu had the same fat and oil content statistically (Table 91). It was found that the crude fat and oil in the second dry season (2016)accession was higher than in the first dry season (2015). *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016) recorded the range of 7.66 ±0.07 % and 22.14±0.08 % with the lowest percentage crude protein recorded in the accession in Coca cola and the highest in the accession in Budo Abio showing lower crude protein content in the second dry season(2016) than in the first dry season (2015).

The accession in the Control site had crude protein content higher than the accession in the other sites except for the accession in Budo Abio and Odoore (Table 91). No significant differences were recorded in the crude protein content of the accession in the Control site and the accession in Otte, Budo Egba, Oyun and Eroomo (Table 91). Accession in Olaolu and Okeodo were statistically the same in the content of the crude protein, so also were the accession in Cocacola and Isale Aluko (Table 91). Crude fibre content in *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second dry season (2016) ranged between 1.05 ±0.05 % and 2.01 ±0.01 % with the lowest recorded in the accession in Budo Abio and the highest in the accession in Ojagboro suggesting lower content of crude fibre in the season than in the first dry season(2015) (Table 91). The crude fibre of the accession in the Control site was lower than the accession in the other sites. Accession in Budo Egba, Mubo, Olaolu and Coca cola were statistically the same in the percentage content of crude fibre, so also were the accession in Budo Abio and Okeodo, Ojagboro and Isale aluko, Eroomo and Odoore (Table 91).

Table 90: Proximate composition(Nutritional) analysis (%)) of fresh edible *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season (2015).

SITE	Moisture	Ash	Fat and Oil	Crude Protein	Crude Fibre	Carbohydrate content
Otte	9.75±0.02^{c}	2.26±0.02^{b}	3.40±0.02^{b}	14.78±0.02^{b}	2.30±0.02^{b}	65.83±0.02^{a}
Budo-Egba	9.71±0.01^{c}	2.32±0.02^{a}	3.45±0.01^{b}	14.75±0.01^{b}	2.32±0.02^{b}	65.74±0.01^{a}
Budo-Abio	9.79±0.01^{c}	2.20±0.01^{b}	3.55±0.01^{a}	14.89±0.01^{a}	2.25±0.01^{c}	65.04±0.01^{ab}
Mubo	9.83±0.02^{b}	2.28±0.02^{b}	3.51±0.01^{a}	14.79±0.01^{b}	2.35±0.01^{b}	64.95±0.01^{b}
Oyun	9.85±0.02^{b}	2.26±0.02^{b}	3.47±0.02^{b}	14.75±0.02^{b}	2.28±0.02^{c}	65.11±0.01^{ab}
Ojagboro	9.69±0.02^{d}	2.32±0.02^{a}	3.39±0.02^{c}	14.65±0.01^{c}	2.35±0.01^{b}	65.66±0.01^{a}
Olaolu	9.86±0.02^{b}	2.30±0.01^{a}	3.42±0.02^{b}	14.71±0.02^{b}	2.32±0.02^{b}	65.03±0.02^{ab}
Eroomo	9.89±0.01^{b}	2.22±0.02^{b}	3.49±0.01^{b}	14.89±0.01^{a}	2.20±0.01^{c}	64.72±0.02^{c}
Okeodo	9.90±0.02^{a}	2.27±0.01^{b}	3.44±0.01^{b}	14.77±0.02^{b}	2.31±0.01^{b}	64.94±0.01^{b}
Coca-cola	9.79±0.01^{c}	2.37±0.02^{a}	3.35±0.01^{c}	14.71±0.02^{b}	2.34±0.02^{b}	65.05±0.01^{ab}
Isale-Aluko	9.70±0.01^{c}	2.35±0.01^{a}	3.32±0.02^{c}	14.73±0.02^{b}	2.40±0.01^{a}	65.38±0.01^{a}
Odoore	9.95±0.02^{a}	2.21±0.01^{b}	3.41±0.01^{b}	14.83±0.02^{a}	2.20±0.01^{c}	64.73±0.01^{c}
Botanical garden (Control site)	9.93±0.01^{a}	2.25±0.01^{b}	3.48±0.02^{b}	14.86±0.01^{a}	2.24±0.01^{c}	64.71±0.01^{c}

Values with the same superscript along the column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

Carbohydrate content in the accession in the second season (2016) ranged between 74.55 ±0.09 % and 75.50 ±0.01 % with the lowest carbohydrate content recorded in the accession in Isale Aluko and the highest in the accession in Odoore showing higher content than in the accession of the first dry season (2015) (Table 91). Carbohydrate content of the accession in the Control site was higher than the accession in the other sites except for the accession in Budo Abio, Oyun and Odoore. The accession in the Control site had the same carbohydrate content statistically with the accession in Otte, Mubo, Olaolu, Okeodo, Cocacola and Odoore. No significant differences were recorded in the carbohydrate content in the accession in Budo Egba, Ojagboro, Eroomo, Eroomo and Isale Aluko, so also were the accession in Budo Abio and Oyun in the second dry season (2016) (Table 91).

Table 92 shows the proximate composition analysis (%)) of fresh edible *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first rainy season (2016). The range of the moisture content of the accession was between 9.65 ±0.00 % and 10.85±0.00 % with the lowest moisture content recorded in Isale Aluko and the highest in Odoore (Table 92). The moisture in the Control site was higher than the other sites except for Oyun, Eroomo and Odoore. The ash content of the accession in the first rainy season (2016) ranged between 1.65±0.25 % and 3.45 ±0.25 % with the lowest ash content recorded in the accession in Eroomo and the highest in the accession in Ojagboro. The ash content of the accession in the Control site was lower than the other sites except for the accession in Budo Abio, Eroomo and Odoore and were statistically the same. Ash content of the accession in Otte, Budo Egba, Mubo, Oyun and Okeodo were statistically the same in the content of ash, so also were the accession in Ojagboro, Coca cola and Isale Aluko (Table 92).Crude fat and oil content of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first rainy season (2016) ranged between 3.40 ±0.00 % and 5.60 ±0.15% with the lowest content recorded in the accession in Otte and highest in the accession in Budo Abio. The accession in the Control site had a higher crude fat and oil content than the accession in the other sites except for the accession in Budo Abio, Mubo, Eroomo and Odoore (Table 92). Accession in all the sites had the same statistical content of crude fat and oil except for Otte, Budo Abio, Coca cola, Odoore and the Control site

Table 91: Proximate composition analysis (%) of fresh edible *Corchorus olitorius* NG/OA/Jun/09/002 second dry season (2016).

Site	Moisture content	Ash content	Crude fat and oil	Crude protein	crude fibre	percentage carbohydrate
Otte	9.14 ± 0.05^{b}	2.22 ±0.05^{bc}	3.29 ± 0.02^{c}	9.77 ±0.06^{bc}	1.87±0.11^{b}	75 .11 ±0.02^{ab}
Budo-Egba	8.18±0.02^{c}	2.54 ±0.03^{b}	4.17 ±0.003^{ab}	10.11 ±0.06^{bc}	1.90±0.11^{ab}	74.89 ±0.03^{b}
Budo-Abio	10.08 ±0.07^{a}	1.81 ±0.09c^{d}	5.38 ±0.07^{a}	22.09±0.01^{a}	1.07 ±0.03^{c}	75.21 ±0.03^{a}
Mubo	10.09±0.05^{a}	2.15 ±0.02^{bc}	4.89 ±0.07^{b}	9.16 ±0.04^{c}	1.89 ±0.01a^{b}	75.10 ±0.01^{ab}
Oyun	10.07 ±0.03^{a}	2.06 ±0.04^{bcd}	4.03 ±0.03^{bc}	10.06 ±0.07^{bc}	1.65 ±0.00^{bc}	75.28 ±0.03^{a}
Ojagboro	9.20 ±0.00^{b}	3.11 ±0.04^{a}	4.22 ± 0.07^{bc}	8.88±0.02^{cd}	2.08 ±0.02^{a}	74.81 ±0.02^{b}
Olaolu	9.97±0.05^{ab}	1.53 ±0.06^{de}	4.19 ± 0.06^{bc}	7.95 ±0.05^{d}	1.90 ± 0.10a^{b}	75.17 ±0.03^{ab}
Eroomo	10.14 ±0.03^{a}	1.21±0.04^{e}	4.75 ± 0.05^{b}	10.11 ±0.08^{bc}	1.41 ±0.014^{cd}	74.89 ±0.01^{b}
Okeodo	8.13 ±0.05^{c}	2.55 ±0.03^{b}	4.37 ±0.09^{bc}	8.04 ±0.01^{d}	1.57 ± 0.02^{c}	75.04 ±0.05^{ab}
Coca-cola	7.91 ±0.04^{cd}	3.19 ± 0.04^{ab}	4.05± 0.00^{bc}	7.58 ±0.03^{d}	1.93±0.06a^{b}	75.13 ±0.04^{ab}
Isale-Aluko	8.04 ±0.01^{c}	3.07 ±0.06^{ab}	4.06±0.09^{bc}	7.81 ±0.04^{d}	2.00 ± 0.05^{a}	74.48 ±0.04^{b}
Odoore	10.19±0.01^{a}	1.67 ± 0.02^{cde}	5.03 ±0.04^{ab}	11.21 ± 0.08^{b}	1.47 ±0.03^{cd}	75.59 ±0.01^{a}
Botanical garden (Control site)	9.11±0.07^{b}	1.97 ±0.03^{bcd}	4.53 ±0.01^{b}	10.77 ± 0.13^{bc}	1.19 ±0.01^{d}	74.14 ±0.03^{ab}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

Corchorus olitorius accession NG/OA/Jun/09/002 in the first rainy season (2016) recorded the range of 10.15 ±0.25 % and 23.50±0.10 % of crude protein with the lowest percentage recorded in the accession in Ojabgoro and the highest in the accession in Budo Abio (Table 92). The accession in the Control site had crude protein content higher than the accession in the other sites except for the accession in Budo Abio (Table 92). No significant differences were recorded in the crude protein content of the accession in the Control site and the accession in Otte,Mubo, , Oyun, Ojagboro, Olaolu, Eroomo,Coca cola and Isale Aluko (Table 92). Accession in Okeodo and Odoore were statistically the same in the content of the crude protein (Table 92). Crude fibre content *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first rainy season (2016) ranged between 1.68 ±0.14 % and 2.29 ±0.12 % with the lowest recorded in the accession in Isale Aluko and the highest in the accession in Budo Abio. The crude fibre of the accession in the Control site washigher than the other sites except for Budo Abio and Eroomo (Table 92). Accession in Otte, Budo Egba, Mubo, Oyun, Olaolu and Coca cola were statistically the same in the percentage content of crude fibre. Carbohydrate content of *Corchorus olitorius* accession NG/OA/Jun/09/002 ranged between 70.00 ±0.00 % and 72.00 ±0.00 % with the lowest in Eroomo and the highest in Mubo (Table 92). Carbohydrate content of the accession in the Control site was higher than the other sites(Table 92).

Table 93 shows proximate (nutritional) composition analysis (%) of fresh edible *Corchorus olitorius* NG/OA/Jun/09/002 in the second rainy season (2017). The range of the moisture content of the accession was in the range of 9.70±0.00% and 11.20 ±0.00% with the lowest obtained in Coca cola and the highest Oyun suggesting higher moisture content than the first rainy season (2016) (Table 93). The moisture content of the accession in the Control site was higher than the other sites except for Odoore. The moisture content in the Control site was higher than all the accession except for Ojagboro, Eroomo, Okeodo and Coca cola.Percentage ash of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second rainy season (2017) ranged between 2.25±0.09 % and 3.51± 0.14 % with the lowest obtained in the accession in Odoore while the highest in Mubo showing higher ash content than the first rainy season (2016) (Table 93). Percentage ash of the accession in the Control site was higher than the other sites except for Otte, Olaolu and Odoore but had the same statistical ash content with Otte (Table 93).

Table 92: Proximate composition analysis (%)) of fresh edible *Corchorus olitorius* NG/OA/Jun/09/002 first rainy season (2016).

SITE	MOISTURE	ASH	FAT AND OIL	CRUDE PROTEIN	CRUDE FIBRE	PERCENTAGE CARBONHYDRATE
Otte	10.03 ± 0.11^{c}	2.65 ± 0.10^{bc}	3.40 ± 0.00^{c}	10.95 ± 0.15^{c}	2.15 ± 0.15^{b}	70.55 ± 0.15^{bc}
Budo-Egba	10.18 ± 0.10^{c}	2.80 ± 0.00^{b}	4.42 ± 0.19^{ab}	11.35 ± 0.25^{bc}	2.27 ± 0.29^{ab}	70.46 ± 0.26^{bc}
Budo-Abio	10.52 ± 0.15^{b}	1.95 ± 0.10^{cd}	5.60 ± 0.15^{a}	23.50 ± 0.10^{a}	1.31 ± 0.16^{c}	71.60 ± 0.10^{b}
Mubo	10.55 ± 0.15^{b}	2.20 ± 0.25^{bc}	4.95 ± 0.11^{b}	10.35 ± 0.10^{cd}	2.09 ± 0.12^{ab}	72.00 ± 0.00^{ab}
Oyun	10.80 ± 0.00^{a}	2.60 ± 0.20^{bcd}	4.30 ± 0.00^{bc}	10.27 ± 0.15^{cd}	1.88 ± 0.27^{bc}	72.35 ± 0.25^{a}
Ojagboro	10.14 ± 0.19^{c}	3.45 ± 0.25^{a}	4.62 ± 0.14^{bc}	10.15 ± 0.25^{cd}	2.29 ± 0.16^{a}	70.75 ± 0.22^{bc}
Olaolu	10.22 ± 0.15^{c}	2.75 ± 0.25^{de}	4.46 ± 0.24^{bc}	10.35 ± 0.10^{cd}	$2.11 \pm 0.06a^{b}$	70.90 ± 0.00^{bc}
Eroomo	10.57 ± 0.13^{b}	1.65 ± 0.25^{e}	4.65 ± 0.14^{b}	10.65 ± 0.13^{c}	1.59 ± 0.12^{cd}	70.25 ± 0.00^{c}
Okeodo	10.45 ± 0.10^{bc}	2.80 ± 0.15^{b}	4.54 ± 0.13^{bc}	12.68 ± 0.19^{b}	1.85 ± 0.15^{c}	71.65 ± 0.13^{b}
Coca-cola	9.75 ± 0.15^{d}	3.35 ± 0.10^{ab}	4.40 ± 0.00^{bc}	10.25 ± 0.10^{cd}	2.15 ± 0.10^{ab}	72.00 ± 0.00^{ab}
Isale-Aluko	9.65 ± 0.00^{d}	3.04 ± 0.06^{ab}	4.30 ± 0.00^{bc}	10.35 ± 0.15^{d}	2.25 ± 0.13^{a}	71.89 ± 0.00^{b}
Odoore	10.65 ± 0.15^{ab}	1.67 ± 0.02^{cde}	5.25 ± 0.00^{ab}	12.45 ± 0.15^{b}	1.54 ± 0.07^{cd}	70.35 ± 0.15^{bc}
Botanical garden (Control site)	10.55 ± 0.12^{d}	1.97 ± 0.03^{bcd}	4.72 ± 0.17^{b}	14.61 ± 0.13^{abc}	1.28 ± 0.14^{d}	70.05 ± 0.13^{c}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

Accession in Budo Egba and Isale Aluko had the same percentage ash statistically (Table 93). The range of the percentage crude fat and oil was between 3.58±0.14 % and 5.48 ±0.16 % with the lowest obtained in Otte and the highest in Odoore indicating lower percentage crude fat and oil than the first rainy season (2016) (Table 93). The crude fat and oil content of the accession in the Control site was lower than the other sites except for Budo Abio, Mubo and Odoore (Table 93). The percentage crude protein in *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second rainy season (2017) ranged between 10.65±0.15% and 22.65±0.00% with the lowest obtained in the accession in Budo Egba and the highest in Budo Abio showing lower content than the first rainy season (2016) (Table 93). Percentage crude protein of the accession in the Control site was higher than the other sites except for Budo Abio, Eroomo and Odoore. The percentage crude protein of the accession of the Control site was statistically the same with the crude protein in Budo Abio and Odoore (Table 93). Percentage crude fibre of the accession (*Corchorus olitorius* NG/OA/Jun/09/002) in the second rainy season (2017) ranged between 2.20±0.01% and 2.40±0.01% with the lowest obtained in the accession in Odoore and the highest in Isale Aluko (Table 93). Percentage crude fibre in the Control site was lower than the other sites except for Odoore but was statistically the same with the accession in Budo Abio and Odoore (Table 93).

Percentage carbohydrate of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the second rainy season (2017) ranged between 64.72±0.02% and 65.66±0.01% with the lowest obtained in the accession in Eroomo and the highest in the accession in Ojagboro (Table 93). The result showed lower carbohydrate content than in the first rainy season (2016). Percentage carbohydrate of the accession in the Control site was lower than the other sites but statistically the same with the accession in Eroomo and Odoore (Table 93). Table 94 shows nutritional content (proximate) of *Corchorus olitorius* NG/OA/04/010 in the first dry season (2015). The range of the moisture content of the accession was between 6.64 ± 0.01 % and 6.97 ±0.02 % with the lowest moisture content recorded in the accession in Otte and the highest in the accession in Oyun. Percentage moisture of the accession in the Control site was higher than the moisture content in Otte, Budo Egba, Budo Abio, Olaolu, Okeodo and Coca cola. Accession in Otte, Budo Abio and Olaolu had the same percentage moisture.

No significant differences in the moisture content of accession in Budo Abio, Coca cola and the Control site(Table 94). Percentage moisture in the accession in Mubo and Oyun were statistically the same. Accession in Ojagboro, Eroomo Isale Aluko and Odoore recorded no significant differences in the percentage moisture (Table 94). The range of the percentage ash of *Corchorus olitorius* NG/OA/04/010 in the first dry season (2015) was between 4.33±0.02% and 5.49 ±0.03% with the lowest recorded in the accession in Budo Abio while the highest was recorded in the accession in Ojagboro.

The percentage ash of the Control site was lower than the other sites except for Budo Abio and Oyun (Table 94). The accession in the Control site recorded the same percentage ash as the accession in Otte. Accession in Budo Egba, Mubo, Ojagboro, Olaolu, Eroomo, Okeodo, Coca cola, Isale Aluko and Odoore had the same ststistical values of Percentage ash. No significant differences in the ash content in the accession in Budo Abio and Oyun were recorded. Percentage crude fat and oil of *Corchorus olitorius* NG/OA/04/010 in the first dry season (2015) ranged between 3.64 ±0.03% and 4.20 ± 0.01% with the lowest recorded in the accession in Budo Egba and the highest in the accession in Oyun (Table 94). Accession in the Control site had the same percentage crude fat and oil as in Odoore. Accession in Otte and Budo Egba were statistically the same in the percentage of fat and oil (Table 94). No significant differences were recorded in the percentage fat and oil in the accession in Budo Abio, Mubo, Oyun, Ojagboro, Olaolu, Eroomo, Okeodo and Coca cola (Table 94). The range of percentage crude protein in the accession was between 6.30 ±0.02% and 18.71 ±0.02 % with the lowest recorded in the accession in Otte and the highest in the accession in Oyun. Accession in the Control site has lower percentage crude protein than the other sites except for Otte and Budo Egba (Table 94). Accession in the Control site recorded the same statistical percentage of crude protein as the accession in Otte and Budo Egba . No significant differences were recorded in the percentage crude protein in the accession in Mubo, Ojagboro, Coca cola and Isale Aluko (Table 94). Accession in Olaolu, Eroomo, Okoodo and Odoore had the same percentage crude protein statistically . Accession in Oyun had a relatively higher percentage of crude protein than the other accession in other sites (Table 94).

Crude fibre of *Corchorus olitorius* NG/OA/04/010 in the first dry season (2015) ranged between 1.82 ±0.01% and 2.55 ±0.04% with the lowest percentage crude fibre in the accession in Oyun while the highest was recorded in the accession in Olaolu. Accession in the Control site had the same percentage crude fibre as the accession in Otte, Budo Egba, Budo Abio, Ojagboro, Eroomo, Okeodo, Coca cola, Isale Aluko and Odoore (Table 94). The range of percentage carbohydrate in *Corchorus olitorius* NG/OA/04/010 in the first dry season (2015) ranged between 64.00 ±0.01% and 75.27 ±0.05 % with the lowest ash content of the accession in the Control site was lower than the other sites except for Budo Abio, Mubo and Oyun.

The range of the percentage fat and Oil of the accession in the second dry season (2016) ranged between 4.09±0.08 % and 4.25±0.03 % with the lowest in the accession in Isale Aluko and the highest in the accession in Otte. The fat and oil content of the accession in the Control site was higher than the other sites except for Otte (Table 95). It was found that crude fat and oil in the second dry season (2016) was higher than in the first dry season (2015). Crude protein content in *Corchorous olitorius* accession NG/OA/04/010 in the second dry season (2016) ranged between 6.26±0.00 % and 14.65±0.00 % with the lowest obtained in the accession in Isale Aluko while the highest was obtained in the accession in Budo Abio. Crude protein content in the Control site was higher than the other sites except for Budo Abio (Table 95)

Table 93: Proximate composition (Nutritional) analysis (%)) of fresh edible *Corchorus olitorius* NG/OA/Jun/09/002 second rainy season (2017).

SITE	Moisture	Ash	Crude Fat and Oil	Crude Protein	Crude Fibre	Carbohydrate content
Otte	10.05±0.00^{b}	2.35±0.05^{cd}	3.58±0.14^{d}	11.20±0.00^{ef}	2.11±0.02^{b}	65.83±0.02^{a}
Budo-Egba	10.12±0.09^{b}	2.60±0.00^{c}	4.20±0.01^{bc}	10.65±0.15^{f}	2.18±0.02^{b}	65.74±0.01^{a}
Budo-Abio	10.35±0.25^{abc}	2.48±0.13^{b}	5.35±0.10^{ab}	22.65±0.00^{a}	2.29±0.12^{a}	65.04±0.01^{ab}
Mubo	10.45±0.12^{ab}	3.51±0.14^{a}	4.80±0.00^{b}	12.20±0.10^{def}	2.19±0.01^{b}	64.95±0.01^{b}
Oyun	11.20±0.00^{a}	2.90±0.00^{ab}	4.33±0.02^{bc}	13.22±0.17^{b}	2.15±0.02^{b}	65.11±0.01^{ab}
Ojagboro	9.85±0.10^{d}	2.97±0.15^{ab}	4.15±0.00^{bcd}	15.10±0.00^{bcd}	1.95±0.15^{b}	65.66±0.01^{a}
Olaolu	10.50±0.00^{b}	2.26±0.17^{d}	4.00±0.00^{bcd}	14.90±0.00^{c}	2.18±0.02^{b}	65.03±0.02^{ab}
Eroomo	9.90±0.15^{c}	2.85±0.23^{b}	4.10±0.00^{bcd}	15.45±0.15^{bc}	2.25±0.01^{ab}	64.72±0.02^{c}
Okeodo	9.85±0.22^{c}	2.90±0.00^{ab}	3.72±0.13^{cd}	15.20±0.00^{bc}	2.21±0.06^{ab}	64.94±0.01^{b}
Coca-cola	9.70±0.00^{c}	2.68±0.22^{c}	3.95±0.05^{c}	13.70±0.20^{d}	2.12±0.07^{b}	65.05±0.01^{ab}
Isale-Aluko	10.00±0.00^{b}	2.75±0.14^{bc}	3.98±0.01^{c}	12.85±0.25^{de}	1.68±0.14^{c}	65.38±0.01^{a}
Odoore	10.15±0.12^{b}	2.25±0.09^{d}	5.48±0.16^{a}	16.20±0.00^{b}	2.20±0.08^{ab}	64.73±0.01^{c}
Botanical garden (Control site)	10.05±0.14^{b}	2.45±0.17^{cd}	4.25±0.15^{bc}	15.65±0.22^{bc}	2.20±0.15^{c}	64.71±0.01^{c}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

. Higher crude protein in the accession of the second dry season was observed than the first dry season (2015). The range of the crude fibre in the accession was between 1.92±0.02 % and 2.50±0.02 % with the lowest was obtained in the accession in Oyun and the highest in the accession in Budo Egba which showed higher values than in the first dry season (2015) (Table 95). Percentage crude fibre in the Control site was lower than the other sites except for Budo Abio and Oyun (Table 95).

obtained in the accession in Oyun and the highest in the accession in Budo Abio. Accession in the Control site had percentage carbohydrate higher than the accession in other sites except for Budo Abio (Table 94). Accession in the Control site had the same percentage of carbohydrate as the accession in Budo Abio . No significant differences in the percentage carbohydrate of accession in Otte, Eroomo, Isale Aluko and Odoore were recorded. Accession in Budo Egba, Mubo, Ojagboro, Olaolu, Okeodo and Coca cola were statistically the same in the percentage carbohydrate (Table 94). Table 95 shows the proximate composition (%) of *Corchorous olitorius* accession NG/OA/04/010 in the second dry season (2016). The moisture content of the *Corchorous olitorius* accession NG/OA/04/010 in the second dry season (2016) ranged between 6.91±0.02 % and 7.83±0.03 % with the lowest recorded in the accession in Ojagboro and the highest in the accession in Oyun suggesting higher moisture content in the accession in the second dry season (2016) than in the first dry season (2015). Moisture content in the Control site was higher than the other sites except for Oyun and Odoore (Table 95).

Table 94: Proximate composition analysis (%) of fresh edible *Corchorus olitorius* NG/OA/04/010 in first dry season (2015).

SITE	MOISTURE	ASH	FAT AND OIL	CRUDE PROTEIN	CRUDE FIBRE	PERCENTAGE CARBOHYDRATE
Otte	6.64 ± 0.01^{bc}	5.37 ± 0.02^{ab}	3.67 ± 0.02^{c}	6.30 ± 0.02^{c}	2.32 ± 0.02^{b}	74.82 ± 0.02^{b}
Budo-Egba	6.68 ± 0.02^{bc}	5.46 ± 0.01^{a}	3.64 ± 0.03^{c}	6.35 ± 0.02^{c}	2.30 ± 0.02^{b}	75.07 ± 0.04^{ab}
Budo-Abio	6.75 ± 0.01^{b}	4.33 ± 0.02^{b}	3.81 ± 0.01^{bc}	6.44 ± 0.02^{c}	2.36 ± 0.02^{b}	75.27 ± 0.05^{a}
Mubo	6.93 ± 0.02^{a}	5.44 ± 0.02^{a}	3.83 ± 0.01^{bc}	$6.52 \pm 0.02b^{c}$	2.30 ± 0.02^{b}	75.10 ± 0.01^{ab}
Oyun	6.97 ± 0.02^{a}	4.38 ± 0.01^{b}	4.20 ± 0.01^{a}	18.71 ± 0.02^{a}	1.82 ± 0.01^{c}	64.00 ± 0.01^{c}
Ojagboro	6.83 ± 0.01^{ab}	5.49 ± 0.03^{a}	3.84 ± 0.01^{bc}	6.52 ± 0.02^{bc}	2.31 ± 0.02^{b}	75.02 ± 0.02^{ab}
Olaolu	6.58 ± 0.01^{bc}	5.43 ± 0.01^{a}	3.88 ± 0.01^{bc}	6.62 ± 0.02^{b}	2.55 ± 0.04^{a}	75.14 ± 0.02^{ab}
Eroomo	6.85 ± 0.02^{ab}	5.42 ± 0.01^{a}	3.85 ± 0.01^{bc}	6.63 ± 0.01^{b}	2.32 ± 0.02^{b}	74.96 ± 0.03^{b}
Okeodo	6.66 ± 0.02^{c}	5.40 ± 0.02^{a}	3.84 ± 0.01^{bc}	6.64 ± 0.01^{b}	2.33 ± 0.02^{b}	75.18 ± 0.01^{ab}
Coca-cola	6.76 ± 0.02^{b}	5.44 ± 0.02^{a}	3.84 ± 0.01^{bc}	6.55 ± 0.01^{bc}	2.31 ± 0.01^{b}	75.03 ± 0.01^{ab}
Isale-Aluko	6.86 ± 0.02^{ab}	5.43 ± 0.02^{a}	3.83 ± 0.01^{bc}	$6.50 \pm 0 .02^{bc}$	2.32 ± 0.02^{b}	74.96 ± 0.02^{b}
Odoore	6.82 ± 0.01^{ab}	5.44 ± 0.01^{a}	3.94 ± 0.01^{b}	6.63 ± 0.02^{b}	2.31 ± 0.02^{b}	74.99 ± 0.02^{b}
Botanical garden (Control site)	6.79 ± 0.02^{b}	5.35 ± 0.02^{ab}	3.95 ± 0.01^{b}	6.37 ± 0.01^{c}	2.31 ± 0.01^{b}	75.24 ± 0.01^{a}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

Ash content of the accession in the second dry season (2016) ranged between 4.33±0.01 % and 5.52±0.01 % with the lowest obtained in the accession in Oyun and the highest in the accession in Eroomo showing higher values than in the first dry season (2015) (Table 95).Carboyhdrate content in *Corchorous olitorius* accession NG/OA/04/010 in the second dry season (2016) ranged between 71.52±1.15 % and 73.10±0.00 %. The lowest carbohybrate content was obtained in the accession in Budo Egba and the highest in Oyun accession showing lower content in the accession than the first dry season (2015) (Table 95). Accession in the Control site had lower carbohydrate content than the other sites except for Otte, Budo Egba and Budo Abio (Table 95).

Table 96 shows the proximate composition analysis (%) of fresh edible *Corchorus olitorius* accession NG/OA/04/010 in the first rainy season (2016). The moisture content of *Corchorus olitorius* accession NG/OA/04/010 ranged between 9.89±0.01% and 10.09±0.01% with the lowest moisture content obtained in the accession in Coca cola and the highest in the accession in Budo Abio (Table 96). The moisture content of the accession in the Control site was higher than the accession in other sites except for Budo Abio and Oyun (Table 96). The range of ash content of the accession was between 1.89±0.01% and 2.25±0.01% with the lowest obtained in Eroomo accession and the highest in Coca cola (Table 96). Percentage ash of the accession in the Control site was lower than other sites except for the accession in Eroomo. Percentage crude fat and oil of the accession in the first rainy season (2016) ranged between 2.90±0.01% and 3.25±0.01% with the lowest content obtained in Cocacola and the highest in Budo Abio and Odoore (Table 96). The crude fat and oil content in the Control site was higher than the other sites except for Budo Abio, Eroomo and Odoore.

Percentage crude protein in the accession in the first rainy season (2016) ranged between 14.49±0.01% and 14.71±0.01% with the lowest obtained in the accession in Coca cola and the highest in the accession in Budo Abio (Table 96). Accession in the Control site had higher percentage crude protein than the accession in the other sites except for Budo Abio. The percentage crude fibre of the accession ranged between 2.10±0.01% and 2.52±0.01a% with the lowest recorded in Budo Abio and the highest in Coca cola (Table 96).

Table 95. Proximate Composition (%) of *Corchorous olitorius* accession NG/OA/04/010 in the second dry (2016).

Site	Moisture content	Ash Content	Fat and Oil content	Crude protein content	Crude fibre content	Carbohydrate content
Otte	7.14±0.08^{a}	5.42±0.01^{a}	4.25±0.03^{a}	6.51±0.00^{ab}	2.41±0.01^{ab}	71.58±0.81^{b}
Budo Egba	7.08±0.02^{a}	5.51±0.01^{a}	4.16±0.14^{a}	6.55±0.00^{ab}	2.50±0.02^{a}	71.52±1.15^{b}
Budo Abio	7.22±0.03^{bc}	4.52±0.03^{b}	4.13±0.15^{a}	14.65±0.00^{a}	1.97±0.01^{b}	72.02±1.15^{ab}
Mubo	7.12±0.02^{a}	4.44±0.03^{b}	4.06±0.07^{a}	6.67±0.00^{b}	2.41±0.02^{ab}	72.67±0.00^{ab}
Oyun	7.83±0.03^{b}	4.33±0.01^{b}	4.12±0.04^{a}	6.81±0.00^{ab}	1.92±0.02^{b}	73.10±0.00^{a}
Ojagboro	6.91±0.02^{b}	5.54±0.01^{a}	4.10±0.01^{a}	6.73±0.00^{ab}	2.41±0.02^{ab}	72.48±0.58^{b}
Olaolu	6.97±0.03^{b}	5.51±0.01^{a}	4.10±0.02^{a}	6.81±0.00^{ab}	2.43±0.01^{ab}	72.28±0.02^{b}
Eroomo	7.16±0.02^{a}	5.52±0.01^{a}	4.13±0.03^{a}	6.77±0.00^{ab}	2.39±0.01^{ab}	71.65±0.58^{b}
Okeodo	7.20±0.02^{a}	5.48±0.01^{a}	4.12±0.03^{a}	6.75±0.00^{ab}	2.41±0.02^{ab}	72.98±0.58^{ab}
Cocacola	7.05±0.01^{a}	5.47±0.00^{a}	4.14±0.03^{a}	6.59±0.00^{ab}	2.42±0.01^{ab}	72.76±0.24^{ab}
Isale Aluko	7.20±0.01^{a}	5.47±0.01^{a}	4.09±0.08^{a}	6.26±0.00^{b}	2.42±0.02^{ab}	72.56±0.00^{ab}
Odoore	7.24±0.03^{a}	5.50±0.01^{a}	4.18±0.05^{a}	6.61±0.00^{ab}	2.44±0.01^{ab}	72.32±0.00^{ab}
Botanical Garden (Control site).	7.22±0.06^{a}	5.39±0.01^{a}	4.19±0.09^{a}	6.86±0.00^{ab}	2.37±0.01^{ab}	72.11±0.00^{a}

Values with the same superscript along the same column are statistically the same at $p \leq 0.05$. Values represent mean±SD.

The crude content in the Control site accession was lower than the other sites except for the accession in Budo Abio but had the same crude fibre content as Budo Abio, Mubo and Eroomo. Percentage carbohydrate of *Corchorus olitorius* NG/OA/04/010 in the second rainy season (2016) ranged between 67.06±0.02% and 67.84±0.01% with the lowest carbohydrate content obtained in the accession in Budo Abio and the highest in the accession in Okeodo (Table 96). Carbohydrate content in the Control site was lower than the other sites except for Budo Abio (Table 96). Table 97 shows the proximate composition analysis (%)) of fresh edible *Corchorus olitorius* NG/OA/04/010 in the second rainy season (2017). The moisture content of the accession ranged between 7.75±0.02 % and 11.14 ± 0.07 % with the lowest recorded in the Isale Aluko and the highest in Budo Abio showing higher moisture content than in the first rainy season (2016) (Table 97). The accession in the Control site had lower moisture content than other sites except for Ojagboro, Olaolu, Okeodo, Cocacola and Isale Aluko (Table 97). Accession in Otte and Budo Egba had the same moisture content statistically (Table 97). No significant differences in the moisture content of the accession in Budo Abio and Eroomo, so also were the accession in Mubo and Oyun, Coca cola and Isale Aluko. The range of ash content in *Corchorus olitorius* accession NG/OA/04/010 in the second rainy season (2017) ranged between 1.06 ±0.02 % and 2.10 ±0.13% with the lowest value obtained in the Control site and the highest in Ojagboro suggesting lower ash content than in the first rainy season (2016) (Table 97).. The accession in the Control site had lower ash content than other sites (Table 97). Accession in the Control site had statistically the same ash content as Odoore.

Accession in Budo Egba, Ojagboro, Coca cola and Isale Aluko had the same statistical values of ash content. No significant differences in the ash content in Budo Abio and Oyun, so also were Mubo and Olaolu (Table 97). The crude fat and oil content of *Corchorus olitorius* NG/OA/04/010 in the second rainy season (2017) .ranged between 2.84 ±0.01% and 3.95 ±0.01 % with the lowest content in Ojagboro and the highest in the Control site indicating higher crude fibre content than in the first rainy season (2016) (Table 97). The fat and oil content in the Control site was higher than the other sites (Table 97). Accession in the Control site and Odoore were statistically the same in the fat and oil content. Statistically the same crude fat and oil content were recorded in Otte and Budo Egba (Table 97) . No significant differences in the fat and oil content in Budo Abio, Mubo and Eroomo were recorded, so also were in Oyun, Olaolu, Okeodo, Coca cola and Isale Aluko (Table 97). The crude protein content of the accession recorded the range between 7.95±0.11 % and 21.52 ±0.09[a] % suggesting lower crude protein content than in the first rainy season (2016) (Table 97).. The lowest crude protein content was recorded in Ojagboro and the highest in Oyun. Crude protein content in the Control site was lower than the accession in the other sites except for Ojagboro, Okeodo, Coca cola and Isale Aluko. There were no significant differences in the crude protein content in the accession in the Control site, Olaolu, Okeodo, Coca cola, Isale Aluko and Odoore (Table 97). Accesion in Otte and Budo Egba had the same statistical content of crude protein, so also were Mubo and Eroomo. The crude fibre content of *Corchorus olitorius* NG/OA/04/010 in the second rainy season (2016) ranged between 1.03 ±0.08 % and 2.98 ±0.11% with the lowest recorded in the Control site and the highest in Ojagboro showing lower crude fibre content than in the first rainy season (2016) (Table 97). (Table 97). The accession in the Control site had lower crude fibre content than other sites. No significant differences were obtained in the crude fibre content of the accession in Otte and Odoore. Crude fiber content in Budo Egba and Okeodo, Budo Abio and Eroomo, Mubo, Olaolu and Coca cola had the same statistical crude fibre between at $p \leq 0.05$(Table 97). The range of the carbohydrate content in the accession was between 58.19 ± 0.01 % and 75.18 ± 0.01 % with the lowest recorded in Oyun and the highest in Okeodo suggesting higher carbohydrate content than in the first rainy season (2016) (Table 97). The carbohydrate content in the Control site was higher than the other sites except for Ojagboro, Okeodo, Isale Aluko and Odoore (Table 97).

4.13: Correlation coefficient of heavy metal in soil, water, vegetables accessions and physico-chemical properties of soil.

Table 98 shows the correlation between cadmium content of the shoot and root of *Amaranthus hybridus* NG/AA/03/11/010, total soil cadmium, phyto available cadmium of the soil used to raise the accession, total cadmium of water used for irrigating the accession and the physico chemical parameters of the soil in the first dry season (2015). There was negative significant correlation between the cadmium concentration of the root and the phytoavailable cadmium in the soil (r= - 0.32) at $p \leq 0.05$ implying that the root Cadmium was inversely proportional to the phytoavailable Cd, that is, low Cd was available for plant uptake in the first dry season (2015) (Table 98). Table 99 shows correlation coefficient between the cadmum of the shoots and roots of *Amaranthus hybridus accession* NG/AA/03/11/010 in the second dry season (2016). Cadmium content of the shoot had a significant positive correlation with the cadmium content in the root (r=0.57**) at $p \leq 0.00$ suggesting that more Cd was translocated from the root to the shoot of the accessions in the second dry season (2016) than in the first dry season (2015) through a common source (Table 99).

Table 96: Proximate(Nutritional) composition analysis (%) of fresh edible *Corchorus olitorius* accession NG/OA/04/010 in the first rainy season (2016)

Site	Moisture content	Ash content	Fat and Oil content	Crude Protein content	Crude Fibre Content	Carbohydrate content
Otte	10.01±0.01^{a}	2.12±0.01^{a}	3.06±0.02^{c}	14.52±0.01^{c}	2.20±0.01^{d}	67.32±0.02^{d}
Budo-Egba	10.04±0.02^{a}	2.16±0.01^{a}	3.14±0.02^{b}	14.50±0.02^{c}	2.22±0.01^{d}	67.40±0.01^{c}
Budo-Abio	10.09±0.01^{a}	2.07±0.01^{ab}	3.25±0.01^{a}	14.71±0.01^{a}	2.10±0.01^{e}	67.06±0.02^{g}
Mubo	10.03±0.02^{a}	2.10±0.01^{ab}	3.13±0.02^{b}	14.53±0.01^{c}	2.15±0.02^{e}	67.30±0.02^{d}
Oyun	10.08±0.02^{a}	2.04±0.02^{ab}	3.15±0.01^{b}	14.55±0.01^{c}	2.23±0.02^{d}	67.41±0.01^{c}
Ojagboro	9.91±0.01^{b}	2.20±0.01^{a}	3.10±0.01^{b}	14.57±0.02^{c}	2.28±0.02^{d}	67.40±0.01^{c}
Olaolu	9.95±0.01^{b}	2.19±0.01^{a}	3.12±0.01^{b}	14.51±0.01^{c}	2.21±0.01^{d}	67.36±0.02^{d}
Eroomo	10.02±0.01^{a}	1.89±0.01^{b}	3.23±0.02^{a}	14.56±0.01^{c}	2.17±0.01^{e}	67.26±0.01^{e}
Okeodo	10.03±0.02^{a}	2.05±0.01^{ab}	3.18±0.01^{b}	14.59±0.01^{c}	2.33±0.02^{c}	67.84±0.01^{a}
Coca-cola	9.89±0.01^{b}	2.25±0.01^{a}	2.90±0.01^{d}	14.49±0.01^{d}	2.52±0.01^{a}	67.78±0.02^{b}
Isale-Aluko	9.93±0.01^{b}	2.20±0.02^{a}	2.95±0.01^{d}	14.52±0.01^{c}	2.48±0.02b	67.45±0.01^{c}
Odoore	10.01±0.01^{a}	2.09±0.01^{ab}	3.25±0.01^{a}	14.69±0.01^{b}	2.23±0.01^{d}	67.26±0.02^{e}
Botanical garden (Control site)	10.05±0.01^{a}	1.92±0.02^{b}	3.21±0.01^{a}	14.70±0.01^{a}	2.11±0.01^{e}	67 .20±0.01^{e}

Values with the same superscript along the same column are statistically the same at p ≤0.05. Values represent mean±SD

Organic matter in the soil correlated positively with the soil pH (r=0.33*) at $p \leq 0.02$ indicating that the soil organic matter was enhanced by the soil pH in the second dry season , that is, the soil organic matter was directly proportional to the soil pH in the second dry season (2016) (Table 98). Table 100 shows the correlation coefficient between cadmium content of *Amaranthus hybridus* accession NG/AA/03/11/010, THS, PHS, THW and the physico chemical properties of soil in the first rainy season (2016). There was significant positive correlation between the cadmium content of the root, the total heavy metal of soil (r=0.31*) at $p \leq 0.05$ and the phytoavailable heavy metal of soil (r=0.35*) at $p \leq 0.03$ implying that there was Cd in the soil and were readily transferred to the root (Table 100). Total heavy of soil used to raise the vegetables had a significant positive correlation with the phytoavailable heavy metal of the soil (r=0.47**) at $p \leq 0.01$ suggesting a direct proportion between the total soil Cd and the bioavailable Cd to the accessions through similar source and a significant negative correlation with the soil pH (r=-0.32*) at $p \leq 0.05$ indicating that the soil pH did not enhance total Cd and bioavaililty in soil which can hinder or lower Cd availability and mobility in soil for the accession uptake in the first rainy season (2016).

pH of the soil had a significant positive correlation with Organic matter (r=0.99**) at $p \leq 0.00$ showing that the soil pH enhanced high soil organic matter in the first rainy season (2016) (Table 100). There were more correlation between the Cd activites and the physicochemical properties of the soil in the first rainy season (2016) due to positive effect of the physicochemical properties of the soil enhancing heavy metal fractionation and mobility in soil and water for uptake by the vegetables as a result of seasonal variation (Table 100). Table 101 shows the correlation between cadmium content of *Amaranthus hybridus* NG/AA/03/11/010 in the second rainy season (2017),THS, PHS,THW and physico chemical properties of soil. There was significant positive correlation between the cadmium content in the shoot of the accession and the pthytoavailable heavy metal in soil (r= 0.31*) at $p \leq 0.05$ suggesting more Cd translocated to the shoot in the second rainy season (2017)(Table 101).

Table 97: Proximate(Nutritional) composition analysis (%) of fresh edible *Corchorus olitorius* accession NG/OA/04/010 in the second rainy season (2017)

SITE	MOISTURE	ASH	FAT AND OIL	CRUDE PROTEIN	CRUDE FIBRE	PERCENTAGE CARBOHYDRATE
Otte	10.11 ± 0.07^{bc}	2.01 ± 0.05^{ab}	3.67 ±0.02^{b}	11.55 ±0.05^{bc}	1.56 ±0.03^{cde}	69.41 ±0.02^{bc}
Budo-Egba	10.17 ±0.05^{bc}	2.07 ±0.01^{a}	3.64 ±0.03^{b}	11.17 ±0.13^{c}	1.68 ±0.02^{cd}	70.21 ±0.04^{b}
Budo-Abio	11.14 ± 0.07^{a}	1.49 ±0.06^{bc}	3.81 ±0.01^{ab}	13.09 ±0.09^{b}	1.36 ±0.07^{de}	67.51 ±0.07^{bc}
Mubo	10.65 ±0.05^{b}	1.70 ±0.02^{b}	3.83 ±0.01^{ab}	9.67±0.02^{cd}	1.84 ±0.07^{bc}	70.10 ±0.19^{b}
Oyun	10.45 ±0.07^{b}	1.56 ±0.07^{bc}	3.20 ± 0.01^{bc}	21.52 ±0.09^{a}	1.79 ±0.11^{bcd}	58.19 ±0.01^{c}
Ojagboro	8.02 ±0.08^{d}	2.10 ±0.13^{a}	2.84 ±0.01^{c}	7.95±0.11^{e}	2.98 ±0.11a	74.14 ±0.05^{ab}
Olaolu	8.28 ±0.01^{cde}	1.68 ±0.06^{b}	3.18 ±0.01^{bc}	9.11 ±0.02^{d}	1.72 ±0.04^{bc}	73.09 ±0.02^{ab}
Eroomo	11.10 ± 0.00^{a}	1.32 ±0.09^{c}	3.85 ±0.01^{ab}	10.42 ±0.06^{cd}	1.31 ± 0.02^{de}	70.96 ± 0.03^{b}
Okeodo	8.77 ±0.02^{cd}	1.21 ± 0.06^{cd}	3.24 ±0.01^{bc}	8.75 ±0.04^{d}	1.64 ±0.05^{cd}	75.18 ± 0.01^{a}
Coca-cola	7.98 ±0.02^{e}	2.15 ±0.02^{a}	3.14 ±0.01^{bc}	8.20 ±0.03^{d}	1.87 ± 0.01^{bc}	70.67 ±0.05^{b}
Isale-Aluko	7.75 ±0.02^{e}	2.04 ±0.06^{a}	3.03 ±0.01^{bc}	8.14 ±0.0^{d}	2.59 ±0.01a^{b}	74.48 ±0.02^{ab}
Odoore	10.15 ±0.04^{bc}	1.09 ± 0.01^{d}	3.94 ±0.01^{a}	9.16 ±0.11^{d}	1.48 ± 0.02^{cde}	74.69 ±0.02^{ab}
Botanical garden (Control site)	9.70 ±0.02^{c}	1.06 ±0.02^{d}	3.95 ±0.01^{a}	9.11 ±0.07^{d}	1.03 ±0.08^{e}	73.24 ±0.01^{ab}

Values with the same superscript along the samecolumn are statistically the same at $p \leq 0.05$.Values represent mean±SD

Table 98: Correlation between cadmium content of *Amaranthus hybridus* NG/AA/03/11/010 ,THS, PHS,THW ,pH and organic matter of soil in the first dry season (2015) .

		Cd shoot	Cd root	THS	PHS	THW	pH	ORG. MAT
Cd shoot	Pearson Correlation	1	0.21	-0.13	0.11	0.02	-0.02	-0.12
	Sig		0.20	0.43	0.51	0.90	0.92	0.47
Cd root	Pearson Correlation		1	0.16	-0.32*	0.05	0.21	0.21
	Sig			0.34	0.05	0.77	0.21	0.20
THS	Pearson Correlation			1	-0.03	0.07	0.19	-0.01
	Sig				0.84	0.68	0.25	0.98
PHS	Pearson Correlation				1	0.24	-0.20	-0.00
	Sig					0.15	0.22	0.99
THW	Pearson Correlation					1	-0.15	-0.04
	Sig						0.38	0.83
pH	Pearson Correlation						1	0.27
	Sig							0.09
ORG MAT	Pearson Correlation							1
	Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed) Cd=Cadmiun. THS=Total heavy metal in soil.PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter.

Table 99: Correlation Coefficient between the cadmum of the shoots and roots of *Amaranthus hybridus* accession NG/AA/03/11/010, total cadmium in soil, phyto available cadmium in soil, total cadmium in water and some physico chemical properties of soil in the second dry season (2016).

	CdS	CdR	THS	PHS	THW	pH	Org Mat.
CdS Pearson Correlation	1	0.57**	-0.00	0.03	-0.25	-0.08	-0.20
Sig. (2-tailed)		0.00	0.99	0.85	0.13	0.65	0.22
N							
CdR Pearson Correlation		1	-0.02	0.12	-0.25	-0.10	0.02
Sig. (2-tailed)			0.90	0.45	0.13	0.55	0.89
N							
THS Pearson Correlation			1	0.02	-0.24	-0.17	-0.15
Sig. (2-tailed)				0.90	0.14	0.30	0.35
N							
PHS Pearson Correlation				1	-0.11	0.23	0.10
Sig. (2-tailed)					0.51	0.15	0.57
N							
THW Pearson Correlation					1	-0.16	0..03
Sig. (2-tailed)						0.35	0.85
N							
pH Pearson Correlation						1	0.33*
Sig. (2-tailed)							0.02
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CdS=cadmium in shoot. CdR=cadmium in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Cadmium content of the root of accession had a significant positive correlation with the phytoavailable metal in soil (0.47**) at $p \leq 0.01$ indicating Cd was readily transferred from the soil to the root of the accession in the second rainy season (2017) (Table 101). Phytoavailable heavy metal in soil had a significant negative correlation with the total heavy metal in water (r= -0.42*) at $p \leq 0.05$ implying that the total Cd in the water used for irrigation in the second rainy season had adverse effect on Cd availability in soil in second rainy season (2017). Significant positive correlation was recorded in the pH of the soil and the organic matter of the soil used to raise the accession (r= 0.39**) at $p \leq 0.01$ showing that soil organic matter was enhanced by the soil pH in the second rainy season (Table 101). Table102 shows the correlation between cadmium concentration in the shoot and root of *Amaranthus hybridus* NG/AO/11/08/039, THS, PHS, THW and the soil physico chemical propreties used to raise the accession in the first dry season (2015). Cadmium content in the root of the accession had a significant positive correlation with the soil organic matter (r=0.46**) at $p \leq 0.00$ indicating that the total Cd in the root was influenced positively by the soil organic matter in the first dry season (2015) suggesting strong interaction (Table 102).

Phytoavailable heavy metal in soil had a significant positive correlation with the soil organic matter (r=98**) at $p \leq 0.00$ implying that the soil organic matter positively influenced Cd bioavailabity to the accession. The positive correlation indicated that in the first dry season (2015) cadmium was available to plant uptake due to high prospensity of soil organic matter. Table 103 shows the Correlation between cadmium of *Amaranthus hybridus* NG/AO/11/08/039, soil water and physico chemical parameters of soil in the second dry season(2016). There was a significant positive correlation between the pH of the soil and the soil organic matter used to raise *Amaranthus hybridus* accession NG/AO/11/08/039 (r= 0.38*) at $p \leq 0.02$ suggesting that the soil pH enhanced positively the soil organic matter in the second dry season (2016) (Table 103). Table 104 shows the correlation between cadmium concentration in the shoot and root of *Amaranthus hybridus* NG/AO/11/08/039, THS, PHS, THW, pH and organic matter of the soil in the first rainy season.

Cadmium content of the shoot had a significant positive correlation with the cadmium content of the root of the accession (r=0.33*) at p ≤0.04 which showed that more cadmium were translocated from the root to the shoot in the first rainy season and a significant positive correlation with the soil phyto available heavy metal of the used to raise the accession at (r=0.73**) at p ≤ 0.00 this indicated that more cadmium were available for the accession uptake in the first rainy season (2016) (Table 104). Cd content of the root had a significant positive correlation with the total heavy metal soil (r=0.34*) at p ≤ 0.03, this suggests that more Cd were transfer from the soil to the root and with the phyto available heavy metal of soil (r=0.39*) at p ≤ 0.02, suggesting Cd bioavailability to the accession for uptake in the first rainy season (2016). Total heavy metal soil had a significant positive correlation with the phytoavailable heavy metal of soil (r=0.47**) at p≤ 0.00 indicating that the total cadmium in soil was proportional to the available Cd in soil for plant uptake and a significant negative correlation with the soil pH (r= -0.32*) at p≤ 0.05 showing negative effect of soil pH on the total Cd in soil in the first rainy season (2016) (Table 104). The soil pH had a significant positive correlation with the soil organic matter at r=0.99** and p ≤ 0.00(Table 104). The result showed that more availablility and mobility of Cd for plant uptake in the first rainy season (2016) because of favourable pH and high availability of soil organic organic matter caused by the seasonal variation (Table 104).

Table 105 shows the correlation between cadmium concentration of *Amaranthus hybridus* NG/AO/11/08/039 THS, PHS, THW and the physico chemical properties of soil used to raise the accession in the second rainy season (2017). Cadmium content in the shoot of *Amaranthus hybridus* NG/AO/11/08/039 reported significant negative correlation with the cadmium content of the root (r= - 0.33*) at p ≤ 0.04 indicating a negative effect of Cd translocated from the root to the shoot, that is, less amount of Cd was translocated from the root to the shoot in the second rainy season (2017) and a significant positive correlation with the phyto available heavy metal in soil (r=0.37*) at p≤0.05 suggestion more Cd available to the accessions for uptake (Table 105). Cadmium concentration in the root of the accession had a significant positive correlation with the phytoavailable heavy metal ar r=0.40* and p≤0.03 suggeting more Cd transfer from the soil to the root (Table 105).

Table 100: Correlation coefficient between cadmium content of *Amaranthus hybridus* NG/AA/03/11/010, THS, PHS, THW , pH and organic matter of soil first rainy season (2016) .

	Cd shoot	Cd root	THS	PHS	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	0.24	0.22	-0.19	0.00	-0.10	-0.10
Sig		0.14	0.19	0.25	0.99	0.57	0.55
Cd root Pearson Correlation		1	0.31*	0.35*	0.21	0.01	-0.15
Sig			0.05	0.03	0.20	0.97	0.93
THS Pearson Correlation			1	0.47**	-0.27	-0.32*	-0.29
Sig				0.00	0.10	0.05	0.07
PHS Pearson Correlation				1	0.04	-0.12	-0.14
Sig					0.82	0.45	0.41
THW Pearson Correlation					1	-0.01	-0.07
Sig						0.97	0.68
pH Pearson Correlation						1	0.99**
Sig							0.00
ORG MAT Pearson Correlation							1
Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cd S=cadmium inshoot. Cd R=cadmium in root Cd=Cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 101: Correlation between cadmium content of *Amaranthus hybridus* NG/AA/03/11/010 , THS, PHS, THW and the physico chemical properties of soil second rainy season (2017).

	Cd shoot	Cd root	THMS	PHS	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	-0.07	-0.20	0.31*	-0.14	0.19	-0.01
Sig		0.66	0.22	0.05	0.40	0.24	0.95
Cd root Pearson Correlation		1	0.19	0.47**	0.05	-0.07	-0.22
Sig			0.26	0.01	0.74	0.66	0.18
THMS Pearson Correlation			1	0.21	-0.16	0.16	-0.18
Sig				0.37	0.34	0.33	0.27
PHS Pearson Correlation				1	-0.42*	0.22	-0.18
Sig					0.05	0.17	0.30
THW Pearson Correlation					1	0.13	0.06
Sig						0.42	0.71
pH Pearson Correlation						1	0.39’’
Sig							0.01
ORG MAT Pearson Correlation							1
Sig							

Cd=Cadmiun. THS=Total heavy metal in soil.. PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter.

Table 102: Correlation of cadmium concentration of *Amaranthus hybridus* NG/AO/11/08/039, THMS , PHS, THW and the physico chemical properties of soil in the first dry season(2015).

	Cd shoot	Cd root	THS	PHS	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	-0.09	0.14	-0.05	-0.12	0.29	0.22
Sig		0.59	0.40	0.74	0.48	0.07	0.18
Cd root Pearson Correlation		1	0.20	0.08	0.08	0.12	0.46**
Sig			0.23	0.62	0.64	0.47	0.00
THS Pearson Correlation			1	-0.33	-0.01	0.07	-0.01
Sig				0.84	0.97	0.68	0.98**
PHS Pearson Correlation				1	-0.15	0.24	0.00
Sig					0.38	0.15	0.99
THW Pearson Correlation					1	0.22	0.10
Sig						0.18	0.56
pH Pearson Correlation						1	0.27
Sig							0.09
ORG MAT Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed) Cd=Cadmiun. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 103. Correlation Coefficient between the cadmum of the shoots, roots *Amaranthus hybridus* accession NG/AO/11/08/039, total cadmium in soil, phyto available cadmium in soil, total cadmium in water and some physico chemical properties of soil in the second dry (2016).

	CdS	CdR	THS	PHS	THW	pH	Org Mat.
CdS Pearson Correlation	1	0.04	0.04	-0.06	-0.14	-0.08	0.01
Sig. (2-tailed)		0.79	0.81	0.71	0.38	0.63	0.10
N							
CdR Pearson Correlation		1	0.12	-0.11	-0.04	0.04	0.21
Sig. (2-tailed)			0.47	0.51	0.83	0.83	0.21
N							
THS Pearson Correlation			1	-0.02	-0.24	-0.17	-0.15
Sig. (2-tailed)				0.90	0.14	0.30	0.35
N							
PHS Pearson Correlation				1	-0.11	0.23	0.10
Sig. (2-tailed)					0.51	0.15	0.57
N							
THW Pearson Correlation					1	-0.16	0.03
Sig. (2-tailed)						0.35	0.85
N							
pH Pearson Correlation						1	0.38*
Sig. (2-tailed)							0.02
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CdS=cadmium in shoot. CdR=cadmium in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 104: Correlation coefficient between cadmium concentration of *Amaranthus hybridus* NG/AO/11/08/039, THS, PHS, THW and the physico chemical properties of the soil in the first rainy season(2016).

	Cd shoot	Cd root	THMS	PHM	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	0.33*	0.30	0.73**	0.12	-0.08	-010
Sig		0.04	0.06	0.00	0.47	0.63	0.56
Cd root Pearson Correlation		1	0.34*	0.39*	0.15	-0.20	-0.20
Sig			0.03	0.02	0.36	0.23	0.23
THS Pearson Correlation			1	0.47**	-0.27	-0.32*	-0.29
Sig				0.00	0.10	0.05	0.07
				1	0.04	-0.12	-0.14
					0.82	0.45	0.41
PHM Pearson Correlation					1	-0.01	-0.07
Sig						0.97	0.68
THW Pearson Correlation						1	0.99**
Sig							0.00
pH Pearson Correlation							1
Sig							
ORG MAT Pearson Correlation							
Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cd S=cadmium in shoot. Cd R=cadmium in root

Cd=Cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter.

Phyto available heavy metal in soil had significant positive correlation with the soil pH ($r=0.41^*$) at $p\leq0.05$ and organic matter ($r=0.50^{**}$) at $p\leq0.03$ showing that the soil pH and organic matter enhanced the availability of Cd in soil for plant uptake in the second rainy season (2017) (Table 105). Soil pH had a significant positive correlation with the organic matter in the soil ($r=0.39^{**}$) at $p\leq0.01$ suggesting that the pH enhanced high soil organic matter in the second rainy season (2017) (Table 105). Table 106 shows the correlation between cadmium concentration of *Amaranthus hybridus* NGBO125, soil, water and physico chemical parameters of soil in the first dry season (2015). The cadmium concentration of the root had significant positive correlation with the total heavy metal in soil ($r=0.37^*$) at $p\leq0.02$ suggesting a direct proportion, strong correlation with the pH of the soil ($r=0.40^{**}$) at $p \leq 0.01$ indicating that the soil pH strongly enhanced Cd transfer from the soil to the root of the accession and the soil organic matter ($r= 0.37^*$) at $p \leq 0.05$ showing the positive effect of the soil organic matter on the root Cd, that is, the soil organic matter support more mobility of Cd from the doil to the root (Table 106).

Table 107 shows the correlation between the cadmium concentration of *Amaranthus hybridus* NGBO125, THMS , PHS, THW, pH and organic matter of soil in the second dry season (2016). The table shows that there were significant positive correlation between the Cd concentration in shoot of the accession and the phytoavailable Cd in soil ($r=0.44^*$) at $p\leq0.03$ suggesting Cd translocation from the soil to shoot of the accession in the second dry season due to strong interaction between them (2016), the root Cd content had a significant positive correlation with the phytoavailable Cd ($r=0.33^*$) at $p\leq0.05$ indicating readily Cd transfer from the soil to the root in the second dry season (2016) ,the phytoavailable Cd had a significant positive correlation with the soil pH ($r=0.37^*$) at $p\leq0.04$ indicating that the soil pH in the second dry season (2016) enhanced the phytoavailability of Cd in soil (Table 107). A significant positive correlation was recorded between the soil organic matter and the pH($r=0.39^*$) at $p\leq0.01$ indicating that the soil pH in the second dry season enhanced the activities of the soil organic matter than in the first dry season (2015) (Table 107).

Table 105 : Correlation between cadmium concentration of *Amaranthus hybridus* NG/AO/11/08/039, THS, PHS, THW and the physico chemical properties of the soil in the second rainy season (2017).

		Cd shoot	Cd root	THMS	PHM	THW	pH	ORG. MAT
Cd shoot	Pearson Correlation	1	-0.33*	-0.18	0.37*	0.23	-0.02	0.31
	Sig		0.04’	0.29	0.05	0.17	0.91	0.06
Cd root	Pearson Correlation		1	0.31	0.40*	-0.07	0.05	-0.02
	Sig			0.06	0.03	0.66	0.78	0.90
THS	Pearson Correlation			1	0.22	-0.16	0.16	-0.18
	Sig				0.09	0.34	0.33	0.27
PHM	Pearson Correlation				1	- 0.29	0.41*	0.50*
	Sig					0.08	0.05	0.03
THW	Pearson Correlation					1	0.13	0.06
	Sig						0.42	0.71
pH	Pearson Correlation						1	0.39’’
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Cd=cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil . THW=Total heavy metal in water.ORG.MAT=Organic matter

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Table 106 : Correlation of cadmium concentration of *Amaranthus hybridus* NGBO125, THS, PHS, THW ,pH and organic matter of soil in the first dry season (2015).

	Cd shoot	Cd root	THS	PHM	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	-0.15	-0.08	-0.01	-0.11	0.23	-0.13
Sig		0.37	0.63	0.94	0.50	0.16	0.42
Cd root Pearson Correlation		1	0.37*	-0.19	0.00	0.40**	0.37*
Sig			0.02	0.26	0.99	0.01	0.02
THS Pearson Correlation			1	-0.33	-0.15	0.07	-0.01
Sig				0.84	0.35	0.68	0.98
PHM Pearson Correlation				1	-0.14	0.24	-0.00
Sig					0.40	0.15	0.99
THW Pearson Correlation					1	-0.22	0.19
Sig						0.89	0.25
pH Pearson Correlation						1	0.28
Sig							0.09
ORG MAT Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Cd=cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 108 presents the correlation coefficient of cadmium concentration of the shoot and root *Amaranthus hybridus* accession NGBO125, THMS, PHS, THW, pH and organic matter of soil in the first rainy season (2016). The cadmium content of the shoot had significant positivite correlation with the cadmium content of the root (r=0.89**) at $p \leq 0.00$ indicating Cd translocation from the root to the shoot of the accession in the first rainy season (2016), the total heavy metal of the soil (r=96**) at $p \leq 0.00$ showing strong positive influence of the soil Cd on the root Cd and the phyto available metal of soil (r=0.98**) at $p \leq 0.00$ suggesting high availability of Cd in the soil for transfer to the root in the first rainy season (2016) (Table 108). Cd content of the root had significant positive correlation with total heavy metal soil (r=0.86**) and $p \leq 0.00$ indicating a very strong positive relationship and phytoavailable heavy metal soil (r=0.92) at $p \leq 0.00$ implying high Cd availability for the accession uptake (Table 108). Total heavy metal of soil had a significant positive correlation with the phytoavailable metal of the soil (r=0.95**) at $p \leq 0.00$ this result showed strong direct positive influence of the concentration of total soil Cd on the readily available Cd in soil for the accession uptake in the first rainy season (2016). The soil pH had a significant positive correlation with the soil organic matter at r=0.99** and $p \leq 0.00$ indicating that the soil pH strongly enhanced the soil organic matter in the first rainy season (2016) (Table 108).

Table 109 shows a positive significant correlation was obtained between the soil organic matter and the pH of the soil used to raise *Amaranthus hybridus* accession NGBO125 in the second rainy season (2017) (r=0.30*) at $p \leq 0.02$ which showed that the soil organic matter was positively influenced by the soil pH in the second rainy season suggesting strong interaction (2017) (Table 109). Table 110 shows the correlation between cadmium concentration of *Corchorus olitorius* NG/OA/Jun/09/002, water and physico chemical parameters of soil in the first dry season (2015). Strong negative correlation between the Cd concentration of the shootand the organic matter of the soil was recorded (r= - 0.40**) at $p \leq 0.01$ showing an adverse influence of the soil organic matter on the Cd content in the shoot of the accession in the first dry season (2015) (Table 110).

Table 107 : Correlation of cadmium concentration of *Amaranthus hybridus* NGBO125, THS, PHS, THW ,pH and organic matter of soil in the second dry season (2016).

	Cd shoot	Cd root	THMS	PHS	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	0.06	0.05	0.44*	0.12	0.02	-0.05
Sig		0.74	0.75	0.03	0.54	0.89	0.76
Cd root Pearson Correlation		1	0.23	0.33*	0.11	-0.22	-0.40
Sig			0.16	0.05	0.52	0.18	0.01
THS Pearson Correlation			1	0.22	-0.16	0.16	-0.18
Sig				0.10	0.34	0.33	0.27
PHS Pearson Correlation				1	-0.28	0.37*	0.19
Sig					0.07	0.04	0.63
THW Pearson Correlation					1	0.13	0.06
Sig						0.42	0.71
pH Pearson Correlation						1	0.39*
Sig							0.01
ORG MAT Pearson Correlation							1
Sig							

Cd=Cadmiun. THS=Total heavy metal in soil. PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

There was a strong negative correlation between the Cd of the root and the organic matter of the soil (r= - 0.41**) at $p \leq 0.01$ indicating an adverse influence of the soil organic matter on the root Cd content and a significant negative correlation with the pH of soil (r= 0.61**) at $p \leq 0.00$, this showed that the soil organic matter was strongly inhibited by the soil pH in the first dry season (2015) (Table 110). Table 111. Correlation Coefficient between the cadmum of the shoots, roots of *Corchorous olitorius* accession NG/AO/Jun/09/002, total cadmium in soil, phyto available cadmium in soil, total cadmium in water and some physico chemical properties of soil in the second dry season (2016) (Table 111). Cadmium content of the shoot of *Corchorous olitorius* accession NG/AO/Jun/09/002, had a positive significant correlation with the cadmium content of the root (r=0.33**) at $p \leq 0.04$ meaning that a significant relationship existed between the shoot Cd content and the root Cd content, possibly enhancing Cd translocation from the root to the shoot in the second dry season (2016) and the total heavy metal (cadmium) in soil (r=0.46**) at $p \leq 0.00$ suggesting strong positive relationship between the total soil Cd and the shoot Cd content in the second dry season (2016) (Table 111).

There was a significant positive correlation between the cadmium content in the root and the total heavy metal in soil (r=0.72**) at $p \leq 0.00$ suggesting high relationship between the total soil Cd and the root Cd in the second dry season (2016). The total heavy metal in water correlated positively with the soil organic matter (r=0.33*) at $p \leq 0.04$ suggesting that the irrigated water Cd supported the activity of the soil organic matter in that planting season (Table 111). Organic matter in the soil had a significant positive correlation with the soil pH (r=0.37*) at $p \leq 0.02$ which showed that the soil pH had a significant positive relationship with the soil organic matter enhancing its activities and quality in the second dry season (2016) (Table 111). Table112 presents the correlation coefficient between cadmium concentration of *Corchorus olitorius* NG/OA/Jun/09/002 THMS , PHS, THW, pH and organic matter of soil in the first rainy season (2016). Cadmium content in the shoot had significant positive correlation with the content of the root (r=0.80**) at $p \leq 0.00$ indicating high Cd translocation from the root to the shoot in the first rainy season (2016) (Table 112), the total heavy metal of soil (r=0.61**) at $p \leq 0.00$ showing that Cd in shoot was strongly influenced positively by the concentration of total soil Cd in the first rainy season (2016), the phytoavailable heavy metal (r=0.59**) at $p \leq 0.02$

suggesting a high content of phytoavailable Cd to the shoot in that season and a significant negative correlation with the soil organic matter (r= - 0.32*) at $p \leq 0.05$ suggesting the adverse effect of soil organic matter (Table 112). Cd content of the root had significant positive correlation with the total heavy metal of soil (r=0.65**) at $p \leq 0.00$ indicating strong positive relationship and influence of total soil Cd on the concentration of Cd in the root of the accession in that season and the phytoavailable heavy metal of soil (r=0.77**) at $p \leq 0.01$ showing high concentration of Cd readily available to the accession for uptake in the first rainy season (2016) (Table 112). Total heavy metal soil had a significant positive correlation with the phytoavailable heavy in soil (r=0.47**) at $p \leq 0.02$ indicating that the more the total soil Cd, the more the readily available Cd in the soil for the accession uptake in the first rainy season (2016) and a significant negative correlation with the soil pH (r= -0.36*) at $p \leq 0.04$ indicating the adverse effect of the soil pH on the soil Cd content with no interaction (Table 112). There was a significant positive correlation between the soil pH and the soil organic matter (r=0.99**) at $p \leq 0.00$ showing a strong positive dependence and influence of the soil organic matter on the soil pH in the first rainy season (2016) (Table 112).

Table 113 presents the correlation between cadmium concentration of *Corchorus olitorius* NG/OA/Jun/09/002 THMS , PHS, THW, pH and organic matter of soil in the second rainy season (2017). There were significant positive correlation between the Cd content of the shoot of the accession and the phytoavailable heavy metal (r= 0.30*) at $p \leq 0.05$ indicating readily available Cd for translocation to the shoot of the accession . Significant positive correlation was obtained between the cadmium content of the root and the phytoavailable heavy metal (r = 0.42*) and $p \leq 0.03$ (Table 113) suggesting readily available Cd to be transferred from the soil to the root in the second rainy season indicating interaction between the two variables (2017). The total Cd in the soil had a significant positive correlation with the phytoavailable heavy metal (r= 0.37*) and $p \leq 0.03$ showimg the positive influence or relationship the total soil Cd had on the readily available Cd in that season (Table113). The phytoavailable heavy metal in soil had a significant positive correlation with the soil pH (r= 0.39 *) at $p \leq 0.03$ showing that the soil pH enhanced the phytoavailability of Cd in soil and the soil organic matter (r= 0.49*) at p=0.03

showed that the soil organic matter supported the speciation or fractionation of Cd in soil making it readily avaialable to the accession (phytoavailable) (Table113).

Soil pH had a strong positive correlation with the soil organic matter (r= 0.39**) at $p \leq 0.01$ indicating a strong significant positive influenced of the soil organic matter by the soil pH in the second rainy season (2017) (Table 113). Table 114 shows the Correlation between cadmium concentration of *Corchorus olitorius* NG/OA/04/010, soil, water and physico chemical parameters of soil in the first dry season (2015). There were positie correlation between the cadmium concentration of the root, the total cadmium of soil used to raise the accession (r= 0.37*) at $p \leq 0.02$ indicating that the total soil Cd is directly proportional to the Cd content in the root, a strong positive correlation with the soil pH (r= 0.40**) at $p \leq 0.01$ showing that the soil pH enhanced Cd translocation in the accession in the first dry season and a significant positive correlation with the soil organic matter (r= 0.38*) at $p \leq 0.02$ showing more of Cd translocated to the shoot due to the positive interaction of the root with the soil organic matter (Table 114). Table 115 presents the correlation coefficient of cadmium concentration of *Corchorus olitorius* accession NG/OA/04/010 THS, PHS, THW, pH and organic matter of soil in the second dry season (2016). A significant positive correlation between the cadmium content of the shoot of *Corchorous olitorius* accession NG/OA/04/010, the cadmium content of the root (r=0.39**) at $p \leq 0.01$ and the pH of soil and the soil organic matter (r=0.36*) at $p \leq 0.02$(Table 115).

The result showed that soil pH and the organic matter enhanced Cd transfer to the root from the soil and Cd translocation to the shoot from the root. Table 116 shows the correlation coefficient of cadmium concentration of *Corchorus olitorius* NG/OA/04/010 THMS, PHS, THW, pH and organic matter of soil in the first rainy season (2016). The cadmium content of the shoot had significant positive correlation with the cadmium content of the root (r=0.84**) at $p \leq 0.00$ indication a very strong positive interaction which might have enhanced Cd translocation for, the root to the shoot of the accession and the total heavy metal of water (r=0.31*) at $p \leq 0.05$ (Table 116).

Table 108: Correlation of cadmium concentration of *Amaranthus hybridus* NGBO125, THMS , PHS, THW, pH and organic matter of soil first rainy season (2016).

		Cd shoot	Cd root	THMS	PHS	THW	pH	ORG. MAT
Cd shoot	Pearson Correlation	1	0.89**	0.96**	0.98**	0.04	0.05	0.04
	Sig		0.00	0.00	0.00	0.80	0.75	0.82
Cd root	Pearson Correlation		1	0.86**	0.92**	-0.01	0.20	0.18
	Sig			0.00	0.00	0.96	0.24	0.27
THMS	Pearson Correlation			1	0.95**	0.01	-0.08	-0.10
	Sig				0.00	0.96	0.63	0.57
PHS	Pearson Correlation				1	0.01	0.08	0.07
	Sig					0.94	0.63	0.67
THW	Pearson Correlation					1	0.29	0.29
	Sig						0.08	0.08
pH	Pearson Correlation						1	0.99**
	Sig							0.00
ORG MAT	Pearson Correlation							1
	Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cd S=cadmium inshoot. Cd R=cadmium in root .Cd=Cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 109: Correlation Coefficient between the cadmum of the shoots, roots of *Amaranthus hybridus accession NGBO125,* total cadmium in soil, phyto available cadmium in soil, total cadmium in water and some physico chemical properties of soil in the second rainy season (2017).

		CdS	CdR	THS	PHS	THW	Org Mat.	pH
CdS	Pearson Correlation	1	0.08	-0.10	-0.10	-0.08	-0.26	-0.36
	Sig. (2-tailed)		0.62	0.55	0.55	0.65	0.11	0.03
	N							
CdR	Pearson Correlation		1	0.06	0.28	-0.01	-0.21	0.04
	Sig. (2-tailed)			0.72	0.08	0.96	0.19	0.81
	N							
THS	Pearson Correlation			1	-0.02	-0.24	-0.17	-0.15
	Sig. (2-tailed)				0.90	0.14	0.30	0.36
	N							
PHS	Pearson Correlation				1	-0.11	0.23	0.10
	Sig. (2-tailed)					0.51	0.15	0.57
	N							
THW	Pearson Correlation					1	-0.16	0.03
	Sig. (2-tailed)						0.35	0.85
	N							
Org. Mat.	Pearson Correlation						1	0.30*
	Sig. (2-tailed)							0.02
	N							
pH	Pearson Correlation							1
	Sig. (2-tailed)							
	N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CdS=cadmium in shoot. CdR=cadmium in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.
THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 110: Correlation between cadmium concentration of *Corchorus olitorius* NG/OA/Jun/09/002, THS ,PHS,THW,pH and organic matter of soil in the first dry season (2015).

		Cd shoot	Cd root	THS	PHM	THW	ORG. MAT	pH
Cd shoot	Pearson Correlation	1	-0.13	-0.21	-0.00	-0.01	-0.40**	0.12
	Sig		0.44	0.20	0.99	0.97	0.01	0.49
Cd root	Pearson Correlation		1	-0.10	0.28	0.91	-0.41**	0.61**
	Sig			0.53	0.09	0.58	0.01	0.00
THS	Pearson Correlation			1	-0.03	-0.16	-0.01	0.07
	Sig				0.84	0.35	0.98	0.68
PHM	Pearson Correlation				1	-0.14	-0.00	0.24
	Sig					0.35	0.99	0.15
THM	Pearson Correlation					1	0.19	-0.02
	Sig						0.25	0.89
pH	Pearson Correlation						1	0.27
	Sig							0.09
ORG MAT	Pearson Correlation							1
	Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Cd=cd. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 111. Correlation Coefficient between the cadmum of the shoots, roots of *Corchorous olitorius* accession NG/AO/Jun/09/002, total cadmium in soil, phyto available cadmium in soil, total cadmium in water and some physico chemical properties of soil of the second dry season (2016).

	CdS	CdR	THS	PHS	THW	pH	Org Mat.
CdS Pearson Correlation	1	0.33*	0.46**	0.03	-0.02	-0.23	-0.12
Sig. (2-tailed)		0.04	0.00	0.88	0.92	0.16	0.49
N							
CdR Pearson Correlation		1	0.72**	-0.09	-0.02	-0.08	-0.11
Sig. (2-tailed)			0.00	0.60	0.91	0.61	0.95
N							
THS Pearson Correlation			1	-0.10	0.10	-0.07	0.08
Sig. (2-tailed)				0.56	0.54	0.69	0.64
N							
PHS Pearson Correlation				1	-0.15	-0.20	0.05
Sig. (2-tailed)					0.36	0.22	0.75
N							
THW Pearson Correlation					1	0.17	0.33*
Sig. (2-tailed)						0.30	0.04
N							
pH Pearson Correlation						1	0.37*
Sig. (2-tailed)							0.02
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CdS=cadmium in shoot. CdR=cadmium in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 112: Correlation of cadmium concentration of *Corchorus olitorius* NG/OA/Jun/09/002, THMS , PHS, THW, pH and organic matter of soil in the first rainy season (2016).

	Cd shoot	Cd root	THMS	PHS	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	0.80**	0.61**	0.59**	0.04	0.05	-0.32*
Sig		0.00	0.00	0.02	0.80	0.75	0.05
Cd root Pearson Correlation		1	0.65**	0.77**	-0.01	0.20	0.18
Sig			0.00	0.00	0.96	0.24	0.27
THMS Pearson Correlation			1	0.47**	0.01	-0.08	-0.10
Sig				0.02	0.96	0.63	0.57
PHS Pearson Correlation				1	0.01	0.08	0.07
Sig					0.94	0.63	0.67
THW Pearson Correlation					1	0.29	0.29
Sig						0.08	0.08
pH Pearson Correlation						1	0.99**
Sig							0.00
ORG MAT Pearson Correlation							1
Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cd S=cadmium inshoot. Cd R=cadmium in root

Cd=Cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Cd content of the root had significant positive correlation with the the total heavy metal of soil ($r=0.62^{**}$) at $p \leq 0.00$ showing very high interaction that could have facilitated Cd transfer from the soil to the root, the phytoavailable heavy metal in soil ($r=0.55^{**}$) at $p \leq 0.00$ implying readily available Cd for the accession uptake and a significant negative correlation with the soil organic matter ($r = -0.32^{*}$) at $p \leq 0.05$ showing a negative interaction which could have inhibited the support of the soil organic matter in Cd uptake in the first rainy season (2016) suggesting no correlation. The total heavy metal of soil had a significant positive correlation with the phytoavailable heavy metal of soil ($r=0.49^{**}$) at $p \leq 0.02$ showing a very strong interaction causing more phytoavailable Cd in the soil and a significant negative correlation with the soil pH ($r= -0.32^{*}$) at $p \leq 0.05$ indicating adverse effect the total Cd in soil (Table 116) the first rainy season (2016). Soil pH had a significant positive correlation with the soil organic matter ($r=0.92^{**}$) at $p \leq 0.00$ (Table 116) showing a very strong interaction where the soil pH enhanced the activities of the soil organic matter in the first rainy season (2016) (Table 116). Table 117 presents the correlation between the cadmium concentration of *Corchorus olitorius* NG/OA/04/010, THS , PHS, THW, pH and organic matter of soil in the second rainy (20170. Cd content of the root had a significant positive correlation with the phyto available heavy metal in soil ($r=0.39^{*}$) at $p \leq 0.05$ showing a weak positive interaction in the second rainy season (2017) than in the first rainy season (2016) .

Phyto available metal in soil had significant positive correlation with the soil pH ($r=0.31^{*}$) at $p \leq 0.05$ and the soil organic matter ($r=0.49^{*}$) at $p \leq 0.04$ suggestion the pH and organic matter in the second rainy enhanced the fractionation of Cd in soil. pH of the soil had a significant positive correlation with the soil organic matter ($r=0.45^{**}$) at $p \leq 0.01$indicating that the interaction enhanced the activities of the organic matter in the second rainy season(2017) (Table 117). Table 118 shows the Correlation between copper concentration of *Amaranthus hybridus* NG/AA/03/11/010, soil, water and physico chemical parameters of soil in the first dry season (2015). Copper concentration of the shoot had positive significant correlations with the copper content of the root ($r= 0.95^{**}$) at $p \leq 0.00$ indicating strong positive interaction that enhanced Cu translocation from the shoot to the root of the accession, the phytoavailable copper of soil ($r=0.95^{**}$) at $p \leq 0.00$ suggesting availability of Cu to the shoot, soil pH ($r= 0.45^{**}$) at $p \leq 0.01$ and the soil organic matter ($r=0.41^{**}$) at $p \leq 0.01$ showing strong interaction enhancing Cu translocation to the shoot in the first dry season(2015) (Table 118).

Table 113: Correlation between cadmium concentration of *Corchorus olitorius* NG/OA/Jun/09/002 THMS, PHS, THW, pH and organic matter of soil in the second rainy season (2017).

	Cd shoot	Cd root	THMS	PHS	THW	pH	ORG. MAT
Cd shoot Pearson Correlation	1	0.12	-0.05	0.30*	0.24	-0.15	-0.25
Sig		0.46	0.75	0.05	0.15	0.37	0.12
Cd root Pearson Correlation		1	0.08	0.42*	0.02	-0.22	0.04
Sig			0.64	0.03	0.92	0.15	0.82
THMS Pearson Correlation			1	0.37*	-0.16	0.16	-0.18
Sig				0.03	0.34	0.33	0.27
PHS Pearson Correlation				1	-0.28	0.39*	0.49*
Sig					0.31	0.05	0.03
THW Pearson Correlation					1	0.13	0.06
Sig						0.42	0.71
pH Pearson Correlation						1	0.39’’
Sig							0.01
ORG MAT Pearson Correlation							1
Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cd=Cadmiun. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter.

Table 114: Correlation between cadmium concentration of *Corchorus olitorius* NG/OA/04/010 , THS, PHS,THW, pH and organic matter of soil in the first dry season(2015).

		Cd shoot	Cd root	THS	PHM	THW	pH	ORG. MAT
Cd shoot	Pearson Correlation	1	-0.15	-0.08	-0.01	-0.11	0.23	-0.13
	Sig		0.37	0.63	0.94	0.50	0.16	0.42
Cd root	Pearson Correlation		1	0.37*	-0.19	0.00	0.40**	0.38*
	Sig			0.02	0.26	0.99	0.01	0.02
THS	Pearson Correlation			1	-0.03	-0.16	0.07	-0.01
	Sig				0.84	0.35	0.68	0.98
PHM	Pearson Correlation				1	-0.14	0.24	-0.00
	Sig					0.40	0.15	0.99
THW	Pearson Correlation					1	-0.02	0.19
	Sig						0.89	0.25
pH	Pearson Correlation						1	0.27
	Sig							0.09
ORG MAT	Pearson Correlation							1
	Sig							

** High significant correlation at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed) Cd-cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 116: Correlation coefficient of cadmium concentration of *Corchorus olitorius* NG/OA/04/010 THS , PHS, THW, pH and organic matter of soil in the first rainy season (2016).

	Cd shoot	Cd root	THMS	PHS	THW	pH	ORG. MAT
Cds shoot Pearson Correlation	1	0.84**	0.24	0.15	0.31*	-0.23	-0.26
Sig		000	0.14	0.36	0.05	0.16	0.12
Cd root Pearson Correlation		1	0.62**	0.55**	0.19	-0.30	-0.32*
Sig			0.00	0.00	0.25	0.07	0.05
THMS Pearson Correlation			1	0.49**	-0.27	-0.32*	-0.29
Sig				0.02	0.10	0.05	0.07
				1	0.04	-0.12	-0.14
PHS Pearson Correlation					0.82	0.45	0.41
Sig					1	-0.07	-0.07
						0.97	0.68
THW Pearson Correlation						1	0.92**
							0.00
Sig							
pH Pearson Correlation							0.33*
Sig							0.05
ORG MAT Pearson Correlation							1
Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cd S=cadmium inshoot. Cd R=cadmium in root

Cd=Cadmium. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 117 : Correlation of cadmium concentration of *Corchorus olitorius* NG/OA/04/010 THS , PHS, THW, pH and organic matter of soil in the second rainy season (2017).

		Cd shoot	Cd root	THMS	PHS	THW	pH	ORG. MAT
Cd shoot	Pearson Correlation	1	0.17	-0.08	-0.20	0.03	-0.09	-0.00
	Sig		0.28	0.64	0.07	0.87	0.58	0.99
Cd root	Pearson Correlation		1	0.09	0.39*	-0.22	-0.08	-0.01
	Sig			0.57	0.05	0.18	0.64	0.95
THMS	Pearson Correlation			1	0.29	-0.16	0.16	-0.18
	Sig				0.11	0.34	0.33	0.27
PHS	Pearson Correlation				1	-0.29	0.31*	0.49*
	Sig					0.09	0.05	0.04
THW	Pearson Correlation					1	0.13	0.06
	Sig						0.42	0.71
pH	Pearson Correlation						1	0.45’’
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cd=Cadmiun. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Copper content of the root of the accession had significant positive correlation with the phytoavailable copper of soil ($r=0.91^{**}$) at $p \leq 0.00$, the soil pH at at $r=0.34^{*}$and $r=0.03$, the organic matter at $r=0.42^{**}$ and $p \leq 0.01$ (Table 118).Total copper content in soil had a significant negative correlation with the phytoavailable copper in the soil ($r= -0.37^{*}$) at $p \leq 0.02$ suggesting no interaction. Phyto available copper in soil had a significant positive correlation with the organic matter of soil ($r=0.41^{**}$) at $p \leq 0.01$ indicating that the activities of the soil organic matter strongly enhanced the phytoavailability of Cu in soil in the first dry season (2015) (118). Table 119 shows the correlation coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/AA/03/11/010, total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil in the second dry season (2016). There was positive correlation between the copper content of the shoots of *Amaranthus hybridus* accession NG/AA/03/11/010 and the copper content of the root ($r=0.70^{**}$) at $p \leq 0.00$ indicating a strong interaction which enhanced Cu translocation from the root to the stem in the second dry season (2016) (Table 119). pH of the soil correlated significantly positive with the soil organic matter ($r=0.39^{*}$) at $p \leq 0.02$ indicating the viability of soil organic matter under the positive influence of pH in the second dry season (2016) (Table 119).

Table 120 presents the correlation coefficient between copper content of *Amaranthus hybridus* accession NG/AA/03/11/010, THS, PHS, THW, pH and organic matter of soil in the first rainy season (2016). Copper content in the shoot had significant positive correlation with the copper content in the root ($r=0.51^{**}$) at $p \leq 0.00$ suggesting more Cu translocation from the root of the accession to the shoot in the first rainy season (2016), the total heavy metal of soil ($r=0.93^{**}$) at $p \leq 0.00$, and the phytoavailable heavy metal ($r=0.91^{**}$) at $p \leq 0.00$ showing very strong positive interaction (Table 120). Cu content of the root had a significant positive correlation with the total heavy metal soil ($r=0.58^{**}$) at $p \leq 0.00$ suggesting more Cu transfer from the soil to root of the accession, and a significant positive correlation with phytoavailable heavy metal in soil ($r=0.62^{**}$) at $p \leq 0.00$ indicating a strong interaction. Total heavy metal soil had a significant correlation with the phytoavailable heavy ($r=0.95^{**}$) at $p \leq 0.00$ suggesting a strong interaction enhancing readily available Cu in the soil (Table 120). Soil pH had a significant positive correlation with the soil organic matter ($r=0.89^{**}$) at $p \leq 0.00$ showing a very strong positive influence of soil pH on the soil organic matter (Table 120).

Table 118: Correlation between copper concentration of *Amaranthus hybridus* NG/AA/03/11/010 ,THS, PHS, THW, pH and organic matter of soil first dry season (2015).

	Cu shoot	Cu root	THS	PHM	THW	pH soil	Org. mat
Cu shoot Pearson Correlation	1	0.95**	-0.28	0.95**	-0.03	0.45**	0.41**
Sig		0.00	0.09	0.00	0.86	0.01	0.01
Cu root Pearson Correlation		1	-0.26	0.91**	-0.03	0.34*	0.42**
Sig			0.11	0.00	0.88	0.03	0.01
THS Pearson Correlation			1	-0.37*	-0.26	0.04	0.02
Sig				0.02	0.12	0.81	0.90
PHS Pearson Correlation				1	-0.02	0.24	0.41**
Sig					0.98	0.15	0.01
THW Pearson Correlation					1	-0.01	-0.23
Sig						0.08	0.15
pH soil Pearson Correlation						1	0.25
Sig							0.13
Org. mat soil							1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Cu=copper. THS=Total heavy metal in soil. PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 119: Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/AA/03/11/010, total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil in the second dry season (2016)

	CuS	CuR	THS	PHS	THW	pH	Org Mat.
CuS Pearson Correlation	1	0.70**	0.23	0.05	0.00	0.08	0.03
Sig. (2-tailed)		0.00	0.17	0.78	0.98	0.62	0.87
N							
CuR Pearson Correlation		1	-0.11	0.16	-0.02	0.05	0.03
Sig. (2-tailed)			0.50	0.33	0.90	0.75	0.84
N							
THS Pearson Correlation			1	0.18	-0.24	-0.17	-0.15
Sig. (2-tailed)				0.28	0.14	0.30	0.35
N							
PHS Pearson Correlation				1	-0.01	0.20	0.05
Sig. (2-tailed)					0.97	0.22	0.75
N							
THW Pearson Correlation					1	-0.16	0.03
Sig. (2-tailed)						0.35	0.85
N							
pH Pearson Correlation						1	0.39*
Sig. (2-tailed)							0.02
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CuS=copper in shoot.

CuR=copper in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

Table 120. Correlation between copper content of *Amaranthus hybridus* NG/AA/03/11/010 ,THS, PHS,THW , pH and organic matter of soil in the first rainy season (2016).

		Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot	Pearson Correlation	1	0.51**	0.93**	0.91**	0.12	-0.01	-0.03
	Sig		0.00	0.00	0.00	0.45	0.98	0.84
Cu root	Pearson Correlation		1	0.58**	0.62**	0.07	0.14	0.09
	Sig			0.00	0.00	0.67	0.41	0.59
THMS	Pearson Correlation			1	0.95**	0.01	-0.0	-0.09
	Sig				0.00	0.96	0.63	0.57
PHS	Pearson Correlation				1	0.01	0.08	0.07
	Sig					0.94	0.63	0.67
THW	Pearson Correlation					1	0.29	0.29
	Sig						0.08	0.08
pH	Pearson Correlation						1	0.89**
	Sig							0.00
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cu S=Copper in shoot; Cu R= Copper in root.

Cu=Copper. THS=Total heavy metal in soil.PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 121 shows the correlation between copper content of *Amaranthus hybridus* accession NG/AA/03/11/010, THS, PHS, THW , pH and organic matter of soil in the second rainy (2017). Copper content of the shoot had a significant negative correlation with the total heavy metal in soil (r= - 0.34*) at $p \leq 0.04$ suggesting an adverse interaction between the Cu content of soil and the Cu content in the shoot of the accession the second rainy season (2017). Copper content of the root of the accession had a significant positive correlation with the total heavy soil at r=0.69** and $p \leq 0.00$ indicating a strong interaction that would have facilitated Cu transfer from the soil to the root in the second rainy season (2017) (Table 121). The soil pH had a significant positive correlation with the organic matter of the soil (r=0.33**) at $p \leq 0.01$ showing very strong positive interaction (Table 121).

Table 122 shows significant positive correlation between the copper content of the shoot of *Amaranthus hybridus* accession NG/AO/11/08/039 and the Cu content of the root (r=0.72**) at $p \leq 0.00$ indicating strong positive interaction suggesting more translocation of Cu from the root to the shoot in the first dry season (2015) (Table 122). The soil pH had a significant positive correlation with the soil organic matter (r=0.48**) at $p \leq 0.01$ indicating a very strong positive influence of pH on the soil matter in the first dry season (2015) (Table 122). Table 123 shows the correlation coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/AO/11/08/039, total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil second dry season (2016) (Table 123). There was significant positive correlation between the copper content of the shoot of *Amaranthus hybridus* accession NG/AO/11/08/039 and the Cu content of the root (r=0.72**) at $p \leq 0.00$ showing strong positive interaction that facilitated Cu translocation form the root to the shoot of the accession in the second dry season (2016). The soil pH had a significant positive correlation with the soil organic matter (r=0.48**)at $p \leq 0.01$ implying a strong interaction (Table 123).

Table 124 shows the correlation coefficient between the copper concentration of *Amaranthus hybridus* accession NG/AO/11/08/039 THS, PHS, THW, pH and organic matter of the soil in the first rainy season (2016). There were significant positive correlation between the Copper content of the shoot and the Cu content of the root at (r=0.83**) at $p \leq 0.00$ indicating a very strong positive interaction leading to high Cu translocation from the root to the shoot, the total heavy metal soil ($r=0.84^{**}$) at $p \leq 0.00$ showing very strong positive interaction with the Cu in shoot supporting high translocation of Cu to the shoot and the phytoavailable heavy metal ($r=0.87^{**}$) at $p \leq 0.00$ showing very strong interaction that facilitated the fractionation of Cu to an exchangeable form of Cu . (Table 124). Cu content of the root had significant positive correlation with total heavy metal soil ($r=0.95^{**}$) at $p \leq 0.00$ and the phytoavailable heavy metal ($r=0.97^{**}$) at $p \leq 0.00$ indicating a very strong interaction that supported Cu fractionation enhancing Cu phytoavailability in the soil. Total heavy metal of the soil had a significant positive correlation with phytoavailable heavy metal ($r=0.95^{**}$) at $p \leq 0.00$ showing a very strong positive interaction. Soil pH had a significant positive correlation with the soil organic matter ($r=0.94^{**}$) at $p \leq 0.00$ suggesting strong positive interaction enhancing the activities of soil organic matter by the influence of soil pH (Table 124).

Table 125 shows the correlation between the copper concentration of *Amaranthus hybridus* accession NG/AO/11/08/039 THS, PHS, THW, pH and organic matter of the soil in the second rainy season (2017). The Cu content in the root of the accession had a significant positive correlation with the total Cu in soil ($r=0.69^{**}$) at $p \leq 0.00$ indicating strong positive interaction which enhanced Cu transfer from the soil to the root of the accession in the second rainy season (2017). The soil pH had a significant positive correction with the soil organic matter ($r=0.66^{**}$) at $p \leq 0.01$ implying a strong interaction that positively influence the activities of the soil organic matter in the second rainy (2017).

Table 121: Correlation between copper content of *Amaranthus hybridus* NG/AA/03/11/010 ,THS, PHS,THW , pH and organic matter of soil in the second rainy season (2017).

		Cu shoot	Cu root	THS	PHS	THW	pH	ORG. MAT
Cu shoot	Pearson Correlation	1	-0.07	-0.34'	0.24	0.01	0.02	-0.01
	Sig		0.67	0.04	0.15	0.95	0.91	0.97
Cu root	Pearson Correlation		1	0.69''	-0.13	-0.07	-0.11	-0.18
	Sig			0.00	0.45	0.67	0.49	0.29
THMS	Pearson Correlation			1	-0.24	0.11	-0.30	-0.19
	Sig				0.14	0.50	0.07	0.24
PHS	Pearson Correlation				1	-0.05	0.17	0.18
	Sig					0.74	0.31	0.25
THW	Pearson Correlation					1	0.08	0.18
	Sig						0.63	0.28
pH	Pearson Correlation						1	0.33''
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

** correlation is significant at the 0.01level (2-tailed) * correlation is significant at the 0.05level (2-tailed) Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 122: Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/AO/11/08/039, total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil in the first dry season (2015).

	CuS	CuR	THS	PHS	THW	pH	Org Mat.
CuS Pearson Correlation	1	0.72**	-0.06	0.06	0.07	0.12	0.12
Sig. (2-tailed)		0.00	0.74	0.70	0.66	0.45	0.48
N							
CuR Pearson Correlation		1	0.06	0.11	0.04	0.01	-0.11
Sig. (2-tailed)			0.73	0.52	0.79	0.97	0.50
N							
THS Pearson Correlation			1	0.18	-0.24	-0.17	-0.15
Sig. (2-tailed)				0.28	0.14	0.30	0.35
N							
PHS Pearson Correlation				1	-0.01	0.20	0.05
Sig. (2-tailed)					0.97	0.22	0.75
N							
THW Pearson Correlation					1	-0.16	0.03
Sig. (2-tailed)						0.35	0.84
N							
pH Pearson Correlation						1	0.48**
Sig. (2-tailed)							0.01
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CuS=copper in shoot. CuR=copper in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.
THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 123. Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/AO/11/08/039, total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil second dry season(2016).

	CuS	CuR	THS	PHS	THW	pH	Org Mat.
CuS Pearson Correlation	1	0.72**	-0.06	0.06	0.07	0.12	0.12
Sig. (2-tailed)		0.00	0.74	0.70	0.66	0.45	0.48
N							
CuR Pearson Correlation		1	0.06	0.11	0.04	0.01	-0.11
Sig. (2-tailed)			0.73	0.52	0.79	0.97	0.50
N							
THS Pearson Correlation			1	0.18	-0.24	-0.17	-0.15
Sig. (2-tailed)				0.28	0.14	0.30	0.35
N							
PHS Pearson Correlation				1	-0.01	0.20	0.05
Sig. (2-tailed)					0.97	0.22	0.75
N							
THW Pearson Correlation					1	-0.16	0.03
Sig. (2-tailed)						0.35	0.84
N							
pH Pearson Correlation						1	0.48**
Sig. (2-tailed)							0.01
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CuS=copper in shoot. CuR=copper in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 124 Correlation between the copper concentration of *Amaranthus hybridus* accession NG/AO/11/08/039 THS, PHS, THW, pH and organic matter of the soil first rainy season (2016).

	Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot Pearson Correlation	1	0.83**	0.84**	0.87**	-0.26	-0.12	-0.15
Sig		0.00	0.00	0.00	0.11	0.47	0.38
Cu root Pearson Correlation		1	0.95**	0.97**	0.13	0.04	0.03
Sig			0.00	0.00	0.42	0.83	0.87
THMS Pearson Correlation			1	0.95**	0.01	-0.08	-0.94
Sig				0.00	0.96	0.63	0.57
PHS Pearson Correlation				1	0.01	0.08	0.07
Sig					0.94	0.63	0.67
THW Pearson Correlation					1	0.29	0.29
Sig						0.08	0.08
pH Pearson Correlation						1	0.94**
Sig							0.00
ORG MAT Pearson Correlation							1
Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed)

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 125 : Correlation between the copper concentration of *Amaranthus hybridus* accession NG/AO/11/08/039 THS, PHS, THW, pH and organic matter of the soil in the second rainy season (2017).

	Cu shoot	Cu root	THS	PHS	THW	pH	ORG. MAT
Cu shoot Pearson Correlation	1	0.10	0.05	0.12	-0.15	0.07	-0.10
Sig		0.54	0.75	0.47	0.35	0.66	0.55
Cu root Pearson Correlation		1	0.69’’	-0.31	0.24	-0.01	-0.31
Sig			0.00	0.85	0.14	0.10	0.85
THS Pearson Correlation			1	-0.24	0.11	-0.30	-0.19
Sig				0.14	0.50	0.07	0.24
PHS Pearson Correlation				1	-0.05	0.17	0.19
Sig					0.74	0.31	0.25
						0.08	0.18
THW Pearson Correlation					1		0.28
Sig						0.62’	0.39
						0.02	
pH Pearson Correlation						1	0.66’’
Sig							0.01
ORG MAT Pearson Correlation							1
Sig							

,, correlation is significant at the 0.01level (2-tailed) . , correlation is significant at the 0.05level (2-tailed)

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Total Cu in irrigated water had a significant positive correlation with the soil pH (r=0.62**) at p≤0.02 indicating a strong positive relationship between the Cu in water used for irrigation and the soil pH in the the second rainy season (2017). Table 126 shows the Correlation between copper concentration of *Amaranthus hybridus* accession NGBO125, soil, water and physico chemical parameters of soil in the first dry season (2015) (Table 126). There were strong positive significant correlations between the concentration of copper of the shoot of the accession, the copper concentration of the root (r= 0.95**) at p ≤ 0.01 indicating a strong onteraction that facilitated Cu translocation from the root to the shoot of the accession in the first dry season (2015), the phyto available heavy metal (r=0.92**) at p≤0.01 showing a strong significant positive interaction, the soil pH (r=0.36*) at p≤0.05 indicating a weak positive interaction with Cu in shoot, the soil organic matter (r=0.33*) at p≤0.04 implying a significant weak interaction and a significant negative correlation with the total heavy metal soil (r= - 0.43*) at p≤0.01suggesting a strong adverse interaction (Table 126). There were strong significant positive correlation between the concentration of copper of the root, the phyto available copper in the soil (0.93**) at p ≤0.01 indicating a strong positive interaction that could have enhanced Cu transfer to the root, the soil pH (r=0.36*) at p ≤ 0.01, this also signified a strong positive interaction and with the soil organic matter at (r=0.45**) at p ≤ 0.01 indicating a strong positive significant interaction (Table 126).

The total concentration of copper in soil had a significant negative correlation with the phytoavailable copper of soil (r= -0.37*.) at p ≤ 0.02 showing a strong negative interaction (Table 126). There was a strong significant negative correlation between the phytoavailable copper in soil and the soil organic matter (r= 0.41**) at p ≤0.01 suggesting that the soil organic matter inhibited the activities of the readily available Cu in soil in the first dry season (2015) (Table 126).

Table 127 shows correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NGBO125 total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil in the second dry season (2016). Copper content in the shoots of *Amaranthus hybridus* accession NGBO125 had significant positive correlation with the Cu content of the roots (r=0.71**) at p≤0.00 showing a very strong positive interaction that could have enhanced Cu translocation from the root to the shoot of the accession in the second dry season (2016) and with the total heavy metal soil (r=0.77**) at p ≤0.00 showing a very strong positive interaction. The Cu content of the root had a significant positive correlation with the total heavy metal in soil (r=0.64**) at p ≤0.00 showing a very strong positive interaction (Table 127).

Total heavy metal in water had a significant positive correlation with the soil organic matter (r=0.33*) at p≤0.04 indicating a weak positive interaction. The soil pH correlated significantly positive with the soil organic matter (r=0.30*) at p ≤0.02 showing a significant positive interaction (Table 127). Table 128 presents the correlation coefficient between copper concentration of *Amaranthus hybridus* accession NGBO 125, THS , PHS, THW, pH and organic matter of soil in the first rainy season (2016). There were significant positive correlation between the copper content of the shoot and the copper content of the root (r=0.83**) at p ≤ 0.00 suggesting a very strong positive interaction that could have enhanced Cu translocation form the root to the shoot, the total heavy metal of soil (r=0.84**) at p ≤ 0.00 showing a very strong interaction, and the phytoavailable heavy metal of soil (r = 0.87**) at p ≤ 0.00 (Table 127). Copper content in the root had significant positive correlation with the total heavy metal soil (r= 0.95**) at p ≤ 0.00 indicating a very strong positive interaction leading to high content of Cu transfer from the soil to the root and the phytoavailable copper of the soil (r=0.97**) at p ≤ 0.00 in the first rainy season (2016).

Total heavy metal in the soil had a significant positive correlation with the phytoavailable metal in the soil (r=0.95**) at $p \leq 0.00$. The soil pH had a strong significant positive correlation with the soil organic matter (r=0.91**) at $p \leq 0.00$ showing the significant positive interaction that enhanced the activities of the soil organic matter in the first rainy season (2016) (Table 128). Table 128 shows the correlation between the copper concentration of *Amaranthus hybridus* accession NGBO125, THMS, PHS, THW, pH and organic matter of soil in the first rainy season (2016). There was a significant positive correlation between the copper content of the root of the accession and the total copper in the soil (r=0.63**) at $p \leq 0.00$ indicating strong positive interaction that enhanced Cu transfer from from the soil to the root in the second rainy season (2016) (Table 128). The soil pH had a significant positive correlation with the soil organic matter (r= 0.36**) at $p \leq 0.01$ (Table 128). Table 129 shows the Correlation between copper concentration of *Amaranthus hybridus* accession NGBO125 with the shoot content correlating significantly positive with the total Cu in soil (r=0.63**) at $p \leq 0.00$ indicating very strong interaction from the same imput. The soil pH also correlated significantly positive with the soil organic content (r=0.36**) showing very strong interaction from the same input in the second rainy season (2017).

Table 130 shows the Correlation between copper concentration of *Corchorus olitorius* NG/OA/Jun/09/002, soil, water and physico chemical parameters of soil first dry season (2015).The copper concentration of the shoot of *Corchorus olitorius* accession NG/OA/Jun/09/002 had significant positive correlation with the copper concentration of the root (r= 0.72**) at $p \leq 0.00$ indicating a strong interaction that promoted Cu translocation from the root to the shoot of the accession in the first dry season (2015), phyto available copper content in the soil (r=0.82 **) at $p \leq 0.00$, the soil pH (r= 0.53**) at $p \leq 0.00$ and the total metal in soil (r= - 0.33) at $p \leq 0.04$ (Table 130). Strong significant positive correlation was recorded between the copper concentration of the root and the phytoavailable copper in soil (r= 0.77**) at $p \leq 0.01$ and with the soil pH at (r=0.39*) at $p \leq 0.02$. Total copper in soil and the phyto available copper in soil correlated significantly negative (r = -0.37**) and $p \leq 0.00$ (Table 129). A strong significant correlation was recorded between the phyto available copper of soil and the soil organic matter (r= 0.41**) at $p \leq 0.01$ (Table130). Table 131 shows Cu content in the shoots of *Corchorus olitorius* accession NG/OA/Jun/09/002 had a significant positive correlation with the Cu content of the root (r=0.33*) at p≤0.04 indicating weak translocation of Cu from the shoot to the root of the accession in the second dry season (2016). There was a significant positive correlation between the soil pH and the soil organic matter (r=0.31*) at p ≤0.04 showing the weak but positive influence of soil pH on the soil organic matter (Table 131).

Table 132 shows the correlation coefficient between copper concentration of *Corchorus olitorius* NG/OA/Jun/09/002, THS, PHS, THW, pH and organic matter of soil in the first rainy season (2016). Copper content in the shoot had significant positive correlation with the copper content of the root (r=0.83**) at p ≤ 0.00 showing a very strong positive interaction enhancing high Cu translocation from the root to the shoot of the accession in the first rainy season (2016), the total heavy metal (r=0.92**) at p ≤ 0.00 showing a very strong significant positive interaction and the phytoavailable metal heavy in soil (r=0.88**) at p ≤ 0.00 implying a very high positive significant interaction in the first rainy season (2016) (Table 132). Cu content of the root had positive significant correlation with the total heavy metal of soil (r=0.94**) at p ≤ 0.00 indicating a very strong correlation and the phytoavailable heavy metal in soil (r= 0.88**) at p ≤ 0.00 implying a very strong positive significant correlation.

Total heavy metal of soil had a significant positive correlation with the phytoavailable heavy metal soil (r=0.95**) at p ≤ 0.00 showing a very strong positive interaction. The soil pH had a significant positive correlation with the soil organic matter (r =0.90**) at p ≤ 0.00 (Table 132). Table 133 presents the correlation between copper concentration of *Corchorus olitorius* NG/OA/Jun/09/002 THMS , PHS, THW, pH and organic matter of soil in the second rainy season (2017). The copper content of the root of the accession had a significant positive correlation with the total copper of the soil used to raise the accession (r=0.54**) at p ≤0.00 showing a strong positive interaction (Table 133). The soil pH had a significant positive correlation with the soil organic matter (r=0.37**) at p ≤ 0.01(Table 133).

Table 126 : Correlation between copper concentration of *Amaranthus hybridus* NGBO125 ,THS, PHS, THW pH and organic matter of soil in the first dry season (2015).

	Cu shoot	Cu root	THS	PHM	THW	pH soil	Org. mat soil
Cu shoot Pearson Correlation	1	0.95**	-0.43**	0.92**	-0.05	0.36*	0.33*
Sig		0.00	0.01	0.01	0.76	0.03	0.04
Cu root Pearson Correlation		1	-0.29	0.93**	-0.10	0.36*	0.45**
Sig			0.08	0.01	0.57	0.02	0.01
THS Pearson Correlation			1	-0.37*	-0.26	0.04	0.02
Sig				0.02	0.12	0.81	0.90
PHM Pearson Correlation				1	-0.02	0.24	0.41**
Sig					0.92	0.15	0.01
THW Pearson Correlation					1	-0.01	-0.23
Sig						0.98	0.15
pH Pearson Correlation						1	0.25
Sig							0.13
Org, mat Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Cu=copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water. ORG.MAT=Organic matter

Table 127. Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NGBO125 total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil in the second dry season (2016).

		CuS	CuR	THS	THW	PHS	pH	Org Mat.
CuS	Pearson Correlation	1	0.71**	0.77**	0.01	0.16	0.00	0.15
	Sig. (2-tailed)		0.00	0.00	0.95	0.33	0.98	0.36
	N							
CuR	Pearson Correlation		1	0.64**	0.03	0.07	0.09	-0.09
	Sig. (2-tailed)			0.00	0.88	0.67	0.58	0.61
	N							
PHS	Pearson Correlation			1	-0.10	0.10	-0.07	0.08
	Sig. (2-tailed)				0.56	0.54	0.69	0.64
	N							
THS	Pearson Correlation				1	-0.15	0.20	0.05
	Sig. (2-tailed)					0.36	0.22	0.75
	N							
THW	Pearson Correlation					1	0.17	0.33*
	Sig. (2-tailed)						0.30	0.04
	N							
pH	Pearson Correlation						1	0.30*
	Sig. (2-tailed)							0.02
	N							
Org.Mat	Pearson Correlation							1
	Sig. (2-tailed)							
	N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level (2 tailed).CuS=copper in shoot. CuR=copper in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.
THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil

Table 134 shows the correlation between copper concentration of *Corchorus olitorius* NG/OA/04/010, soil, water and physico chemical parameters of soil in the first dry season (2015). There were significant positive correlation between the copper concentration of the shoot and the copper concentration of the root (r=0.32*) at $p \leq 0.05$ and soil pH (r=0.34*) at $p \leq 0.04$ showing a weak positive interaction (Table 134). Copper concentration of the root had a significant positive correlation with the phyto available heavy metal in soil (r=0.91**) at $p \leq 0.00$ indicating a very strong positive interaction, pH (r=0.44**) at $p \leq 0.01$ and the soil organic matter (r=0.49**) at $p \leq 0.01$ showing strong significant positive correlation. There was strong negative correlation between the total copper content of soil and the phytoavailable copper of soil (r= - 0.30*) at $p \leq 0.02$ (Table 134). Phyto available heavy metal in soil had a significant positive correlation with the soil matter (r=0.41**) at $p \leq 0.01$(Table 134).

Table 135 presents the correlation between the copper concentration of Corchorus olitorius NG/OA/04/010 THMS, PHS, THW and the physico chemical properties in the second dry season (2016). Copper content in the root of the accession had significant positive correlation with the total heavy metal in the soil (r=0.70**) at $p \leq 0.00$ indicating a significant strong positive interaction enhancing Cu transfer from the soil to the root of the accession (Table 135). The soil pH had a significant positive correlation with the soil organic matter (r=0.39**) at $p \leq 0.01$ showing a very strong interaction (Table 135). Table 136 shows the correlation coefficient of copper concentration of *Corchorus olitorius* accession NG/OA/04/010 THMS, PHS, THW, pH and organic matter of soil in the first rainy season (2016). Copper content of the shoot had significant positive correlation with the copper content of the root (r=0.62**) at $p \leq 0.00$ suggesting very strong interaction that could have facilitated Cu translocation from the root to the shoot of the accession, the total heavy metal in soil (r=0.72**) at $p \leq 0.00$ and the phytoavailable heavy metal in soil (r=0.73**) at $p \leq 0.00$ showing very strong positive interaction that could have supported the viability of the readily available Cu to the root of the accession (Table 136).

Table 128 : Correlation coefficient between copper concentration of *Amaranthus hybridus* NGBO 125, THMS , PHS, THW, pH and organic matter of soil in the first rainy season (2016).

	Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot Pearson Correlation	1	0.83**	0.84**	0.87**	-0.26	-0.12	-0.15
Sig		0.00	0.00	0.00	0.11	0.47	0.38
Cu root Pearson Correlation		1	0.95**	0.97**	0.13	0.04	0.03
Sig			0.00	0.00	0.42	0.83	0.87
THMS Pearson Correlation			1	0.95**	0.01	-0.08	-0.09
Sig				0.00	0.96	0.63	0.57
PHS Pearson Correlation				1	0.01	0.08	0.07
Sig					0.94	0.63	0.67
THW Pearson Correlation					1	0.28	0.29
Sig						0.08	0.08
pH Pearson Correlation						1	0.91**
Sig							0.00
ORG MAT Pearson Correlation							1
Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cu S=Copper in shoot; Cu R= Copper in root.

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 129. Correlation between copper concentration of *Amaranthus hybridus* NGBO 125, THMS, PHS, THW, pH and organic matter of soil in the second rainy season (2017).

		Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot	Pearson Correlation	1	0.07	0.00	0.20	-0.06	- 0.14	0.18
	Sig		0.69	0.99	0.23	0.71	0.41	0.28
Cu root	Pearson Correlation		1	0.63’’	-0.24	0.09	-0.00	-0.12
	Sig			0.00	0.15	0.59	0.99	0.48
THMS	Pearson Correlation			1	-0.24	0.11	-0.30	-0.19
	Sig				0.14	0.50	0.07	0.23
PHS	Pearson Correlation				1	-0.05	0.17	0.19
	Sig					0.74	0.31	0.25
THW	Pearson Correlation					1	0.08	0.18
	Sig						0.62	0.28
pH	Pearson Correlation						1	0.36’’
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

,, correlation is significant at the 0.01 level (2-tailed) . , correlation is significant at the 0.05level (2-tailed)

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

The Cu content of the root had significant positive correlation with the total heavy metal soil (r=0.77**) at $p \leq 0.00$ and the phytoavailable heavy metal of the soil (r=0.85**) at $p \leq 0.00$ implying very stron positive interaction. Total heavy metal soil had a significant positive correlation with the phytoavailable heavy metal soil (r=0.95**) at $p \leq 0.00$ showing very strong significant interaction in the first rainy season (2016) (Table 136). The soil pH had a significant positive correlation with the soil organic matter (r=0.79) at $p \leq 0.00$ showing very strong interaction (Table 136). Table 137 presents the correlation between the copper concentration of *Corchorus olitorius* accession NG/OA/04/010 THMS, PHS, THW, pH and organic matter of soil in the second rainy season (2017). Copper content in the root of the accession had significant positive correlation with the total copper content in the soil (r=0.70**) at $p \leq 0.01$ showing very strong interaction that facilitated Cu transfer from the soil to the root in the second rainy season (2017) (Table 137). The soil pH had a significant positive correlation with the soil organic matter (r=0.39**) at $p \leq 0.01$(Table 137). Table 138 shows the correlation between lead concentration of *Amaranthus hybridus* accession NG/AA/03/11/010, soil, water and physico chemical parameters of soil in the first dry season (2015).

The lead concentration in the shoot of the accession had significant positive correlation with the total lead concentration in soil, phyto available lead and the soil pH with $p \leq 0.01$ at respective correlation (r= 0.44**) at $p \leq 0.01$, (r= 0.58**) at $p \leq 0.00$ and(r= 0.46**) at $p \leq 0.00$ showing very strong positive interaction (Table 138).There was significant negative correlation between the lead content of the root and the total lead content of water at (r= - 0.35) at $p \leq 0.03$, significant positive correlation with the phytoavailable lead of soil, soil pH and the soil organic matter at $p \leq 0.01$ and respective correlation coefficient (r= 0.66**) at $p \leq 0.00$, (r=0.46**) at $p \leq 0.00$ and (r=0.58**) at $p \leq 0.00$ (Table 138).

Total lead content in the soil had positive significant correlation with the phyto available lead of the soil and the soil pH at respective correlation coefficient of (r=0.42**) at $p \leq 0.00$ and (r= 0.65**) at $p \leq 0.00$ indicating very strong interaction (Table 138). The phytoavailable lead in the soil used to raise the accession had a significant negative correlation with the total lead content in water (r=- 0.37*) at $p \leq 0.02$ (Table 138).

Table 139 shows that Lead content in the shoot of *Amaranthus hybridus* accession NG/AA/03/11/010 in the second dry season (2016). There were significant positive correlation with the Lead content in the root (r=0.91**) at p ≤0.00 and with the phyto available heavy metal in soil (r=0.33*) at p ≤0.04 in the second dry season (2016) (Table 139) There was strong significant positive correlation between the soil pH and the soil organic matter (r=0.58**) at p ≤0.00 indicating strong positive interaction (Table 139). Table 140 presents the correlation coefficient of Lead content of *Amaranthus hybridus* accession NG/AA/03/11/010, THS, PHS, THW, pH and organic matter of soil in the first rainy season (140). The Lead content in the shoot had significant positive correlation with the Lead content of the root (r=0.63**) at p ≤ 0.00 showing very strong positive interaction enhancing Pb translocation from the root to the shoot of the accession in the first rainy season (2016), the total heavy metal soil (r=0.71**) at p ≤ 0.00 and the phyto available heavy metal in soil (r=0.85**) at p ≤0.00 (Table 140). Pb content in the root had significant positive correlation with the total heavy metal soil (r=0.65**) at p ≤ 0.00, the phyto available heavy metal soil (0.87**) at p ≤ 0.00 and the total heavy metal water (r=0.30**) at p ≤ 0.00 (Table 140).

Total heavy metal soil had a significant positive correlation with the phytoavailable heavy metal in soil (r=0.86**) at p ≤ 0.00. There was a significant positive correlation between the soil pH and the soil organic matter (r=0.86**) at p ≤ 0.00 indicating very strong positive interaction between the variables (Table 140). Pb content in the root had significant positive correlation with the total heavy metal soil (r=0.65**) at p ≤ 0.00, the phyto available heavy metal soil (0.87**) at p ≤ 0.00 and the total heavy metal water (r=0.30**) at p ≤ 0.00 (Table 140). Total heavy metal soil had a significant positive correlation with the phytoavailable heavy metal in soil (r=0.86**) at p ≤ 0.00. There was a significant positive correlation between the soil pH and the soil organic matter (r=0.86**) at p ≤ 0.00 indicating very strong positive interaction (Table 140). Table 141 shows the no correlation between lead concentration of *Amaranthus hybridus* accession NG/AO/11/08/039, soil, water and physico chemical parameters of soil second rainy season (2017) (Table 141).

Table 130 : Correlation between copper concentration of *Corchorus olitorius* NG/OA/Jun/09/002 ,THS, PHS ,THW pH and organic matter of soil in the first dry season(2015).

	Cu shoot	Cu root	THS	PHS .	THW	pH soil	Org. mat soil
Cu shoot Pearson Correlation	1	0.72**	-0.33*	0.82**	-0.12	0.53**	0.28
Sig		0.00	0.04	0.00	0.47	0.00	0.08
Cu root Pearson Correlation		1	-0.25	0.77**	0.04	0.30	0.39*
Sig			0.12	0.00	0.79	0.07	0.02
THS Pearson Correlation			1	-0.37*	-0.26	0.04	0.02
Sig				0.02	0.12	0.81	0.90
PHM Pearson Correlation				1	-0.02	0.24	0.41**
Sig					0.92	0.15	0.01
THW Pearson Correlation					1	-0.01	-0.20
Sig						0.98	0.15
pH soil Pearson Correlation						1	0.25
Sig							0.13
Org mat soil Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Cu=copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 131. Correlation Coefficient between the copper of the shoots, roots of *Corchorus olitorius* accession NG/OA/Jun/09/002 total copper in soil, phyto available copper in soil, total copper in water and some physico chemical properties of soil in the second dry season (2016).

	CuS	CuR	THS	PHS	THW	pH	Org Mat.
CuS Pearson Correlation	1	0.33*	0.02	0.03	-0.15	-0.23	-0.12
Sig. (2-tailed)		0.04	0.93	0.88	0.38	0.16	0.49
N							
CuR Pearson Correlation		1	0.09	-0.09	0.21	-0.08	-0.01
Sig. (2-tailed)			0.60	0.60	0.21	0.61	0.95
N							
THS Pearson Correlation			1	0.18	-0.24	-0.17	-0.15
Sig. (2-tailed)				0.28	0.14	0.30	0.35
N							
PHS Pearson Correlation				1	-0.01	0.20	0.05
Sig. (2-tailed)					0.97	0.22	0.75
N							
THW Pearson Correlation					1	-0.16	0.03
Sig. (2-tailed)						0.35	0.85
N							
pH Pearson Correlation							0.31*
Sig. (2-tailed)						1	0.04
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level (2 tailed). * correlation is significant at the 0.05 level(2 tailed).CuS=copper in shoot. CuR=copper in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH. = hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 132: Correlation between copper concentration of *Corchorus olitorius* NG/OA/Jun/09/002 THMS , PHS, THW, pH and organic matter of soil in the first rainy season (2016).

	Cu shoot	Cu root	THS	PHS	THW	pH	ORG. MAT
Cu shoot Pearson Correlation	1	0.83**	0.92**	0.87**	-0.11	-0.07	-0.06
Sig		0.00	0.00	0.00	0.51	0.68	0.72
Cu root Pearson Correlation		1	0.94**	0.88**	0.06	0.14	0.13
Sig			0.00	0.00	0.72	0.39	0.43
THMS Pearson Correlation			1	0.95**	0.01	0.08	0.07
Sig				0.00	0.96	0.63	0.67
PHS Pearson Correlation				1	0.01	-0.08	-0.09
Sig					0.96	0.63	0.57
THW Pearson Correlation					1	0.29	0.29
Sig						0.08	0.07
pH Pearson Correlation						1	0.90**
Sig							0.00
ORG MAT Pearson Correlation							1
Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cu S=Copper in shoot; Cu R= Copper in root.

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 133: Correlation between copper concentration of *Corchorus olitorius* NG/OA/Jun/09/002 THMS , PHS, THW, pH and organic matter of soil in the second rainy season (2017).

		Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot	Pearson Correlation	1	-0.13	0.14	-0.30	0.11	-0.16	0.08
	Sig		0.44	0.41	0.07	0.52	0.34	0.63
Curoot	Pearson Correlation		1	0.54’’	-0.17	0.17	-0.26	-0.21
	Sig			0.00	0.32	0.29	0.11	0.20
THMS	Pearson Correlation			1	-0.24	0.11	0.30	-0.19
	Sig				0.14	0.50	0.07	0.24
PHS	Pearson Correlation				1	-0.05	0.17	0.19
	Sig					0.74	0.31	0.25
THW	Pearson Correlation					1	0.08	0.18
	Sig						0.61	0.28
pH	Pearson Correlation						1	0.37’’
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

,, correlation is significant at the 0.01level (2-tailed) . , correlation is significant at the 0.05level (2-tailed)

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 134 : Correlation between copper concentration of *Corchorus olitorius* NG/04/010 , THS ,PHS ,THW, pH and organic matter of soil first dry season(2015).

	Cu shoot	Cu root	THS	PHS	THW	pH soil	Org. mat soil
Cu shoot Pearson Correlation	1	0.32*	-0. 20	0.31	0.09	0.34*	-0.03
Sig		0.05	0.21	0.06	0.59	0.04	0.88
Cu root Pearson Correlation		1	-0.24	0.91**	0.06	0.44**	0.49**
Sig			0.14	0.00	0.74	0.01	0.01
THS Pearson Correlation			1	-0.30*	-0.26	0.04	0.02
Sig				0.02	0.12	0.81	0.90
PHM Pearson Correlation				1	-0.02	0.24	0.41**
Sig					0.96	0.15	0.01
THW Pearson Correlation					1	-0.01	-0.23
Sig						0.98	0.15
pH soil Pearson Correlation						1	0.25
Sig							0.13
Org. mat soil Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Cu=copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 135: Correlation between the copper concentration of Corchorus olitorius NG/OA/04/010 THMS, PHS, THW, pH and organic matter of soil in the second dry season (2016).

		Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot	Pearson Correlation	1	-0.07	-0.08	0.17	-0.20	-0.09	-0.26
	Sig		0.68	0.62	0.30	0.22	0.60	0.11
Cu root	Pearson Correlation		1	0.70**	-0.22	0.04	0.10	-0.24
	Sig			0.00	0.18	0.83	0.55	0.15
THMS	Pearson Correlation			1	-0.24	0.11	-0.30	-0.19
	Sig				0.14	0.50	0.07	0.23
PHS	Pearson Correlation				1	-0.05	0.17	0.19
	Sig					0.74	0.31	0.25
THW	Pearson Correlation					1	0.08	0.18
	Sig						0.61	0.28
pH	Pearson Correlation						1	0.39*
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

,, correlation is significant at the 0.01level (2-tailed) . , correlation is significant at the 0.05level (2-tailed)

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 136: Correlation between the copper concentration of *Corchorus olitorius* NG/OA/04/010 THMS , PHS, THW, pH and organic matter of soil in the first rainy season (2016)

	Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot Pearson Correlation	1	0.62**	0.72**	0.73**	0.01	-0.13	0.14
Sig		0.00	0.00	0.00	0.98	0.54	0.40
Cu root Pearson Correlation		1	0.77**	0.85**	-0.07	0.27	0.25
Sig			0.00	0.00	0.66	0.10	0.13
THMS Pearson Correlation			1	0.95**	0.01	-0.08	-0.09
Sig				0.00	0.94	0.63	0.57
PHS Pearson Correlation				1	0.01	0.08	0.07
Sig					0.94	0.63	0.67
THW Pearson Correlation					1	0.28	0.27
Sig						0.08	0.08
pH Pearson Correlation						1	0.79**
Sig							0.00
ORG MAT Pearson Correlation							1
Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Cu S=Copper in shoot; Cu R= Copper in root.

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 142 shows the correlation between lead concentration of *Amaranthus hybridus* accession NG/AO/11/08/039, soil, water and physico chemical parameters of soil first dry season season (2015) (Table 142). There were strong positive significant correlation between the lead content of the shoot of the accession, the lead concentration in the root (r=0.56**) and $p \leq 0.00$, the total lead in soil (r=0.54**) and $p \leq 0.00$, the phytoavailable lead in the soil (r=0.60**) and $p \leq 0.00$ and the soil pH at (r=0.43**) at $p \leq 0.01$(Table 142).

Lead concentration of the root of the accession had a strong positive correlation with the total lead in soil (r=0.37*) at $p \leq 0.02$, phytoavailable lead in soil(r=0.45**) at $p \leq 0.00$, soil pH (r=0.36*) at $p \leq 0.02$ and soil organic matter (r-0.59**) at $p \leq 0.00$ showing significant strong adverse influence (Table 142). The total lead in the soil had strong significant positive correlation with the phytoavailable lead in the soil (r=0.42**) at $p \leq 0.01$ and the soil pH (r=0.65**) and $p \leq 0.00$ indicating very strong positive interaction (Table 142). The phytoavailable lead in the soil had a significant negative correlation with the total lead content in water (r= - 0.37*) at $p \leq 0.02$(Table 142). Table 143 shows that Lead content of the shoot had posivite significance with the Lead content of the root of *Amaranthus hybridus* accession NG/OA/11/08/039 (r=0.92**) at $p \leq 0.00$ in the second dry season (2016) (Table 144). The Pb content in the root was significantly positive with the phyto available metal in soil (r=0.32*) at $p \leq 0.05$ indicating low positive interaction.

Table 137: Correlation between the copper concentration of *Corchorus olitorius* NG/OA/04/010 THMS , PHS, THW, pH and organic matter of soil in the second rainy season (2017)

	Cu shoot	Cu root	THMS	PHS	THW	pH	ORG. MAT
Cu shoot Pearson Correlation	1	-0.07	-0.08	0.17	-0.20	-0.09	-0.26
Sig		0.68	0.62	0.30	0.22	0.60	0.11
Cu root Pearson Correlation		1	0.70**	-0.22	0.04	0.10	-0.24
Sig			0.00	0.18	0.83	0.55	0.15
THMS Pearson Correlation			1	-0.24	0.11	-0.30	-0.19
Sig				0.14	0.50	0.07	0.23
PHS Pearson Correlation				1	-0.05	0.17	0.19
Sig					0.74	0.31	0.25
THW Pearson Correlation					1	0.08	0.18
Sig						0.61	0.28
pH Pearson Correlation						1	0.39**
Sig							0.01
ORG MAT Pearson Correlation							1
Sig							

,, correlation is significant at the 0.01level (2-tailed). , correlation is significant at the 0.05level (2-tailed)

Cu=Copper. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 138: Correlation between lead concentration of *Amaranthus hybridus* NG/AA/03/11/010 THS, PHS ,THW,pH and organic matter of soil first dry (2015).

	Pb shoot	Pbroot	THS	PHS	THW	pH soil	Org. mat soil
Pb shoot Pearson Correlation	1	0.15	0.44**	0.58**	-0.27	0.46**	-0.24
Sig		0.40	0.01	0.00	0.10	0.00	0.15
Pb root Pearson Correlation		1	0.27	0.66**	-0.35*	0.46**	0.58**
Sig			0.10	0.00	0.03	0.00	0.00
THS Pearson Correlation			1	0.42**	0.08	0.65**	0.06
Sig				0.00	0.62	0.00	0.72
PHS soil Pearson Correlation				1	-0.37*	0.31	0.13
Sig					0.02	0.06	0.45
THW Pearson Correlation					1	-0.10	-0.07
Sig						0.54	0.65
pH soil Pearson Correlation						1	0.24
Sig							0.14
Org. mat soil Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 139. Correlation Coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NG/AA/03/11/010 total Lead in soil, phyto available Lead in soil, total Lead in water and some physico chemical properties of soil second dry season (2016) .

		PbS	PbR	THS	PHS	THW	pH	Org Mat.
PbS	Pearson Correlation	1	0.91**	0.15	0.33*	0.03	0.08	0.03
	Sig. (2-tailed)		0.00	0.36	0.04	0.87	0.64	0.84
	N							
PbR	Pearson Correlation		1	0.21	0.24	0.09	-0.07	0.01
	Sig. (2-tailed)			0.21	0.15	0.60	0.66	0.97
	N							
THS	Pearson Correlation			1	0.05	0.21	0.25	0.26
	Sig. (2-tailed)				0.75	0.21	0.13	0.11
	N							
PHS	Pearson Correlation				1	0.26	0.15	-.019
	Sig. (2-tailed)					0.13	0.35	0.25
	N							
THW	Pearson Correlation					1	-0.12	-0.21
	Sig. (2-tailed)						0.46	0.20
	N							
pH	Pearson Correlation						1	0.58**
	Sig. (2-tailed)							0.00
	N							
Org.Mat	Pearson Correlation							1
	Sig. (2-tailed)							
	N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).PbS=Lead in shoot.

PbR=Lead in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 140: Correlation coefficient of Lead content of *Amaranthus hybridus* NG/AA/03/11/010 , THS, PHS, THW, pH and organic matter of soil first rainy season (2016).

		Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot	Pearson Correlation	1	0.63**	0.71**	0.85**	0.06	0.11	0.11
	Sig		0.00	0.00	0.00	0.70	0.50	0.50
Pb root	Pearson Correlation		1	0.65**	0.87**	0.30**	-0.21	-0.24
	Sig			0.00	0.00	0.00	0.19	0.15
THMS	Pearson Correlation			1	0.86**	0.03	0.29	0.25
	Sig				0.00	0.88	0.07	0.13
PHS	Pearson Correlation				1	0.27	0.11	0.07
	Sig					0.10	0.49	0.68
THW	Pearson Correlation					1	-0.01	-0.68
	Sig						0.97	0.68
pH	Pearson Correlation						1	0.86**
	Sig							0.00
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 141: Correlation between Lead content of *Amaranthus hybridus* NG/AA/03/11/010 ,THS, PHS,THW , pH and organic matter of soil in the second rainy season (2017).

	Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot Pearson Correlation	1	-0.02	-0.05	-0.17	-0.17	-0.11	0.09
Sig		0.92	0.77	0.29	0.31	0.50	0.60
Pb root Pearson Correlation		1	-0.04	-0.13	0.15	-0.79	-0.12
Sig			0.83	0.44	0.35	0.64	0.45
THMS Pearson Correlation			1	0.13	0.09	-0.24	-0.28
Sig				0.43	0.59	0.14	0.08
PHS Pearson Correlation				1	-0.18	-0.12	-0.28
Sig					0.29	0.45	0.08
THW Pearson Correlation					1	-0.03	-0.04
Sig						0.87	0.82
							0.07
pH Pearson Correlation						1	0.68
Sig							
ORG MAT Pearson Correlation							1
Sig							

** correlation is significant at the 0.01level (2-tailed) .

Table 142 : Correlation between lead concentration of *Amaranthus hybridus* NG/AO/11/08/039, THS ,PHS, THW pH and organic matter of soil in the first dry season (2015).

	Pb shoot	Pb root	THS	PHS	THW	pH soil	Org. mat soil
Pb shoot Pearson Correlation	1	0.56**	0.54**	0.60**	-0.16	0.43*	0.06
Sig		0.00	0.00	0.00	0.33	0.01	0.70
Pb root Pearson Correlation		1	0.37*	0.45**	-0.28	0.36*	0.59**
Sig			0.02	0.00	0.09	0.02	0.00
THS Pearson Correlation			1	0.42**	0.08	0.65**	0.06
Sig				0.01	0.63	0.00	0.72
PHS soil Pearson Correlation				1	-0.37*	0.31	0.13
Sig					0.02	0.06	0.45
THW Pearson Correlation					1	-0.10	-0.74
Sig						0.54	0.65
pH soil Pearson Correlation						1	0.24
Sig							0.14
Org. mat soil Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 143. Correlation Coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NG/OA/11/08/039 total Lead in soil, phyto available Lead in soil, total Lead in water and some physico chemical properties of soil in the second dry season (2016).

	PbR	PbS	PHS	THS	THW	pH	Org Mat.
PbS Pearson Correlation	1	0.92**	0.22	0.23	0.06	0.05	0.06
Sig. (2-tailed)		0.00	0.17	0.17	0.71	0.82	0.70
N							
PbR Pearson Correlation		1	0.13	0.32*	0.11	0.00	0.06
Sig. (2-tailed)			0.42	0.05	0.50	0.99	0.73
N							
THS Pearson Correlation			1	0.05	0.21	0.25	0.26
Sig. (2-tailed)				0.75	0.21	0.13	0.11
N							
PHS Pearson Correlation				1	0.25	0.15	-0.19
Sig. (2-tailed)					0.13	0.35	0.25
N							
THW Pearson Correlation					1	-0.12	-0.22
Sig. (2-tailed)						0.46	0.20
N							
Org.Mat Pearson Correlation						1	0.41*
Sig. (2-tailed)							0.03
N							
pH Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).PbS=Lead in shoot. PbR=Lead in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil. THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

The soil organic matter had positive significant correlation with the soil pH ($r=0.41^*$) at $p \leq 0.04$ showing low positive interaction in the second dry season (2016) (Table 143). Table 144 shows the correlation between Lead content of *Amaranthus hybridus* NG/AO/11/08/039 ,THS, PHS,THW, pH and organic matter of soil in the first rainy season (2016). There were significant positive correlation between the Pb content of the shoot ($r=0.58^{**}$) at $p \leq 0.00$ showing very strong positive interaction, the total heavy metal soil ($r=0.67^{**}$) at $p \leq 0.00$ and the phyto available heavy metal soil ($r=0.80^{**}$) at $p \leq 0.00$ (Table 144). Pb content of the root had a significant positive correlation with the total heavy metal soil($r=0.66^{**}$) at $p \leq 0.00$ indicating very strong positive interaction and a significant positive correlation with the phyto available heavy metal soil ($r=0.83^{**}$) at $p \leq 0.00$ (Table 144). Total heavy metal soil had a significant positive correlation with the phytoavailable heavy metal in soil ($r=0.88^{**}$) at $p \leq 0.00$ suggesting very strong positive interaction. The soil pH had a significant positive correlation with soil organic matter ($r=0.94^{**}$) at $p \leq 0.00$ (Table 144).

Table 145 presents the correlation between Lead content of *Amaranthus hybridus* NG/AO/11/08/039 ,THS, PHS, THW, pH and organic matter of soil second rainy season (2017). Significant positive correlation between the Lead content of the shoot of the vegetable accession and the total Pb content in the water used for irrigating the vegetable accession ($r=0.33^{**}$) at $p \leq 0.04$. There was a significant negative correlation between the Pb content in the root of the accession and the soil pH ($r= - 0.40^{**}$) at $p \leq 0.01$ and the total heavy metal in soil at ($r=0.38^{**}$) at $p \leq 0.01$(Table 145). Table 146 shows the correlation between lead concentration of *Amaranthus hybridus* NGBO125, soil, water and physico chemical parameters of soil in the first dry season (2015). Lead concentration of the shoot had strong positive correlations with the lead concentration of the root ($r=0.50^{**}$) at $p \leq 0.00$ showing very strong interaction, phytoavailable lead of the soil ($r=0.45^{**}$) at $p \leq$, 0.00, soil pH ($r=0.56^{**}$) and $p \leq 0.00$, and soil organic matter ($r=0.45^{**}$) and $p \leq 0.00$ and a significant negative correlation with the total heavy metal water ($r= -0.37$) at $p \leq 0.00$ (Table 146). The Pb content in the root had significant positive correlation with the total heavy metal in soil ($r=0.47^{**}$) at $p \leq 0.00$, the phyto available heavy metal in soil ($r=0.57^{**}$) at $p \leq 0.00$, the soil pH ($r=0.41^{**}$) at $p \leq 0.01$ and the soil organic matter ($r=0.41^{**}$) at $p \leq 0.00$(Table 146).

Total heavy metal in soil had significant positive correlation with the phytoavailable heavy metal in soil (r= 0. 42**) at $p \leq 0.00$ and the soil pH (r= 0.65**) at $p \leq 0.00$ indicating strong positive interaction. Phytoavailable heavy metal of soil had a significant negative correlation with the total heavy metal in water (r= -0.37*) at $p \leq 0.02$ (Table 146). Table 147 shows Lead content of the shoot of *Amaranthus hybridus* accession NGBO125 had a positive significant correlation with the Pb content of the root (r=0.90**) at $p \leq 0.00$ in the second dry season (2016) (Table 147). The soil organic matter had a significant positive correlation with the soil pH (r=0.40*) at $p \leq 0.02$ in the second dry season (2016) (Table 147). Table 148 presents the correlation coefficient between Lead content of *Amaranthus hybridus* accession NGO 125 ,THS, PHS,THW , pH and organic matter of soil first rainy season (2016). There were significant positive correlation between the Pb content of the shoot, the Pb content of the root (r=0.66**) at $p \leq 0.01$ indicating very strong interaction that enhanced Pb translocation from the root to the shoot of the accession, the total heavy metal soil (r=0.72**) at $p \leq 0.00$ and the phyto available heavy metal of the soil (r=0.82**) at $p \leq 0.00$ (Table 148). The Pb content of the root had a significant positive correlation with the total heavy metal of soil (r= 0.49**) at $p \leq 0.00$ (Table 148). The total heavy metal of the soil had a significant correlation with the phytoavailable heavy metal of the soil (r=0.86**) at $p \leq 0.00$ (Table 148).

The soil pH had a significant positive correlation with the soil organic matter (r=0.39*) at $p \leq 0.04$ showing low significant positive interaction of soil pH enhancing the activities of the soil oranic matter (Table 148). Table 149 shows the correlation between Lead content of *Amaranthus hybridus* NGO 125, THS, PHS, THW, pH and organic matter of soil in the second rainy season (2017). There was significant positive correlation between the Pb content of the shoot and the Pb content in the root of the accession (r = 0.71**) at $p \leq 0.00$ suggesting very strong significant positive interaction facilitating Pb translocation from the root to the shoot and the soil organic matter (r= 0.40**) at $p \leq 0.01$(Table 149). Table 150 shows the correlation between lead concentration of *Corchorus olitorius* accession NG/OA/Jun/09/002, soil, water and physico chemical parameters of soil in the first dry season (2015). Lead concentration in the shoot of the accession had strong significant positive correlation with the lead concentration of the root of the accession (r= 0.79**) at $p \leq 0.00$, the total lead content in soil (r= 0.44**) at $p \leq 0.01$, the phytoavailable lead of the soil (r=0.68**) at $p \leq .00$ and the soil pH (r= 0.48**) at $p \leq 0.00$ (Table 150**).**

Lead concentration of the root of the accession had strong significant positive correlation with the total lead in soil ($r=0.51^{**}$) at $p \leq 0.00$ and the phyto available copper of soil ($r= 0.67^{**}$) at $p \leq 0.00$. Total lead concentration of the soil had strong significant positive correlation with the phytoavailable lead content of the soil ($r=0.42^{**}$) at 0.00 and the soil pH ($r=0.62^{**}$) at $p \leq 0.01$ (Table 150). The phytoavailable lead of the soil used to raise the accession had a significant negative correlation with the total available lead content of water ($r= - 0.37^{*}$) $p \leq 0.02$ (Table 150). Table 151 presents the Lead content of Corchorus olitorius NG/OA/jun/09/002,THS, PHS,THW , pH and physic o chemical properties of soil in the second dry season (2016) (Table 151). There was a significant positive correlation between the Pb content of the shoot and the Pb content of the root of the accession ($r=0.51^{**}$) at $p \leq 0.00$ (Table 151). There was a significant positive correlation between the total Pb content in the water and the the soil pH (0.45^{**}) at $p \leq 0.03$ showing low interaction. Significant positive correlation between the soil pH and the soil organic matter ($r=0.39^{**}$) at $p \leq 0.01$ was recorded (Table 151). Table 152 shows the correlation between Lead content of *Corchorus olitorius* accession NG/OA/jun/09/002, THS, PHS,THW , pH and organic matter of soil in the first rainy season (2016) (Table 152). There were significant positive correlation between the Pb content of the shoot, the Pb content of the root ($r=0.58^{**}$) and $p \leq 0.01$ showing positive interaction enhancing Pb translocation from the root to shoot, the total heavy metal in soil ($r=0.75^{**}$) at $p \leq 0.00$ and the phytoavailable heavy metal of soil at ($r=0.77^{**}$) at $p \leq 0.00$ (Table 152).

The Pb content of the root had significant positive correlation with the phytoavailable heavy metal soil ($r=0.57^{**}$) at $p \leq 0.00$ and with total heavy metal of water ($r=0.31^{*}$) at $p \leq 0.05$ (Table 152). There was significant positive correlation between the total heavy metal of soil and the phytoavailable heavy metal of the soil ($r=0.86^{**}$) at $p \leq 0.00$. Soil pH had a significant positive correlation with the organic matter of the soil at ($r=0.33^{*}$) at $p \leq 0.02$ (Table 152). Table 153 shows the correlation between Lead content of *Corchorus olitorius* accession NG/OA/jun/09/002, THS, PHS,THW , pH and organic matter of soil in the second rainy season (2017).

There was a significant positive correlation between the Pb content of the shoot and the Pb content of the root of the accession ($r=0.51^{**}$) at $p \leq 0.01$ signifies the possible common pollution source of the roots and the shoots (Table 153). Negative correlation was recorded between the Pb content of the shoot of the accession and the soil organic matter ($r=0.35^{**}$) at $p\leq0.01$ (Table 153). Table 154 shows the correlation between lead concentration in the shoot, root, phytoavailable Pb in soil, total Pb in soil, total Pb in water used to raise and irrigate the vegetable accession of *Corchorus olitorius* NG/OA/04/010, and physico chemical parameters of soil in the first dry season (2015). Lead concentration of the shoot of the accession had strong positive correlation with the lead concentration of the root ($r= 0.71^{**}$) at $p\leq 0.0$ very strong positive interaction, total copper concentration of the soil ($r=0.50^{**}$) at $p\leq0.00$, phytoavailable lead in the soil ($r= 0.33^{*}$) at $p \leq 0.04$ and the soil pH ($r=0.69^{**}$) at $p\leq0.00$ (Table 154). The lead concentration of the root had strong positive correlation with the total lead of soil ($r=0.45^{**}$) at $p\leq0.00$, the phyto available lead in soil ($r=0.40^{**}$) at $p\leq0.01$ and the soil pH ($r=0.66^{**}$) at $p \leq 0.01$(154). Total lead concentration in the soil had strong significant positive correlation with the phytoavailable lead of the soil ($r=0.41^{**}$) at $p\leq0.01$ and the soil pH at $r=0.65^{**}$ and $p \leq 0.00$ (Table 154). Phy toavailable lead of the soil had significant negative correlation with the total lead content of water ($r= -0.37^{*}$) at $p \leq 0.02$ showing moderate negative interaction in the first dry dry season (2015) (Table 154).

Table 155 shows the Lead content of the shoot of Corchorus olitorius accession NG/OA/04/010 had significant positive correlation with the Lead content of the shoot ($r=0.81^{**}$) at $p \leq0.00$ and with the phytoavailable heavy metal ($r=0.33^{*}$) at $p \leq0.03$ showing moderate positive interaction in the second dry season (2016) (Table 155). The soil pH had a significant positive correlation with the soil organic matter ($r=0.34^{*}$) at $p\leq0.02$ in the second dry season (2016) (Table 155). Table 156 presents the correlation between Lead content of *Corchorus olitorius* accession NG/OA/04/010, THS, PHS, THW, pH and organic matter of soil in the first rainy season (2016) (Table 156). There were significant positive correlation between the Pb content of the shoot, the Pb content of the root ($r=0.34^{*}$) at $p \leq0.03$ showing moderate positive interaction that enhanced Pb translocation, total heavy metal of the soil ($r=0.73^{**}$) at $p \leq0.00$ indicating very strong positive interaction and the phytoavailable heavy metal ($r=0.66^{**}$) at $p\leq0.00$ (Table 156).

Table 144: Correlation between Lead content of *Amaranthus hybridus* NG/AO/11/08/039 ,THS, PHS,THW , pH and organic matter of soil in the first rainy(2016).

		Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot	Pearson Correlation	1	0.58**	0.67**	0.80**	0.09	0.17	0.13
	Sig		0.00	0.00	0.00	0.60	0.30	0.42
Pb root	Pearson Correlation		1	0.66**	0.83**	0.34	-0.15	-0.20
	Sig			0.00	0.00	0.04	0.35	0.23
THMS	Pearson Correlation			1	0.88**	0.03	0.29	0.25
	Sig				0.00	0.88	0.07	0.13
PHS	Pearson Correlation				1	0.27	0.11	0.07
	Sig					0.10	0.49	0.68
THW	Pearson Correlation					1	-0.01	-0.68
	Sig						0.97	0.68
pH	Pearson Correlation						1	0.94**
	Sig							0.00
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 145: Correlation between Lead content of *Amaranthus hybridus* NG/AO/11/08/039 ,THS, PHS, THW, pH and organic matter of soil in second rainy season(2017).

	Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot Pearson Correlation	1	0.07	0.16	0.21	0.33*	0.03	0.25
Sig		0.66	0.33	0.21	0.04	0.86	0.13
Pb root Pearson Correlation		1	0.34*	-0.02	0.01	-0.40**	-0.04
Sig			0.03	0.91	0.95	0.01	0.79
THMS Pearson Correlation			1	0.13	0.08	-0.24	-0.28
Sig				0.43	0.59	0.14	0.08
PHS Pearson Correlation				1	-0.18	-0.13	-0.04
Sig					0.29	0.45	0.82
THW Pearson Correlation					1	-0.03	0.07
Sig						0.86	0.68
pH Pearson Correlation						1	0.38**
Sig							0.01
ORG MAT Pearson Correlation							1
Sig							

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 146: Correlation between lead concentration of *Amaranthus hybridus* NGBO125 ,THS ,PHS, THW, pH and organic matter of soil in the first dry season(2015)..

	Pb shoot	Pb root	THS	PHS	THW	pH soil	Org. mat soil
Pb shoot Pearson Correlation	1	0.50**	0.30	0.45**	-0.37**	0.56**	0.45**
Sig		0.00	0.07	0.00	0.02	0.00	0.01
Pb root Pearson Correlation		1	0.47**	0.57**	-0.00	0.41**	0.41**
Sig			0.00	0.00	0.99	0.01	0.01
THS Pearson Correlation			1	0.42**	0.08	0.65**	0.06
Sig				0.00	0.62	0.00	0.72
PHS Pearson Correlation				1	-0.37*	0.31	0.13
Sig					0.02	0.06	0.45
THW Pearson Correlation					1	-0.10	-0.07
Sig						0.54	0.65
pH Pearson Correlation						1	0.24
Sig							0.14
Org. mat soil Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 147: Correlation Coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NGBO125 total Lead in soil, phyto available Lead in soil, total Lead in water and some physico chemical properties of soil in the second dry season(2016).

		PbS	PbR	PHS	THS	THW	pH	Org Mat.
PbS	Pearson Correlation	1	0.90**	0.19	0.29	0.15	0.05	0.06
	Sig. (2-tailed)		0.00	0.24	0.08	0.36	0.76	0.81
	N							
PbR	Pearson Correlation		1	0.18	0.24	0.10	0.12	0.12
	Sig. (2-tailed)			0.26	0.14	0.57	0.48	0.44
	N							
THS	Pearson Correlation			1	0.05	0.21	0.25	0.26
	Sig. (2-tailed)				0.75	0.19	0.13	0.11
	N							
PHS	Pearson Correlation				1	0.25	0.15	0.19
	Sig. (2-tailed)					0.13	0.35	0.25
	N							
THS	Pearson Correlation					1	-0.12	-0.21
	Sig. (2-tailed)						0.46	0.18
	N							
pH	Pearson Correlation						1	0.40*
	Sig. (2-tailed)							0.02
	N							
Org.Mat	Pearson Correlation							1
	Sig. (2-tailed)							
	N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).PbS=Lead in shoot. PbR=Lead in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter of soil.

Table 148 : Correlation between Lead content of *Amaranthus hybridus* NGO 125 ,THS, PHS,THW , pH and organic matter of soil the first rainy season(2016).

		Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot	Pearson Correlation	1	0.66**	0.72**	0.82**	-0.01	0.18	0.16
	Sig		0.01	0.00	0.00	0.94	0.28	0.34
Pb root	Pearson Correlation		1	0.49**	0.77	0.23	0.10	0.07
	Sig			0.00	0.00	0.17	0.56	0.67
THMS	Pearson Correlation			1	0.86**	0.03	0.29	0.25
	Sig				0.00	0.88	0.07	0.13
PHS	Pearson Correlation				1	0.27	0.11	0.07
	Sig					0.10	0.49	0.07
THW	Pearson Correlation					1	-0.01	-0.07
	Sig						0.97	0.68
pH	Pearson Correlation						1	0.39*
	Sig							0.04
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 149: Correlation between Lead content of *Amaranthus hybridus* NGO 125 ,THS, PHS, THW , pH and organic matter of soil in the second rainy season (2017).

	Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot Pearson Correlation	1	0.71’’	-0.10	0.07	-0.08	-0.27	-0.25
Sig		0.00	0.53	0.69	0.64	0.10	0.13
Pb root Pearson Correlation		1	0.11	0.18	-0.03	-0.30	-0.22
Sig			0.51	0.29	0.88	0.07	0.17
THMS Pearson Correlation			1	0.13	0.09	-0.24	-0.28
Sig				0.43	0.59	0.14	0.08
PHS Pearson Correlation				1	-0.18	-0.13	-0.04
Sig					0.29	0.45	0.82
THW Pearson Correlation					1	-0.03	0.07
Sig						0.86	0.68
pH Pearson Correlation						1	0.40’’
Sig							0.01
ORG MAT Pearson Correlation							1
Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 150: Correlation between lead concentration of *Corchorus olitorius* NG/OA/Jun/09/002 , THS, PHS , THW , pHand organic matter of soil in the first dry season(2015) .

	Pb shoot	Pb root	THS	PHS	THW	pH soil	Org. mat soil
Pbshoot Pearson Correlation	1	0.79**	0.44**	0.68**	-0.27	0.48**	0.07
Sig		0.00	0.01	0.00	0.10	0.00	0.68
Pb root Pearson Correlation		1	0.51**	0.67**	-0.18	0.30	0.16
Sig			0.00	0.00	0.28	0.07	0.33
THS soil Pearson Correlation			1	0.42**	0.08	0.65**	0.06
Sig				0.01	0.62	0.00	0.72
PHS soil Pearson Correlation				1	-0.37*	0.31	0.13
Sig					0.02	0.06	0.45
THW Pearson Correlation					1	-0.10	-0.07
Sig						0.54	0.65
pH soil Pearson Correlation						1	0.24
Sig							0.14
Org. mat soil Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 151. Correlation between Lead content of Corchorus olitorius NG/OA/jun/09/002 ,THS, PHS,THW , pH and organic matter of soil second dry season(2016).

		Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot	Pearson Correlation	1	0.51’’	-0.03	0.13	0.09	0.05	-0.22
	Sig		0.00	0.87	0.45	0.57	0.76	0.90
Pb root	Pearson Correlation		1	-0.04	0.01	0.20	0.06	0.06
	Sig			0.81	0.86	0.22	0.70	0.71
THMS	Pearson Correlation			1	0.13	0.09	-0.24	-0.28
	Sig				0.43	0.59	0.14	0.08
PHS	Pearson Correlation				1	-0.18	-0.13	-0.04
	Sig					0.29	0.45’	0.82
THW	Pearson Correlation					1	0.03	0.07
	Sig						0.86	0.68
pH	Pearson Correlation						1	0.39’’
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 152: Correlation between Lead content of *Corchorus olitorius NG/OA/jun/09/002* ,THS, PHS,THW , pH and organic matter of soil in the first rainy season(2016).

		Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot	Pearson Correlation	1	0.58**	0.75**	0.77**	-0.25	0.20	0.18
	Sig		0.01	0.00	0.00	0.88	0.21	0.28
Pb root	Pearson Correlation		1	0.30	0.57**	0.31*	-0.26	-0.29
	Sig			0.07	0.00	0.05	0.11	0.07
THMS	Pearson Correlation			1	0.86**	0.03	0.29	0.25
	Sig				0.00	0.26	0.07	0.13
PHS	Pearson Correlation				1	0.88	0.11	-0.07
	Sig					0.26	0.49	0.68
						0.10	-0.01	-0.07
						1	0.97	0.68
THW	Pearson Correlation					1	1	0.33*
	Sig							0.02
pH	Pearson Correlation						1	1
	Sig							
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 153: Correlation between Lead content of *Corchorus olitorius* NG/OA/jun/09/002 ,THS, PHS,THW , pH and organic matter of soil in the second rainy season.

		Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot	Pearson Correlation	1	0.51**	-0.03	0.13	0.09	0.05	-0.22
	Sig		0.00	0.87	0.45	0.57	0.76	0.90
Pb root	Pearson Correlation		1	-0.04	0.01	0.20	0.06	0.06
	Sig			0.81	0.86	0.22	0.70	0.71
THMS	Pearson Correlation			1	0.13	0.09	-0.24	-0.28
	Sig				0.43	0.59	0.14	0.08
PHS	Pearson Correlation				1	-0.18	-0.13	-0.04
	Sig					0.29	0.45	0.82
THW	Pearson Correlation					1	0.03	0.07
	Sig						0.86	0.68
pH	Pearson Correlation						1	0.39**
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

There were significant positive correlation between the Pb content of the root, total heavy metal of the soil ($r=0.32^*$) at $p \leq 0.04$ suggesting low positive interaction in the first rainy season and the phytoavailable heavy metal ($r=0.49^{**}$) at $p \leq 0.00$.The total heavy metal of the soil had a significant positive correlation with the phytoavailable heavy metal soil ($r=0.86^{**}$) at $p \leq 0.00$. The soil pH had a significant positive correlation with the soil organic matter ($r=0.49$) at $p \leq 0.00$ (Table 156).

Table 157 shows the correlation between Lead content of *Corchorus olitorius* accession NG/OA/04/010, THS, PHS, THW, pH and organic matter of soil in the second rainy season (2017). There was significant positive correlation between the total Pb content of the the shoot and the total Pb content in the root ($r=0.35^*$) at $p \leq 0.03$ showing low positive interaction in the second rainy season (Table 157). Significant positive correlation was recorded between the Pb content of the root and the total heavy metal in water ($r= 0.43^{**}$) at $p \leq 0.01$(Table 157). Significant positive correlation between the soil pH and the soil organic matter ($r=0.39^{**}$) at $p \leq 0.01$ was recorded (Table 157). There was significant positive correlation between the total Pb content of the the shoot and the total Pb content in the root ($r=0.35^*$) at $p \leq 0.03$ showing low positive interaction in the second rainy season (Table 157). Significant positive correlation was recorded between the Pb content of the root and the total heavy metal in water ($r= 0.43^{**}$) at $p \leq 0.01$(Table 157). Significant positive correlation between the soil pH and the soil organic matter ($r=0.39^{**}$) at $p \leq 0.01$ was recorded (2017).

Table 154 : Correlation between lead concentration of *Corchorus olitorius* NG/OA/04/010 ,THS. PHS, THW, pH and organic of soil in the first dry season (2015).

	Pb shoot	Pb root	THMS	PHS	TMW	pH of soil	ORG.MAT soil
Pb shoot Pearson Correlation	1	0.71**	0.50**	0.33*	-0.05	0.69**	-0.07
Sig		0.00	0.00	0.04	0.79	0.00	0.68
Pb root Pearson Correlation		1	0.45**	0.40**	-0.18	0.66**	0.22
Sig			0.00	0.01	0.26	0.00	0.18
THMS Pearson Correlation			1	0.41**	0.08	0.65**	0.06
Sig				0.01	0.62	0.00	0.72
PHS Pearson Correlation				1	-0.37*	0.31	0.13
Sig					0.02	0.06	0.45
THWPearson Correlation					1	-0.10	-0.07
Sig						0.54	0.65
pH Pearson Correlation						1	0.24
Sig							0.14
Org. mat soil Pearson Correlation							1
Sig							

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matte

Table 155. Correlation Coefficient between the Lead of the shoots, roots of *Corchorus olitorius* accession NG/OA/04/010 total Lead in soil, phyto available Lead in soil, total Lead in water and some physico chemical properties of soil in the second dry season (2016).

	PbS	PbR	THS	PHS	THW	pH	Org Mat.
PbS Pearson Correlation	1	0.81**	0.11	0.33*	0.13	0.08	-0.05
Sig. (2-tailed)		0.00	0.59	0.03	0.64	0.81	0.90
N							
PbR Pearson Correlation		1	0.20	0.27	0.17	-0.16	0.12
Sig. (2-tailed)			0.21	0.18	0.48	0.80	0.57
N							
THS Pearson Correlation			1	0.09	0.29	0.25	0.26
Sig. (2-tailed)				0.72	0.21	0.13	0.11
N							
PHS Pearson Correlation				1	0.25	0.15	-0.19
Sig. (2-tailed)					0.14	0.35	0.25
N							
THW Pearson Correlation					1	-0.22	-0.26
Sig. (2-tailed)						0.50	0.20
N							
pH Pearson Correlation						1	0.34*
Sig. (2-tailed)							0.02
N							
Org.Mat Pearson Correlation							1
Sig. (2-tailed)							
N							

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).PbS=Lead in shoot.

PbR=Lead in root. THS=Total heavy metal in soil.PHS=Phytoavailable metal in soil.

THW=Total heavy metal in water.pH.= hydrogen ion concentration of soil. OrgMat=Organic matter in soil

Table 156: Correlation coefficient between Lead content of *Corchorus olitorius* NG/OA/04/010, THS, PHS,THW, pH and organic matter of soil first rainy season (2016).

	Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot Pearson Correlation	1	0.34*	0.73**	0.66**	0.02	0.07	0.03
Sig		0.03	0.00	0.00	0.92	0.68	0.86
Pb root Pearson Correlation		1	0.32*	0.49**	-0.26	-0.10	-0.12
Sig			0.04	0.00	0.88	0.53	0.46
THMS Pearson Correlation			1	0.86**	0.03	0.29	0.25
Sig				0.00	0.88	0.07	0.13
PHS Pearson Correlation				1	0.27	0.11	0.07
Sig					0.10	0.49	0.68
THW Pearson Correlation					1	-0.01	-0.68
Sig						0.97	0.68
pH Pearson Correlation						1	0.49**
Sig							0.00
ORG MAT Pearson Correlation							1
Sig							

** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.

Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

4.15: Correlation of heavy metal in soil, water, vegetables accessions and proximate composition of vegetable accessions.

(Table 158). shows the Correlation between cadmium in shoot, root and the nutritional content of *Amaranthus hybridus* accession NG/AA/03/11/010 in the first dry season (2015) (Table 158). The ash content of the accession had significant negative correlation with the fat and oil content (r= - 0.88**) at p ≤0.00, a significant the crude protein content (r=--0.65**) at p ≤0.00, significant positive correlation with the crude fibre content (r= 0.99**) at ≤ 0.00 and with the carbohydrate content (r=0.99**) at ≤ 0.00 (Table 158). There were significant positive correlation between the fat and oil content of the accession, the crude protein (r=0.43**) at p≤0.00 and significant negative correlation with the crude fibre (r= - 0.88**) at p≤0.00 and the carbonhydrate content. There were significant negative correlation between the crude protein content of the accession, the crude fibre (r=- 0.62**) at p ≤0.00 and the carbohydrate content (r = - 0.66*) at p ≤0.00. A significant positive interation was recorded between the crude fibre content and the carbohydrate content (r=0.99*) at p≤0.00 in the first dry season (2015). Table 159 shows the shoot cadmium content had significant positive correlation with the root Cd content (r=0.72**) at p≤0.00, the moisture content at (r=0.73**) at p≤0.00. A positive significant correlation between the root Cd content and the moisture content (r=0.64**) at p≤0.00 suggesting strong interaction. Positive correlation existed between the ash and the crude fibre content (r=0.33*) at p≤0.04, fat and oil with the crude fibre (r=0.38*) at p≤0.04, crude protein content with the crude fibre (r=0.38*) at p≤0.02, the crude fibre with the carbohydrate content (r=0.39*) at p≤0.03 indicating strong interaction between the variables (Table 159) second dry season (2016)

Table 160 shows the correlation between cadmium content of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content of the vegetable accession in the first rainy season (2016) with the root cadmium correlating negatively with the moisture content (r – 0.35*) at p≤0.05 and positively with the ash content (r=0.46**) at p≤0.01.The moisture content of the accession had significant negative correlation with the ash content (r= - 0.70**) at p≤0.00, significant positive correlation with crude fat and oil content (r= 0.45**) at p ≤0.04, crude protein (0.48**) at p≤ 0.01 and the crude fibre content (r= 0.76**) at p ≤ 0.00 suggesting strong interaction between the variables.

The ash content had significant negative correlation with the crude fat and oil (r= -0.66**) at p=0.01, the crude protein (r= - 0.91**), the crude fibre content (r= - 0.32**) at p ≤ 0.02 indicating no interaction between the variables and a significant positive correlation with the carbohydrate content (r= 0.66**) at p≤0.00 suggesting strong interaction. Fat and oil correlated significantly positive with the crude protein content of the accession (r= 0.79**) at p ≤ 0.01 and the crude fibre (r=0.67**). There were significant negative correlation bwteen the crude protein content, the crude fibre (r = -0.72**) at p≤0.00 and the carbohydrate content (r= - 0.33) at p≤0.05 indicating no interaction (Table 160).

Table 161 shows the correlation between cadmium content of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content of the vegetable accession in the second rainy season (2017). The moisture content of the accession had significant negative correlation with the ash content (r= - 0.62**) at p≤0.00, the crude fibre content (r= - 0.40**) at p ≤ 0.01, significant positive correlation with crude fat and oil content (r= 0.33**) at p ≤0.04 indicating low positive interaction and the crude protein content of the accession (r= 0.45**) at p ≤ 0.01 (Table 161). The ash content had significant negative correlation with crude fat and oil content (r= - 0.60**) at p≤ 0.00 and the crude protein content of the accession (r = - 0.83**) at p ≤ 0.00 and a significant positive correlation with the crude fibre content of the accession (r= 0.73**) at p ≤ 0.01 (Table 161). The crude fat and oil content in the accession a significant positive correlation with the crude protein content (r= 0.72**) at p ≤ 0.00, a significant negative correlation with the crude fibre (r = -0.70**) at p ≤ 0.01 (Table 161). A significant negative correlation was recorded between the crude protein content and the crude fibre (r= -0.89**) at p ≤ 0.00 (Table 161).

Table 162 shows the correlation between cadmium in shoot, root and the proximate composition of *Amaranthus hybridus* NG/AO/11/08/039 in the first dry season (2015). Cadmium concentration of the shoot had strong significant positive correlation with the ash content (r= 0.51**) at $p \leq 0.00$, the crude fibre (r= 0.55**) at $p \leq 0.00$ and the percentage carbohydrate in the accession (r= 0.50**) at $p \leq 0.01$ and negative correlations with the percentage crude fat and oil (r= -0.49**) at $p \leq 0.00$ and the crude protein (r= -0.48**) at $p \leq 0.01$ (Table 162).

The ash content of the accession had a negative correlation with crude fat and oil content (r= -0.92**) at $p \leq 0.00$, crude protein (r= - 0.96**) at $p \leq 0.00$, significant positive correlation with the crude fibre content (r= 0.99**) indicating very strong interaction in the first dry season (2015) at $p \leq 0.00$ and the percentage carbohydrate of the accession (r=0.89**) at $p \leq 0.00$ (Table 162).The fat and oil content of the accession had significant negative correlation with the protein content (r= -0.91**) at $p \leq 0.00$ showing a strong negative interaction , with the crude fibre (r= -0.90**) at $p \leq 0.00$ indicating very strong negative interaction and the carbohydrate content (r= -0.95**) at $p \leq 0.00$ (Table 162). Crude protein content had a significant positive correlation with the crude fibre (r =0.68**) at $p \leq 0.00$ and a significant negative correlation with the carbohydrate content (r= - 0.94**) at $p \leq 0.00$ (Table 162). The crude fibre had a significant negative correlation with the percentage carbohydrate content of the accession (r= - 0.99**) at $p \leq 0.00$ indicating vert strong negative interaction in the second dry season (2016) (Table 162). Table 163 shows in the second dry season (2016) that the cadmium content in the shoot of *Amaranthus hybridus* accession NG/AO/11/08/039 had significant positive correlation with the cadmium content in the root (r=0.72**) at $p \leq 0.00$ and significant positive correlation with the moisture content (r=0.73**) at $p \leq 0.00$ (Table 163).

Table 157: Correlation between Lead content of *Corchorus olitorius* accession NG/OA/04/010, THS, PHS,THW , pH and organic matter of soil in the second rainy season (2017).

		Pb shoot	Pb root	THMS	PHS	THW	pH	ORG. MAT
Pb shoot	Pearson Correlation	1	0.35*	-0.11	0.05	-0.08	-0.05	0.08
	Sig		0.03	0.50	0.77	0.62	0.77	0.63
Pb root	Pearson Correlation		1	0.20	0.22	0.43**	-0.18	0.12
	Sig			0.23	0.19	0.01	0.27	0.47
THMS	Pearson Correlation			1	0.13	0.09	-0.24	-0.28
	Sig				0.43	0.59	0.14	0.08
PHS	Pearson Correlation				1	-0.18	-0.13	-0.03
	Sig					0.29	0.45	0.82
THW	Pearson Correlation					1	-0.03	0.07
	Sig						0.86	0.70
pH	Pearson Correlation						1	0.39**
	Sig							0.01
ORG MAT	Pearson Correlation							1
	Sig							

. ** correlation is significant at the 0.01level (2-tailed) . * correlation is significant at the 0.05level (2-tailed). Pb S=Lead in shoot; pb R= Lead in root.Pb=Lead. THS=Total heavy metal in soil..PHS=Phytoavailable heavy metal in soil.THW=Total heavy metal in water.ORG.MAT=Organic matter

Table 158: Correlation between cadmium of shoot , root and the proximate composition of *Amaranthus hybridus* NG/AA/03/11/010 the first dry season (2015).

	Cd shoot	Cd root	Moisture content	Ash content	Fat n oil content	Crude protein content	Crude fibre content	Carbohydrate content
Cd shoot Pearson Correlation	1	0.21	0.27	-0.05	-0.19	0.14	0.01	-0.02
Sig		0.20	0.10	0.78	0.25	0.40	0.97	0.92
Cd root Pearson Correlation		1	0.28	-0.21	-0.12	0.14	-0.03	-0.04
Sig			0.08	0.90	0.47	0.41	0.87	0.81
Moisture content Pearson Correlation			1	-0.27	0.10	0.18	-0.30	-0.28
Sig				0.09	0.53	0.26	0.09	0.08
Ash content Pearson Correlation				1	-0.88**	-0.65**	0.99**	0.99**
Sig					0.00	0.00	0.00	0.00
Fat n oil content Pearson Correlation					1	0.43**	-0.88**	-0.88**
Sig						0.01	0.00	0.00
Protein crude content Pearson Correlation						1	-0.62**	-0.66**
Sig							0.00	0.00
Crude fibre conten Pearson Correlation							1	0.99**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed

Cadmium content of the root had a positive significant correlation with the moisture (r=0.64**) at p≤0.00 implying very strong interaction in the second dry season (2016). The moisture content had a significant positive correlation with the percentage carbohydrate (r=0.34*) at p≤0.04 showing low interaction in the second dry season (2016). The ash content had a significant positive correlation with the crude fibre (r=0.33*) at p≤0.04 showing low positive interaction in the second dry season (2016). The fat and oil content had a positive significant correlation with the crude fibre (r=0.38*) at p≤ 0.04 showing low positive interaction in the second dry season (2016). There was positive correlation between the crude protein content and the crude fibre (r=0.38*) at p ≤0.02. The crude fibre content had a significant positive correlation with the carbohydrate content (r=0.39*) at p≤0.03 in the second dry season showing low positive interaction in the second dry season (2016) (Table 163).

Table 164 shows the correlation coefficient between cadmium content of *Amaranthus hybridus* accession NG/AO/11/08/039 and the proximate content of the vegetable accession in the first rainy season (2016).There were significant negative correlation between the cadmium content of the root of the accession, the moisture content (r= - 0.35*) at p≤0.03, the crude fibre (r= - 0.48**) at p≤0.00, the carbohydrate content (r=- - 0.42**) at p≤0.01, significant positive correlation with the ash content (r=0.77**) at p≤0.00, crude protein (r=0.51**) at p≤0.00, fat and oil content (r=0.37*) at p≤ 0.02 (Table 164).The moisture content of the accession had significant positive correlation with the ash content (r=0.43**) at p≤0.00, the crude fibre (r=0.39*) at p≤ 0.02 and a significant negative correlation with the crude protein (r= - 0.38*) at p≤0.02 (Table 164). The ash content of the accession had significant negative correlation with crude protein (r=- - 0.83**) at p≤0.00, the crude fat and oil content (r=- - 0.60**) at p ≤ 0.00, significant positive correlation with the crude fibre (r=0.75**) at p≤0.00 and the carbohydrate content (r= 0.74**) at p ≤0.00 (Table 164). There were significant negative correlation between the crude protein, the crude fibre content (r= - 0.90**) at p≤ 0.00, carbohydrate content (r= - 0.95**) at p≤0.00 and a significant positive correlation with the fat and oil content (r=0.75**) at p≤0.00.(Table 164).

Table 159. Correlation Coefficient between the cadmium of the shoots, roots of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content second dry season (2016).

	CdS	CdR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
CdS Pearson Correlation	1	0.70**	0.67**	0.05	0.20	0.08	0.03	0.21
Sig.(2tailed)		0.00	0.00	0.78	0.23	0.62	0.87	0.19
N								
CdR Pearson Correlation		1	0.62**	0.16	-0.21	0.05	0.03	0.34*
Sig.(2tailed)			0.00	0.33	0.21	0.75	0.84	0.02
N								
Moisture Pearson Correlation			1	-0.10	0.10	-0.07	0.08	0.29
Sig.(2tailed)				0.56	0.54	0.69	0.64	0.14
N								
Ash Pearson Correlation				1	-0.15	0.20	0.05	0.23
Sig.(2tailed)					0.36	0.22	0.75	0.20
N								
Fat and oil Pearson Correlation					1	0.17	0.33*	0.21
Sig.(2tailed)						0.30	0.04	0.19
N								
Protein Pearson Correlation						1	0.38*	0.29
Sig.(2tailed)							0.02	0.15
N								
Fibre Pearson Correlation							1	0.27
Sig.(2tailed)								0.11
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

CdS=cadmium in shoot. CdR=cadmium in root. CHO=carbohydrate

Table 160: Correlation coefficient between cadmium content of *Amaranthus hybridus* NG/AA/03/11/010 and the proximate content of the vegetable accession in the first rainy (2016) .

	CdS	CdR	Moisture content	Ash content	Fat and oil content	Crude protein	Crude fibre	Carbohydrate content
CdS Pearson Correlation	1	0.24	-0.09	0.14	-0.19	-0.16	0.20	0.28
Sig. (2-tailed)		0.14	0.60	0.29	0.26	0.18	0.22	0.15
N								
. CdR Pearson Correlation		1	-0.35*	0.46**	-0.30	-0.38*	0.42*	0.10
Sig. (2-tailed)			0.05	0.01	0.07	0.02	0.01	0.49
N								
Moisture content Pearson Correlation			1	-0.70**	0.45**	0.48**	0.76**	-0.17
Sig. (2-tailed)				0.00	0.00	0.01	0.00	0.27
N								
Ash content Pearson Correlation				1	-0.66**	-0.91**	-0.32*	0.66**
Sig. (2-tailed)					0.01	0.00	0.03	0.00
N								
Fat and oil Pearson Correlation					1	0.79**	0.67**	0.20
Sig. (2-tailed)						0.00	0.00	0.21
N								
Crude Protein Pearson Correlation						1	-0.72**	-0.33*
Sig. (2-tailed)							0.00	0.05
N								
Fibre Pearson Correlation							1	0.27
Sig. (2-tailed)								0.60
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed) ., *correlation is significant at the 0.05level (1-tailed

Table 161: Correlation between cadmium content of *Amaranthus hybridus* NG/AA/03/11/010 and the proximate content of the vegetable accession in the second rainy season (2017).

	CdS	CdR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate content
CdS Pearson Correlation	1	-0.07	-0.03	0.12	-0.15	-0.21	0.24	-0.03
Sig. (2-tailed)		0.66	0.87	9.47	0.36	0.21	0.15	0.88
N								
CdR Pearson Correlation		1	0.23	-0.20	0.13	0.06	0.05	0.10
Sig. (2-tailed)			0.16	0.23	0.43	0.72	0.77	0.56
N								
Moisture Pearson Correlation			1	-0.62**	0.33*	0.45**	-0.40**	-0.16
Sig. (2-tailed)				0.00	0.04	0.00	0.01	0.35
N								
Ash content Pearson Correlation				1	-0.60**	-0.83**	0.73**	0.20
Sig. (2-tailed)					0.00	0.00	0.00	0.22
N								
Fat and Oil Pearson Correlation					1	0.72**	-0.70**	-0.19
Sig. (2-tailed)						0.00	0.00	0.25
N								
Crude Protein Pearson Correlation						1	-0.89''	-0.14
Sig. (2-tailed)							0.00	0.39
N								
Crude Fibre Pearson Correlation							1	0.19
Sig. (2-tailed)								0.26
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

There were negative correlation between the fat and oil content, crude fibre (r= - 0.74**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.82**) at $p \leq 0.00$ (Table 164). The crude fibre had the a significant positive correlation with the carbohydrate content (r= 0.86**) at $p \leq 0.00$ showing a very strong positive interaction in the first rainy season (2016). (Table 164). Table 165 shows the correlation between cadmium content of *Amaranthus hybridus* accession NG/AO/11/08/039 and the proximate content of the vegetable accession in the second rainy season (2017). A significant negative correlation between the cadmium content of the shoot of the accession and the cadmium content of the root of the accession was recorded (r= - 0.33**) at $p \leq 0.04$ showing low positive interaction in the second rainy season (2016). A significant positive correlation between the Cd content of the root and the moisture content (r=0.38**) at $p \leq 0.01$ was recorded (Table 165). Moisture content of the accession had a significant negative correlation with the ash content (r= - 0.79**) and $p \leq 0.00$ and the crude fibre (- 0.64**) at $p \leq 0.01$, and significant positive correlation with the fat and oil content (r = 0.69**) at $p \leq 0.00$ and with crude protein (r=0.44**) at $p \leq 0.01$(Table 165). The ash content of the accession had a significant negative correlation with the fat and oil content (r= - 0.78**) at $p \leq 0.00$, the crude protein (r= - 0.79**) at $p \leq 0.01$ and a significant positive correlation with the crude fibre (r= 0.87**) at $p \leq 0.01$ (Table 165).

Significant positive correlation between the fat and oil content and the crude protein content of the accession (r=0.67**) at $p \leq 0.01$ was recorded and a significant negative correlation with the crude fibre (r = - 0.61**) at $p \leq 0.01$and a significant negative correlation between the crude protein content and the crude fibre content (r= - 0.87**) at $p \leq 0.01$ indicating very strong negative interaction (Table 165). Table 166 shows the correlation coefficient between cadmium in shoot, root and the nutritional content of *Amaranthus hybridus* accession NGBO125 in the first dry season (2015).

Table 162 : Correlation between cadmium of shoot , root and the proximate composition of *Amaranthus hybridus* NG/AO/11/08/039 the first dry season (2015).

	Cd shoot	Cd root	Moisture content	Ash content	Fat n oil content	Crude Protein content	Crude fibre content	Carbohydrate content
Cd shoot Pearson Correlation	1	-0.09	0.10	0.51**	-0.49**	-0.48**	0.55**	0.50**
Sig		0.59	0.54	0.00	0.00	0.00	0.00	0.00
Cd root Pearson Correlation		1	0.07	-0.20	-0.29	0.17	-0.22	-0.22
Sig			0.67	0.23	0.23	0.30	0.18	0.17
Moisture content Pearson Correlation			1	-0.37	.09	0.13	-0.19	-0.19
Sig				0.30	0.57	0.42	0.24	0.26
Ash content Pearson Correlation				1	-0.92**	-0.95**	0.98**	0.89**
Sig					0.00	0.00	0.00	0.00
Fat n oil content Pearson Correlation					1	-0.91**	-0.90**	-0.95**
Sig						0.00	0.00	0.00
Crude protein content Pearson Correlation						1	0.68**	-0.94**
							0.00	0.00
Sig								
Crude fibre content Pearson Correlation							1	-0.99**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

The cadmium concentration of the shoot of the accession had strong significant positive correlation with the cadmium concentration of the root (r= 0.51**) at $p \leq 0.00$, the ash content (r=0.45**) at $p \leq 0.00$, crude fibre (r= 0.39*) at $p \leq 0.02$ and the percentage carbohydrate with r= 0.47** at $p \leq 0.00$, negative correlation with the percentage fat and oil (r= - 0.50**) at $p \leq 0.00$ (Table 166). The ash content of the accession had strong positive significant correlation with the percentage fat and oil (r= 0.94**) at $p \leq 0.00$, the crude fibre(r=0.94**) at $p \leq 0.00$ and percentage carbohydrate (r= 0.96**) at $p \leq 0.00$ and a significant negative correlation between the crude protein (r= - 0.66**) at $p \leq 0.01$ (Tale 166).

The percentage crude fat and oil of the accession had significant positive correlation with the crude protein of the accession (r= 0.65**) at $p \leq 0.01$ and strong significant negative correlation with the crude fibre (r= - 0.97**) at $p \leq 0.00$ and with the percentage carbohydrate (r= - 0.98**) at $p \leq 0.01$(Table 166). The crude protein content of the accession had strong negative correlation with the crude fibre (r= - 0.75**) at $p \leq 0.00$ and percentage carbohydrate (r= - 0.68**) at $p \leq 0.00$ (Table 166). Crude fibre content of the accession had a strong negative correlation with the percentage carbohydrate (r= 0.98**) at $p \leq 0.01$ in the first dry season (2015) (Table 166).

Table 167 presents the correlation coefficient between the cadmium of the shoots, roots of Amaranthus hybridus accession NGBO125 and the proximate content of the accession in the second dry season (2015). There were significant positive correlation between the cadmium comtent in the shoots of the accession, the cadmium content in the roots at (r=0.71**) at $p \leq 0.00$, the moisture content (r=79**) at $p \leq 0.00$ and the carbohydrate content at (r= 0.38*) at $p \leq .02$ (Table 167).

Cadmium content in the roots had a significant positive correlation with the moisture content of the accession (r=0.68**) at $p \leq .00$ (Table 167). crude protein (r= 0.76**) at $p \leq 0.00$. The crude fibre had significant negative correlation with the crude protein (r = - 0.89**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.96) at $p \leq 0.00$ (Table 167). The crude protein had a significant positive correlation with the carbohydrate content (r=0.84**) at $p \leq 0.00$ (Table 167).

Table 163. Correlation Coefficient between the cadmium of the shoots, roots of *Amaranthus hybridus* accession NG/AO/11/08/039 and the proximate content accession in the second dry season (2016).

	CdS	CdR	Moisture content	Ash content	Fat and oil contents	Crude Protein content	Crude fibre content	CHO
CdS Pearson Correlation	1	0.72**	0.73**	0.06	0.09	0.12	0.12	0.28
Sig.(2tailed)		0.00	0.00	0.70	0.59	0.45	0.48	0.21
N								
CdR Pearson Correlation		1	0.64**	0.11	-0.12	0.01	-0.11	0.26
Sig.(2tailed)			0.00	0.51	0.45	0.97	0.50	0.18
N								
Moisture Pearson Correlation			1	-0.10	0.10	-0.07	0.08	0.34*
Sig.(2tailed)				0.52	0.54	0.69	0.64	0.04
N								
Ash Pearson Correlation				1	-0.15	0.20	0.33*	0.28
Sig.(2tailed)					0.36	0.22	0.04	0.12
N								
Fat and oil Pearson Correlation					1	0.17	0.38*	0.29
Sig.(2tailed)						0.30	0.04	0.43
N								
Protein Pearson Correlation						1	0.38*	0.20
Sig.(2tailed)							0.02	0.31
N								
Crude fibre Pearson Correlation							1	0.39*
Sig.(2tailed)								0.03
N								
CHO content Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level (2 tailed). * correlation is significant at the 0.05 level(2 tailed) .CdS=cadmium in shoot. CdR=cadmium in root. CHO=carbohydrate

Table 164: Correlation between cadmium content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession in the first rainy season (2016).

	CdS	. CdR	Moisture content	Ash content	Crude protein	Fat and oil	Crude fibre	Carbohydrate content
CdS Pearson Correlation	1	-0.09	0.24	0.18	-0.19	-0.18	0.20	0.16
Sig. (2-tailed)		0.60	0.14	0.29	0.24	0.27	0.22	0.33
N								
CdR Pearson Correlation		1	-0.35*	0.77**	0.51**	0.37*	-0.48**	-0.42**
Sig. (2-tailed)			0.03	0.00	0.00	0.02	0.00	0.01
N								
Moisture. content Pearson Correlation			1	0.43**	-0.38*	-0.29	0.39*	0.27
Sig. (2-tailed)				0.00	0.02	0.08	0.02	0.10
N								
Ash content Pearson Correlation				1	-0.83**	-0.60**	0.75**	0.74**
Sig. (2-tailed)					0.00	0.00	0.00	0.00
N								
Crude protein Pearson Correlation					1	0.75**	-0.90**	-0.95**
Sig. (2-tailed)						0.00	0.00	0.00
N								
Fat and oil Pearson Correlation						1	-0.74**	-0.82**
Sig. (2-tailed)							0.00	0.00
N								
Crude fibre Pearson Correlation							1	0.86**
Sig. (2-tailed)								0.00
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed) ., *correlation is significant at the 0.05 level (1-tailed)

Table 165: Correlation between cadmium content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession second rainy season (2017).

	CdS	CdR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate Content
CdS Pearson Correlation	1	-0.33*	-0.24	0.23	-0.26	-0.07	0.08	0.20
Sig. (2-tailed)		0.04	0.15	0.16	0.11	0.67	0.63	0.21
N								
CdR Pearson Correlation		1	0.38**	-0.29	0.30	0.18	-0.26	0.07
Sig. (2-tailed)			0.01	0.77	0.06	0.26	0.11	0.67
N								
Moisture Pearson Correlation			1	-0.79**	0.69**	0.44*	-0.64**	0.03
Sig. (2-tailed)				0.00	0.00	0.01	0.00	0.86
N								
Ash content Pearson Correlation				1	-0.78**	-0.79**	0.87**	0.10
Sig. (2-tailed)					0.00	0.00	0.00	0.56
N								
Fat and Oil Pearson Correlation					1	0.67**	-0.61**	-0.25
Sig. (2-tailed)						0.00	0.00	0.13
N								
Crude Protein Pearson Correlation						1	-0.87**	0.02
Sig. (2-tailed)							0.00	0.92
N								
Crude Fibre Pearson Correlation							1	-0.17
Sig. (2-tailed)								0.31
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

**correlation is significant at the 0.01level (2-tailed). * correlation is significant at the 0.05level (2-tailed).

The moisture content of the accession had a significant positive correlation with the carbohydrate content of the accession ($r= 0.39^*$) at $p\leq 0.04$. There were significant positive correlation between the fat and oil content of the accession, the crude fibre content ($r= 0.33^*$) at $p\leq 0.04$ and the carbohydrate content ($r=0.34^*$) at $p\leq 0.02$ (Table 167). Crude protein content of the accession had significant positive correlation with the crude fibre content ($r=0.33^*$) at $p\leq0.02$ and the carbohydrate content ($r=0.42^*$) at $p\leq0.03$ indicating low positive interaction in the second dry season (Table 167).

Table 168 shows the correlation coeffient between cadmium content of *Amaranthus hybridus* accession NGO125 and the proximate content of the vegetable accession first rainy season (2016). There were significant positive correlation between the cadmium content of the shoot, the cadmium content of the root ($r=0.33^*$) at $p \leq0.04$, the ash content ($r=0.48^{**}$) at $p \leq0.00$, the crude fibre ($r=0.37^{**}$) at $p \leq 0.00$, the carbohydrate content ($r=0.38^*$) at $p \leq0.02$, significant negative correlation with the moisture content ($r= - 0.33^*$) and the crude protein content ($r= - 0.44^{**}$) at $p \leq0.01$ (Table 168). The cadmium content of the root had significant positive correlation with the ash content,($r=0.61^{**}$) at $p\leq0.00$, the crude fibre ($r=0.43^{**}$) at $p \leq 0.01$, the carbohydrate content at ($r=0.42^{**}$) at $p \leq 0.01$, significant negative correlation with the moisture content ($r= - 0.38^*$) at $p\leq0.02$ and the crude protein ($r= - 0.53^{**}$) at $p \leq0.00$ (Table 168). There were significant negative correlation between the moisture content of the accession, the ash content ($r = – 0.78^{**}$) at $p \leq0.00$, the fat and oil content ($r= - 0.40^{**}$) at $p \leq0.01$, the crude fibre ($r= - 0.46^{**}$) at $p \leq0.00$, the carbohydrate content ($r= - 0.44^{**}$) at $p \leq0.01$ and a significant positive correlation with crude protein ($r=0.52^{**}$) at $p \leq0.00$ (Table 168). There were significant negative correlation between the ash content, the fat and oil content ($r= - 0.61^{**}$) at $p \leq0.01$, the crude protein ($r= - 0.83^{**}$) at $p \leq0.00$, significant positive correlation with the crude fibre ($r= - 0.73^{**}$) at $p \leq 0.00$ and the carbohydrate content ($r= 0.73^{**}$) at the $p \leq0.00$ (Table 168).

Table 166: Correlation between cadmium in shoot , root and the proximate composition of *Amaranthus hybridus* accession NGBO125 in the first dry season (2015).

	Cd shoot	Cd root	Moisture	Ash content	Fat and Oil content	Crude protein content	Crude fibre conttent	Carbohydrate content
Cd shoot Pearson Correlation	1	0.51**	-0.03	0.45**	-0.50**	-0.04	0.39*	0.47**
Sig		0.00	0.86	0.00	0.00	0.81	0.02	0.00
Cd root Pearson Correlation		1	-0.07	0.19	-0.17	0.21	0.18	0.13
Sig			0.68	0.25	0.29	0.20	0.27	0.44
Moisture content Pearson Correlation			1	0.16	-0.17	-0.18	0.17	0.16
Sig				0.34	0.32	0.27	0.30	0.32
Ash content Pearson Correlation				1	0.94**	-0.66**	0.94**	0.96**
Sig					0.00	0.00	0.00	0.00
Fat n oil content Pearson Correlation					1	0.68**	-0.97**	-0.98**
Sig						0.00	0.00	0.00
Crude protein content Pearson Correlation						1	-0.75**	-0.68**
Sig							0.00	0.00
Crude fibre content Pearson Correlation							1	0.98**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 167 . Correlation Coefficient between the cadmium of the shoots, roots of Amaranthus hybridus accession NGBO125 and the proximate content of the accession in the second dry season (2016).

	CdS	CdR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO
CdS Pearson Correlation	1	0.71**	0.73**	0.01	0.00	0.16	0.15	0.38*
Sig.(2tailed)		0.00	0.00	0.95	0.98	0.33	0.36	0.02
N								
CdR Pearson Correlation		1	0.64**	0.03	0.09	0.07	-0.09	0.28
Sig.(2tailed)			0.00	0.88	0.58	0.67	0.61	0.17
N								
Moisture Pearson			1	-0.10	-0.07	0.10	0.09	0.39*
Correlation					0.66	0.54	0.64	0.04
Sig.(2tailed)				0.56				
N								
Ash Pearson Correlation				1	0.20	-0.15	0.05	0.23
Sig.(2tailed)					0.22	0.36	0.75	0.17
N								
Fat and oil Pearson					1	0.17	0.33*	0.34*
Correlation						0.30	0.04	0.02
Sig.(2tailed)								
N								
Protein Pearson Correlation						1	0.38*	0.42*
Sig.(2tailed)							0.02	0.03
N								
Fibre Pearson Correlation							1	0.22
Sig.(2tailed)								0.19
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

CdS=cadmium in shoot. CdR=cadmium in root. CHO=carbohydrate

Table 168: Correlation between cadmium content of *Amaranthus hybridus* NGO125 and the proximate content of the vegetable accession in the first rainy season (2016).

	CdS	CdR	Moisture.	Ash	. Fat	Protein	Fibre	CHO
CdS Pearson Correlation	1	0.33*	-0.33*	0.48**	-0.30	-0.44**	0.37**	0.38*
Sig. (2-tailed)		0.04	0.04	0.00	0.06	0.01	0.00	0.02
N								
CdR . Pearson Correlation		1	-0.38*	0.61**	-0.28	-0.53**	0.43**	0.42**
Sig. (2-tailed)			0.02	0.00	0.09	0.00	0.01	0.01
N								
Moisture Pearson Correlation			1	-0.78**	-0.40**	0.52**	-0.46**	-0.44**
Sig. (2-tailed)				0.00	0.01	0.00	0.00	0.01
N								
Ash Pearson Correlation				1	-0.61**	-0.83**	0.73**	0.74**
Sig. (2-tailed)					0.01	0.00	0.00	0.00
N								
Fat and oil Pearson Correlation					1	0.76**	-0.73**	-0.82**
Sig. (2-tailed)						0.00	0.00	0.00
N								
. Crude fibre Pearson Correlation						1	-0.89**	-0.96**
Sig. (2-tailed)							0.00	0.00
N								
Crude protein Pearson Correlation							1	0.84**
Sig. (2-tailed)								0.00
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

**correlation is significant at the 0.01level (2-tailed). correlation is significant at the 0.05 level (2-tails)

The fat and oil content had significant negative correlation with the crude fibre (r= - 0.73**) at $p \leq 0.00$, the carbohydrate content (r= - 0. 82**) at $p \leq 0.00$. Table 169 shows the correlation coefficient between cadmium content of *Amaranthus hybridus* NGO125 and the proximate content of the vegetable accession the second rainy season (2017). The moisture content of the accession had significant negative correlation with the ash content (r= - 0.76**) at $p \leq 0.00$, the crude fibre (r= - 0.76**) at $p \leq 0.00$, the carbohydrate (r= - 0.62**) at $p \leq 0.00$, significant positive correlation with the fat and oil content with r= 0.49** at $p \leq 0.00$ and the protein content (r= 0.58**) at $p \leq 0.01$ (Table 169).

Significant negative correlation between the ash content, the crude protein content with r= - 0.52** at $p \leq 0.00$, significant positive correlation with the crude fibre content (r=0. 88**) at $p \leq 0.00$ and the carbohydrate content (r = 0.50**) at $p \leq 0.00$ (Table 169). The fat and oil content had a significant positive correlation with the crude protein content (r=0.48**) at $p \leq 0.00$ and significant negative correlation with carbohydrate content (r=0.95**) at $p \leq 0.00$ (Tale 169). Significant negative correlation between the crude protein content of the accession, the crude fibre (r = - 0.43**) at $p \leq 0.00$ and the carbohydrate content (r= -0.95** at $p \leq 0.00$ were recorded (Tale 169). There were significant positive correlation between the crude fibre content of the accession and carbohydrate content (r= 0.37**) at $p \leq 0.00$ in the second rainy season (Table 169)

Table 170 shows the correlation between cadmium in shoot , root and the proximate content of *Corchorus olitorius* NG/OA/Jun/09/002 in the first dry season (170). The cadmium concentration of the shoot of the accession had significant negative correlation with the percentage fat and oil of the accession (r= - 0.31*) at $p \leq 0$ .05 (Table 170). Cadmium concentration of the root had strong positive significant correlation with the percentage fat and oil (r= 0.73**) at $p \leq 0.00$, percentage crude protein (r= 0.85**) at $p \leq 0.00$ and significant positive correlation with the percentage crude fibre (r= 0.80**) at $p \leq 0.01$ (Table 170). There were significant negative correlation between the cadmium concentration of the root, the ash content (r= -0.51**) at $p \leq 0.00$ the percentage carbohydrate (r= -0.84**) at $p \leq 0.01$ showing strong adverse interaction in the first dry season (2015).

The moisture content of the accession had a significant positive correlation with the percentage fat and oil ($r=0.26$) at $p \leq 0.04$, significant negative correlation with the percentage crude fibre with r= -0.54** at $p \leq 0.00$ and the percentage carbohydrate (r= -0.27*) at $p \leq 0.04$ indicating low interaction (Table 170). The ash content of the accession had strong positive significant correlation with the percentage fat and oil (r = 0.45**) at $p \leq 0.00$, percentage crude fibre with r=0.54** at $p \leq 0.00$, percentage carbohydrate (r=0.59**) at $p \leq 0.0$ and a strong negative correlation with the percentage crude protein (r = - 0.59**) at $p \leq 0.0$ (Table 170).The percentage fat and oil of the accession had a significant positive correlation with the percentage crude protein (r= 0.87**) at $p \leq 0.01$ and significant negative correlations with the percentage crude fibre (r= -0.80**) at $p \leq 0.00$ and carbohydrate content of the accession (r= -0.88**) at $p \leq 0.01$(Table 170). The percentage crude protein of the accession had strong significant negative correlation with the crude fibre (r= - 0.91) at $p \leq 0.00$ and the carbohydrate content (r= -0.80) at $p \leq 0.00$ (Tale 170). Crude fibre of the accession had a strong significant positive correlation with the percentage carbohydrate (r= 0.91**) at p ≤ 0. 0.0 in the first dry season (2015) (Table 170). Table 171 shows that the cadmium content in the root had a significant positive correlation with the moisture content (r=0.80**) at $p \leq 0.00$. The moisture content was of a significant negative correlation with the carbohydrate content (r=-0.33*) at $p \leq 0.05$. There was a significant positive correlation between the fat and oil content and the crude fibre (r=0.33*) at $p \leq 0.04$. Crude protein content had significant positive correlation with the crude fibre (r=0.38*) at $p \leq 0.02$ and the carbohydrate content (r=0.33*) at $p \leq 0.04$ indication low interaction in the second dry season (2016). There was a positive significant correlation between the crude fibre and the carbohydrate content (r=0.47*) at $p \leq 0.02$ (Table 171).

Table 172 shows the correlation coefficient between cadmium content of *Corchorous olitorius* accession NG/AO/jun/09/002 and the proximate content of the vegetable in the first rainy season. Cadmium content of the shoot had a negative correlation with the crude protein content of the vegetable accession (r= - 0.33*) at $p \leq 0.04$ (Table 172). Cadmium content of the root had significant positive correlation with the ash content of the accession (r=0.42**) at $p \leq 0.01$, the protein content ($r=0.47^{**}$) at $p \leq 0.01$, with the crude fibre ($r=0.35^{*}$) at $p \leq 0.03$ and a significant negative correlation with the moisture content ($r= - 0.39^{*}$) at $p \leq 0.02$ (Table 172).

There were significant negative correlation between the moisture content, the ash content ($r= - 0.33^{*}$) at $p \leq 0.04$, with the crude fibre ($r= - 0.71^{**}$) at $p \leq 0.00$ and a significant positive correlation with the fat and oil content ($r=0.45^{**}$) at $p \leq 0.01$. Significant negative correlation between the ash content, the fat and oil content ($r= - 0.42^{**}$) at $p \leq 0.01$, the crude protein content ($r = - 0.50^{*}$) at $p \leq 0.04$ and a significant positive correlation with the crude fibre content ($r=0.58^{**}$) at $p \leq 0.00$ (Table 172) were recorded. Fat and oil content of the accession had a significant positive correlation with the crude protein content ($r =0.47^{*}$) at $p \leq 0.03$ and a significant negative correlation with the crude fibre content ($r= - 0.64^{**}$) at $p \leq 0.00$.

Table 169: Correlation between cadmium content of *Amaranthus hybridus* accession NGO125 and the proximate content of the vegetable accession the second rainy season (2017).

	CdS	CdR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate Content
CdS Pearson Correlation	1	0.06	-0.08	0.20	0.05	0.07	0.09	0.08
Sig. (2-tailed)		0.74	0.62	022	0.76	0.66	0.57	0.65
N								
CdR Pearson Correlation		1	0.27	-0.06	0.29	-0.02	-0.04	-0.02
Sig. (2-tailed)			0.10	0.70	0.07	0.91	0.83	0.92
N								
Moisture Pearson Correlation			1	-0.76’’	0.49’’	0.58’’	-0.76’’	-0.62’’
Sig. (2-tailed)				0 .00	0.00	0.00	0.00	0.00
N								
Ash content Pearson Correlation				1	-0.30	-0.52’’	0.88’’	0.50’’
Sig. (2-tailed)					0.06	0.00	0.00	0.00
N								
Fat and Oil Pearson Correlation					1	0.48’’	-0.22	-0.60’’
Sig. (2-tailed)						0.00	0.17	0.00
N								
Crude Protein Pearson Correlation						1	-0.43’’	-0.95’’
Sig. (2-tailed)							0.00	0.00
N								
Crude Fibre Pearson Correlation							1	0.37’’
Sig. (2-tailed)								0.02
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 170: Correlation between cadmium of shoot , root and the proximate composition of *Corchorus olitorius*. NG/OA/Jun/09/002 in the first dry season (2015).

	Cd root	Cd root	Moisture content	Ash content	Fat n oil content	Crude protein	Crude fibre	Carbohydrate content
Cd shoot Pearson Correlation	1	-0.13	-0.17	0.26	-0.31*	-0.19	0.20	0.20
Sig		0.44	0.31	0.12	0.05	0.25	0.23	0.23
Cd root Pearson Correlation		1	0.17	-0.51**	0.73**	0.85**	0.80**	-0.84**
Sig			0.32	0.00	0.00	0.00	0.00	0.00
Moisture content Pearson Correlation			1	-0.07	0.26*	0.24	-0.54**	-0.27*
Sig				0.58	0.04	0.06	0.00	0.04
Ash content Pearson Correlation				1	0.45**	-0.59**	0.54**	0.59**
Sig					0.00	0.00	0.00	0.00
Fat n oil content Pearson Correlation					1	0.87**	-0.80**	-0.88**
Sig						0.00	0.00	0.00
Crude protein content Pearson Correlation						1	-0.91**	-1.00**
Sig							0.00	0.00
Crude fibre content Pearson Correlation							1	0.91**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

The crude protein content had a significant positive correlation with the crude fibre content with ($r=0.57^{**}$) at $p \leq 0.01$ (Table 172) The percentage fat and oil of the accession had a strong significant positive correlation with crude protein ($r= 0.56^{**}$) Table 173 presents the correlation between cadmium content of *Corchorous olitorius* NG/AO/jun/09/002 and the proximate content of the vegetable accession second rainy season (2017). The Cd content of the root had negative correlation with the moisture content ($r=038^{**}$) The moisture content of the accession had significant positive correlation with the fat and oil ($r= 0.55^{**}$) and $p \leq 0.00$ content and the carbohydrate content ($r=0.51^{**}$) at $p \leq 0.01$ and a significant negative correlation with the ash content ($r= - 0.38^{**}$) at $p \leq 0.05$ (Table 173).

The ash content of the accession had significant negative correlation with the fat and oil content ($r= -0.43^{**}$) at $p \leq 0.01$ and the crude protein content ($r= - 0.36^{**}$) at $p \leq 0.00$ and a significant positive correlation with crude fibre ($r= 0.60^{**}$) at $p \leq 0.01$(Table 173). Significant positive correlation at $p \leq 0.01$ were recorded between the fat and oil cointent, the crude protein ($r= 0.60^{**}$), the crude fibre ($r=0.65^{**}$) at $p \leq 0.00$ and the carbohydrate content at ($r=0.63^{**}$) at $p \leq 0.00$. The crude protein had a significant negative correlation with the crude fibre ($r= - 0.73^{**}$) at $p \leq 0.01$ showing strong interaction in the second rainy season (2017) (Table 173). Table 174 shows the correlation between cadmium in shoot, root and the nutritional content of *Corchorus olitorius* NG/OA/04/010 in the first dry season (2015). Cadmium content of the root accession had strong significant negative correlation with the ash content ($r = - 0.58^{**}$) at $p \leq .00$ and the crude fibre ($r= - 0.40^{**}$) at $p \leq 0.00$ (Table 174).

The moisture content of the accession had strong significant positive correlation with the ash content (r= 0.47**) at p ≤0.00 and the crude fibre (r=0.82**) at p ≤ 0.00, and had signficant negative correlation with the crude protein (r = - 0. 84**) at p ≤ 0.0 and the percentage carbohydrate (r= - 0.34) at p≤0.04(Table 174). The ash content of the accession had a significant positive correlation with the crude fibre (r= 0.77**) at p ≤ 0. 01, strong significant negative correlation between the ash content of the accession, the percentage crude fat and oil (r = - 0. 47**) and the crude protein (r = - 0.48**) and p ≤ 0.00 (Table 174). and p ≤ 0.01. The percentage protein of the accession had a strong significant negative correlation with the crude fibre (r = - 0. 80**) and p ≤ 0.00(Table 174). Table 175 presents the significant positive correlation between the cadmium content in the shoot of *Corchorous olitorius* accession NG/OA/04/010 with the cadmium content of the root (r=0.33* at p≤0.04) and with the moisture content (r=0.46**) at p≤0.00. There were significant positive correlation between the Cd content in the root, the moisture content (r=0.72**) at p≤0.00 and the crude protein content (r=0.34*) at p≤0.04. Crude protein content had a significant positive correlation with the carbohydrate content (r=0.33*) at p≤0.05. The crude fibre content correlated significantly positive with the carbohydrate (r=0.42)* at p≤0.02 in the second dry season (2016) (Table 175).

Table 176 presents the correlation coefficient between cadmium content of *Corchorous* olitorius NG/AO/04/010 and the proximate content of the vegetable accession in the first rainy season (2016). Cadmium content of the shoot had a significant positive correlation with the ash content of the vegetable accession with r=0.33* at p ≤0.04 (Table176). The cadmium content of the root was correlated significantly positive with the ash content (r =0.48**) at p ≤0.00 and with the crude fibre (r=0.35*) at p ≤0.03. There were significant negative correlation between the moisture content, the ash content (r= - 0.45**) at p≤0.00, the crude fibre (r= - 0.65) at p ≤0.00, with the carbohydrate content (r= -0.55**) at p≤0.00, significant positive correlation with the fat and oil content (r=0.82**) at p≤0.00 and with the crude protein content (r=0.52**) at p ≤0.00 (Table `176). The ash content had a significant negative correlation with the fat and oil content (r= - 0.56**) at p ≤0.00 and a significant positive correlation with the crude fibre (r=0.67**) at p ≤0.00 (Table 175).

Table 171. Correlation Coefficient between the cadmium of the shoots, roots of *Corchorous olitorius* accession NG/OA/Jun/09/002 and the proximate content of the accession in the second dry season (2016).

	CdS	CdR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO
CdS Pearson Correlation	1	0.67**	0.66**	-0.17	0.26	-0.07	0.17	-0.22
Sig.(2tailed)		0.00	0.00	0.29	0.11	0.68	0.32	0.17
N								
CdR Pearson Correlation		1	0.80**	-0.12	0.07	-0.03	0.03	0.29
Sig.(2tailed)			0.00	0.47	0.65	0.87	0.87	0.41
N								
Moisture Pearson Correlation			1	-0.10	0.10	0.07	0.08	-0.33*
Sig.(2tailed)				0.56	0.54	0.69	0.64	0.05
N								
Ash Pearson Correlation				1	-0.15	0.20	0.05	0.23
Sig.(2tailed)					0.36	0.22	0.75	0.16
N								
Fat and oil Pearson Correlation					1	0.17	0.33*	-0.07
Sig.(2tailed)						0.30	0.04	0.83
N								
Protein Pearson Correlation						1	0.38*	0.33*
Sig.(2tailed)							0.02	0.04
N								
Fibre Pearson Correlation							1	0.47*
Sig.(2tailed)								0.02
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

CdS=cadmium in shoot. CdR=cadmium in root. CHO=carbohydrate

Table 172: Correlation between cadmium content of *Corchorous olitorius* accession NG/AO/jun/09/002 and the proximate content of the vegetable in the first rainy season (2016)..

	CdS	CdR	Moisture content	Ash content	Fat and oil	Crude protein	Crude fibre	Carbohydrate content
Cd S Pearson Correlation	1	0.24	-0.20	0.17	-0.05	-0.33*	0.16	-0.73
Sig. (2-tailed)		0.14	0.23	0.32	0.76	0.04	0.33	0.66
N								
Cd R Pearson Correlation		1	-0.39*	0.42**	-0.21	0.47**	0.35*	0.05
Sig. (2-tailed)			0.02	0.01	0.20	0.01	0.03	0.78
N								
Moisture content Pearson			1	-0.33*	0.45**	0.23	-0.71**	0.23
Correlation				0.04	0.01	0.20	0.00	0.16
Sig. (2-tailed)								
N								
Ash content Pearson Correlation				1	-0.42**	-0.50*	0.58**	0.01
Sig. (2-tailed)					0.01	0.04	0.00	0.96
N								
Fat and oil Pearson Correlation					1	0.47*	-0.64**	0.21
Sig. (2-tailed)						0.03	0.00	0.19
N								
Crude protein Pearson Correlation						1	0.57**	-0.12
Sig. (2-tailed)							0.01	0.46
N								
Crude fibre Pearson Correlation							1	0.24
Sig. (2-tailed)								0.19
N								
Carbohydrate content Pearson								1
Correlation								
Sig. (2-tailed)								
N								

**correlation is significant at the 0.01level (2-tailed),* correlation is significant at the 0.05level (2-tailed). Cd S=cadmium content in shoot. Cd R=cadmium content in root

Table 173: Correlation between cadmium content of *Corchorous olitorius* NG/AO/jun/09/002 and the proximate content of the vegetable accession in the second rainy season(2017).

	CdS	CdR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre Content	Carbohydrate content
CdS Pearson Correlation	1	0.12	-0.04	0.38**	-0.04	0.02	0.18	0.20
Sig. (2-tailed)		0.46	0.81	0.01	0.81	0.93	0.29	0.23
N								
CdR Pearson Correlation		1	-0.06	-0.18	-0.11	-0.02	-0.05	-0.17
Sig. (2-tailed)			0.72	0.26	0.51	0.92	0.76	0.32
N								
Moisture Pearson Correlation			1	-0.38**	0.55**	0.22	-0.30	0.51**
Sig. (2-tailed)				0.02	0.00	0.17	0.07	0.00
N								
Ash content Pearson Correlation				1	-0.43**	-0.36*	0.60**	0.03
Sig. (2-tailed)					0.00	0.03	0.00	0.88
N								
Fat and Oil Pearson Correlation					1	0.60**	0.65**	0.63**
Sig. (2-tailed)						0.00	0.00	0.00
N								
Crude Protein Pearson Correlation						1	-0.73**	0.05
Sig. (2-tailed)							0.00	0.78
N								
Crude Fibre Pearson Correlation							1	-0.19
Sig. (2-tailed)								0.26
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 174: Correlation between cadmium of shoot , root and the proximate composition of *Corchorus olitorius*. NG/OA/04/010 in the first dry season (2015).

	Cd shoot	Cd root	Moisture content	Ash content	Fat n oils	Crude Protein content	Crude fibre content	Carbohydrate content
Cd shoot Pearson Correlation	1	-0.15	-0.26	0.07	-0.27	0.01	-0.14	0.01
Sig		0.37	0.11	0.68	0.10	0.94	0.40	0.96
Cd root Pearson Correlation		1	-0.30	-0.58**	0.13	0.28	-0.40**	0.28
Sig			0.06	0.00	0.44	0.09	0.01	0.08
Moisture content Pearson Correlation			1	0.47**	-0.21	-0.84**	0.82**	-0.34*
Sig				0.00	0.21	0.00	0.00	0.04
Ash content Pearson Correlation				1	-0.47**	-0.48**	0.77**	-0.25
Sig					0.00	0.00	0.00	0.12
Fat and oils content Pearson Correlation					1	0.56**	-0.28	-0.76
Sig						0.00	0.08	0.65
Crude protein content Pearson Correlation						1	-0.80**	0.20
Sig							0.00	0.22
Crude fibre content Pearson Correlation							1	-0.29
Sig								0.07
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 175: Correlation Coefficient between the cadmium of the shoots, roots of *Corchorous olitorius* accession NG/OA/04/010 and the proximate content of the accession in the second dry season (2016).

	CdS	CdR	Moisture Content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content.
CdS Pearson Correlation	1	0.33*	0.46**	0.03	-0.02	0.22	-0.23	-0.12
Sig.(2tailed)		0.04	0.00	0.88	0.92	0.17	0.16	0.49
N								
CdR Pearson Correlation		1	0.72””	-0.09	-0.02	0.34*	-0.08	-0.01
Sig.(2tailed)			0.00	0.60	0.91	0.04	0.61	0.95
N								
Moisture Pearson Correlation			1	-0.10	0.10	0.23	-0.07	0.08
Sig.(2tailed)				0.56	0.54	0.17	0.69	0.64
N								
Ash Pearson Correlation				1	-0.15	-0.21	0.20	0.09
Sig.(2tailed)					0.36	0.31	0.22	0.64
N								
Fat and oil Pearson Correlation					1	0.25	0.17	0.05
Sig.(2tailed)						0.32	0.30	0.75
N								
Protein Pearson Correlation						1	0.27	0.33*
Sig.(2tailed)							0.19	0.05
N								
Fibre Pearson Correlation							1	0.42*
Sig.(2tailed)								0.02
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

CdS=cadmium in shoot. CdR=cadmium in root. CHO=carbohydrate

Table 176: Correlation coefficient between cadmium content of *Corchorous olitorius* NG/AO/04/010 and the proximate content of the vegetable accession in the first rainy season (2016).

	Cd S	Cd R	Moisture content	Ash content	Fat and oil content	Crude protein	Crude fibre	Carbohydrate content
Cd S Pearson Correlation	1	0.24	-0.02	0.33*	-0.01	-0.04	0.16	-0.09
Sig. (2-tailed)		0.14	0.90	0.04	0.96	0.82	0.32	0.57
N								
Cd R Pearson Correlation		1	-0.16	0.48**	-0.19	0.02	0.35*	-0.13
Sig. (2-tailed)			0.34	0.00	0.25	0.91	0.03	0.42
N								
Moisture content Pearson Correlation			1	-0.45**	0.82**	0.52**	-0.65**	-0.55**
Sig. (2-tailed)				0.00	0.00	0.00	0.00	0.00
N								
Ash content Pearson Correlation				1	-0.56**	-0.09	0.67**	-0.14
Sig. (2-tailed)					0.00	0.61	0.00	0.39
N								
Fat and oil content Pearson Correlation					1	0.05	-0.78**	-0.11
Sig. (2-tailed)						0.80	0.00	0.51
N								
Crude protein Pearson Correlation						1	-0.20	-0.91**
Sig. (2-tailed)							0.21	0.00
N								
Crude fibre Pearson Correlation							1	0.21
Sig. (2-tailed)								0.20
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed), *correlation is significant at the 0.05level (2-tailed). Cd S=cadmium content in shoot. Cd R=cadmium content in root.

There was a significant negative correlation between the fat and oil content and the crude fibre (r= - 0.78**) at $p \leq 0.00$. Protein content correlated significantly negative with the crude protein content (r= - 0.91**) at $p \leq 0.00$ in the first rainy season (2016) (Table 176). 177 shows the correlation between cadmium content of *Corchorous olitorius* accession NG/AO/04/010 and the proximate content of the vegetable accession in the second rainy season (2017). There was significant negative correlation between the moisture of the accession and the ash content of the accession (r= - 0.52**) and $p \leq 0.00$ (Table 177). Significant negative correlation between the ash content of the accession and the fat and oil content (r= - 0.61**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre content (r= 0.69**) at $p \leq 0.00$ were recorded (Table 177). There was a significant positive correlation between the fat and oil content and the crude fibre content (r=0.80**) at $p \leq 0.00$. Protein content recorded a significant negative correlation with the carbohydrate content (r = - 0.95**) at $p \leq 0.00$ (Table 177). Table 178 shows the correlation between copper in shoot, root and the proximate composition of *Amaranthus hybridus* NG/AA/03/11/010 in the first dry season (2015). Strong significant positive correlation between the copper content of the shoot, the copper content of the root (r=0.94**) at $p \leq 0.00$, with the ash content (r=0.31*) at $p \leq 0.05$, the carbohydrate content (r=0.31*) at $p \leq 0.05$ and a significant negative with the crude protein content (r= - 0.44**) at $p \leq 0.01$ were recorded (Table 178).

Copper content of the root of the accession had negative significant correlation with the crude protein (r= - 0.32*) at $p \leq 0.05$ (Table 178). The ash content of the accession had strong significant positive correlation with the crude fibre (r=0.95**) at $p \leq 0.00$, the carbohydrate content (r= 0.99**) at $p \leq 0.00$, strong significant negative correlation with the fat and oil content (r= -0.88**) at $p \leq 0.00$ and the crude protein content (r= -0.65**) at $p \leq 0.01$ (Table 178). The crude fat and oil content of the accession had a strong significant positive correlation with the crude protein (r= 0.43**) at $p \leq 0.01$, strong significant negative correlation with the crude fibre (r= - 0.88**) at $p \leq 0.00$ and the carbohydrate content (r= -0.85**) at $p \leq 0.00$ (Table 178). The crude protein of the accession had strong significant negative correlation with the crude fibre (r= - 0.62**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.66**) at $p \leq 0.01$ (Table 178). The crude fibre of the accession had a strong positive correlation with the carbohydrate content of the accession (r= 0.99**) at $p \leq 0.01$ in the first dry season (2015) (Table 178).

Table 177: Correlation between cadmium content of *Corchorous olitorius* NG/AO/04/010 and the proximate content of the vegetable in the second rainy season (2017).

	CdS	CdR	Moisture content	Ash content	Fat and Oil Content	Crude Protein Content	Crude Fibre content	Carbohydrate Content
CdS Pearson Correlation	1	0.18	-0.08	0.17	-0.02	0.04	0.07	-0.13
Sig. (2-tailed)		0.28	0.65	0.31	0.88	0.79	0.66	0.43
N								
CdR Pearson Correlation		1	-0.31	0.05	0.22	-0.13	0.07	0.14
Sig. (2-tailed)			0.06	0.77	0.17	0.43	0.69	0.39
N								
Moisture Pearson Correlation			1	-0.52**	0.24	0.17	-0.24	-0.15
Sig. (2-tailed)				0.00	0.15	0.31	0.15	0.36
N								
Ash content Pearson Correlation				1	-0.61**	-0.09	0.69**	-0.10
Sig. (2-tailed)					0.00	0.59	0.00	0.53
N								
Fat and Oil Pearson Correlation					1	0.03	0.80’’	0.00
Sig. (2-tailed)						0.85	0.00	0.10
N								
Crude Protein Pearson Correlation						1	-0.20	-0.95**
Sig. (2-tailed)							0.23	0.00
N								
Crude Fibre Pearson Correlation							1	0.15
Sig. (2-tailed)								0.35
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 178 : Correlation between copper of shoot , root and theproximate composition of *Amaranthus hybridus* NG/AA/03/11/010 in the first dry season (2015).

	Cu shoot	Cu root	Moisture content	Ash content	fat n oil content	Crude protein content	Crude fibre content	Carbohydrate content
Cu shoot Pearson Correlation	1	0.94**	0.03	0.31*	-0.28	-0.44**	0.29	0.31*
Sig		0.00	0.85	0.05	0.09	0.01	0.07	0.05
Cu root Pearson Correlation		1	0.13	0.14	-0.14	-0.32*	0.10	0.14
Sig			0.44	0.40	0.42	0.05	0.54	0.41
Moisture content Pearson Correlation			1	-0.27	0.10	0.18	-0.28	-0.28
Sig				0.09	0.53	0.26	0.09	0.08
Ash content Pearson Correlation				1	-0.88**	-0.65**	0.95**	0.99**
Sig					0.00	0.00	0.00	0.00
Fat n oils Pearson Correlation					1	0.43**	-0.88**	-0.86**
Sig						0.01	0.00	0.00
Crude protein Pearson Correlation						1	-0.62**	-0.66**
Sig							0.00	0.00
Crude fibre Pearson Correlation							1	0.99**
Sig								0.00
Carbohydrate								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 179 shows the correlation coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content in the second dry season (2016). There were significant positive correlation between the copper content in the shoot, the copper in the root (r=0.70**) at p≤0.00. There were significant positive correlation between the moisture content, the crude fat and oil r=0.38*) at p≤0.02, the crude fibre content(r=0.59**) at p≤0.00, significant negative correlation with the crude fibre content (r= - 0.65**) at p≤0.00 and with the carbohydrate content (r= - 0.63**) at p≤0.00. The ash content had significantly negative correlation with the fat and oil content (r= - 0.97**) at p≤0.00, the crude protein (r = - 0.77**) at p≤0.00, significant positive correlation with the crude fibre (r = 0.86**) at p ≤ 0.00 and the carbohydrate content (r=0.89**) at p≤0.00 (Table 179). There was a significant positive correlation between the crude fat and oil content and the crude protein (r= 0.80**) at p≤0.00, significant negative correlation with the crude fibre (r= - 0.90**) at p≤0.00 and the carbohydrate content (r=0.91**) at p≤0.00.

The crude protein had significant negative correlation with the crude fibre content (r= - 0.84**) at p≤0.00 and the carbohydrate content (r = – 0.85**) at p≤0.00. Crude fibre had a significant positive correlation with the carbohydrate content (r=0.95**) at p ≤0.00 (Table 179).Table 180 presents the correlation coefficient between copper content of *Amaranthus hybridus* NG/AA/03/11/010 and the proximate content of the vegetable accession in first rainy season (2016). Copper content of the shoot had a significant positive correlation with the copper content of the root (r=0.51**) at p ≤0.00 (Table180).

Table 179. Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content in the second dry season (2016).

	CuS	CuR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
CuS Pearson Correlation	1	0.70**	0.23	0.02	-0.01	0.07	-0.10	-0.03
Sig.(2tailed)		0.00	0.17	0.92	0.93	0.65	0.53	0.88
N								
CuR Pearson Correlation		1	-0.11	0.07	-0.06	0.01	0.08	0.08
Sig.(2tailed)			0.51	0.65	0.71	0.93	0.61	0.63
N								
Moisture Pearson Correlation			1	-0.28	0.38*	0.59**	-0.65**	-0.63**
Sig.(2tailed)				0.08	0.02	0.00	0.00	0.00
N								
Ash Pearson Correlation				1	-0.97**	-0.77**	0.86**	0.89**
Sig.(2tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil Pearson Correlation					1	0.80**	-0.90**	-0.91**
Sig.(2tailed)						0.00	0.00	0.00
N								
Protein Pearson Correlation						1	-0.84**	-0.85**
Sig.(2tailed)							0.00	0.00
N								
Crude fibre Pearson Correlation							1	0.95**
Sig.(2tailed)								0.00
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

CuS=cadmium in shoot. CuR=cadmium in root. CHO=carbohydrate

Cu content of the root had significant negative correlation with the moisture content of the vegetable accession (r= - 0.54**) at $p \leq 0.00$. There were significant negative correlation between the percentage moisture of the vegetable accession and the ash content (r= - 0.70**) at $p \leq 0.00$, the crude fibre content (r= - 0.34*) at $p \leq 0.03$, the carbohydrate content (r= - 0.42**) at $p \leq 0.01$, significant positive correlation with the fat and oil content (r=0.45**) at $p \leq 0.01$ and with the crude protein (r=0.46**) at $p \leq 0.00$ (Table 180). There were significant negative correlation between the ash content of the vegetable and the fat and oil content (r= - 0.65**) at $p \leq 0.00$, the crude protein content (r= -0.84**) at $p \leq 0.00$, significant positive correlation with the crude fibre (r=0.71**) at $p \leq 0.00$ and the carbohydrate content (r=0.73**) at $p \leq 0.00$. (Table 180). The fat and oil content of the vegetable had a significant positive correlation with the crude protein content (r=0.77**) at $p \leq 0.00$, negative correlation with the crude fibre (r= - 0.75**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.86**) at $p \leq 0.00$. The crude protein content of the vegetable accession had negative correlation with the crude fibre content (r=- - 0.86**) at $p \leq 0.00$ and with the carbohydrate content (r= - 0.94**) at $p \leq 0.00$. The crude fibre content of the vegetable correlated significantly positive with the carbohydrate content (r=0.80**) at $p \leq 0.00$ (Table 180).

Table 181 shows the correlation between copper content of *Amaranthus hybridus* accession NG/AA/03/11/010, and the proximate content of the vegetable accession in the second rainy season (2017).The Cu content of the root of the accession had a significant negative correlation with the moisture content (r= - 0.33*) at $p \leq 0.04$ and the crude fibre content (r= - 0.38**) at $p \leq 0.02$(Table 181). Significant negative correlation was recorded between the moisture content of the accession , the ash content (r = - 0.62**) at $p \leq 0.00$, the crude fibre content (r= - 0.40) at $p \leq 0.01$, significant positive correlation with the fat and oil content (r= 0.33*) at $p \leq 0.04$ and the crude protein content at (r=0.45**) at $p \leq 0.00$ (Table 181). The ash content of the accession had significant negative correlation with the fat and oil content (r= - 0.60**) $p \leq 0.00$ and the crude protein content (r= - 0.83**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre content (r=0.72**) at $p \leq 0.01$(Table 181).

The fat and oil content of the accession had a significant positive correlation with the crude protein (r=0.72**) at $p \leq 0.00$ and a significant negative correlation with the crude fibre content (r= - 0.70**) at $p \leq 0.00$ (Tble 181). A significant negative correlation between the crude protein and the crude fibre content of the accession (r= - 0.89**) at $p \leq 0.01$ was recorded (Table 181). Table 182 shows the correlation between copper in shoot, root and the nutritional content of *Amaranthus hybridus* accession NG/AO/11/08/039 in the first dry season (2015). The copper concentration of the root had strong significant positive correlation with the fat and oil content (r = 0.99**) at $p \leq 0.00$, the crude protein content (r = 1.00**) at $p \leq 0.00$, the crude fibre content (r= 0.36*) at $p \leq 0.02$, the percentage carbohydrate (r= 0.41**) at $p \leq 0.01$, strong significant negative correlation with the moisture content (r = - 0.96**) and $p \leq 0.00$ and the ash content (r= -0.95**) at $p \leq 0.01$ (Table 182). The moisture content of the accession had a strong significant positive correlation with the ash content (r = 0.91**) at $p \leq 0.01$, strong significant negative correlations with the fat and oil content (r= -0.94**) at $p \leq 0.00$, the crude protein content (r= - 0.96**) at $p \leq 0.00$, the crude fibre content(r= -0.38*) at $p \leq 0.02$ at the carbohydrate content (r= - 0.41**) at $p \leq 0.00$ (Table 182). The ash content of the accession had strong negative correlation with the fat and oil content (r= -0.93**) at $p \leq 0.00$ and the crude protein content (r= - 0.94**) at $p \leq 0.00$, the crude fibre content (r = -0.31*) at $p \leq 0.05$ and the carbohydrate content (r= -0.37* at $p \leq 0.02$ (Table 182).The fat and oil content of the accession had strong significant correlation with the crude protein content at r= 0.99** and $p \leq 0.00$ and with the carbohydrate content (r= 0.32*) at $p \leq 0.05$. (Table 182). The crude protein content of the accession had positive correlation with the crude fibre content (r= 0.35*) at $p \leq 0.03$ and the carbohydrate content (r= 0.39*) at $p \leq 0.05$(Table 182).

There was a strong significant positive correlation between the crude fibre of the accession and the carbohydrate content (r= 0.95**) at $p \leq 0.00$ (Table 182). Table 183 shows the correlation coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/OA/11/08/039 and the proximate content in the second dry season (2016). Copper content in the shoot of *Amaranthus hybridus* accession NG/OA/11/08/039 had a significant positive correlation with the copper content of the root (r= 0.72**) at $p \leq 0.00$. The ash content had significant negative correlation with the fat and oil content (r= - 0.96**) at $p \leq 0.00$, the crude protein (r= - 0.88**) at $p \leq 0.00$, strong significant positive correlation with the crude fibre (r=0.78**) at $p \leq 0.00$ and the carbohydrate content (r=0.98**) at $p \leq 0.00$ (Table 183).

Table 180: Correlation coefficient between copper content of *Amaranthus hybridus* NG/AA/03/11/010 and the proximate content of the vegetable accession in the first rainy (2016).

	Cu S	Cu R	Moisture content	Ash content	Fat and oil content	Crude protein content	Crude fibre content	Carbohydrate conetnt
Cu S Pearson Correlation	1	0.51**	-0.05	-0.07	0.24	-0.09	-0.09	0.06
Sig. (2-tailed)		0.00	0.77	0.67	0.14	0.60	0.60	0.73
N								
Cu R Pearson Correlation		1	-0.54**	0.12	-0.15	-0.17	0.00	0.21
Sig. (2-tailed)			0.00	0.45	0.48	0.31	0.99	0.20
N								
Moisture content Pearson Correlation			1	-0.70**	0.45**	0.46**	-0.34*	-0.42**
Sig. (2-tailed)				0.00	0.01	0.00	0.03	0.01
N								
Ash content Pearson Correlation				1	-0.65**	-0.84**	0.71**	0.73**
Sig. (2-tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil content Pearson Correlation					1	0.77**	-0.75**	-0.86**
Sig. (2-tailed)						0.00	0.00	0.00
N								
Crude protein content Pearson Correlation						1	-0.86**	-0.94**
Sig. (2-tailed)							0.00	0.00
N								
Crude fibre content Pearson Correlation							1	0.80**
Sig. (2-tailed)								0.00
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

**correlation is significant at the 0.01level (2-tailed). * correlation is significant at the 0.05level (2-tailed). Cu S=copper content in shoot. Cu R=copper content in root.

Table 181: Correlation between copper content of *Amaranthus hybridus* NG/AA/03/11/010 ,and the proximate content of the vegetable accession in the second rainy season (2017).

	CuS	CuR	Moisture content	Ash content	Fat and Oil Content	Crude Protein Content	Crude Fibre content	Carbohydrate content
CuS Pearson Correlation	1	-0.07	-0.29	0.11	-0.22	-0.09	-0.00	0.24
Sig. (2-tailed)		0.67	0.70	0.51	0.19	0.57	0.99	0.14
N								
CuR Pearson Correlation		1	-0.33’	0.30	-0.13	-0.27	0.38’	0.25
Sig. (2-tailed)			0.04	0.07	0.44	0.10	0.02	0.13
N								
Moisture Pearson Correlation			1	-0.62	0.33’	0.45’’	-0.40’	-0.16
Sig. (2-tailed)				0.00	0.04	0.00	0.01	0.35
N								
Ash content Pearson Correlation				1	-0.60’’	-0.83’’	0.72’’	0.20
Sig. (2-tailed)					0.00	0.00	0.00	0.22
N								
Fat and Oil Pearson Correlation					1	0.72’’	-0.70’’	-0.19
Sig. (2-tailed)						0.00	0.00	0.25
N								
Crude Protein Pearson Correlation						1	-0.89’’	-0.14
Sig. (2-tailed)							0.00	0.39
N								
Crude Fibre Pearson Correlation							1	0.19
Sig. (2-tailed)								0.26
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 182:. Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/OA/11/08/039 and the proximate content in the first dry season (2015).

	Cu shoot	Cu root	Moisture content	Ash content	fat and oil cotent	Crude protein content	Crude fibre content	Carbohydrate content
Cu shoot Pearson Correlation	1	-0.17	0.09	0.10	0.19	-0.19	0.02	-0.05
Sig		0.30	0.57	0.42	0.24	0.26	0.90	0.75
Cu root Pearson Correlation		1	-0.96”	-0.95”	0.99”	1.00”	0.36’	0.41”
Sig			0.00	0.00	0.00	0.00	0.02	0.01
Moisture content Pearson Correlation			1	0.91”	-0.94”	-0.96”	-0.38’	-0.41”
Sig				0.00	0.00	0.00	0.02	0.00
Ash content Pearson Correlation				1	-0.93”	-0.94”	-0.31’	-0.37”
Sig					0.00	0.00	0.05	0.02
Fat n oil contentPearson Correlation					1	0.99”	0.29	0.32*
Sig						0.00	0.08	0.05
Crude protein content Pearson Correlation						1	0.35*	0.39*
Sig							0.03	0.02
Crude fibre fibre content Pearson Correlation							1	0.95**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

The fat and oil had a strong significant positive correlation with the crude protein with ($r=0.86^{**}$) at $p \leq 0.00$, strong significant negative correlation with the crude fibre ($r= - 0.74^{**}$) at $p \leq 0.00$ and with carbohydrate content ($r= - 0.96^{**}$) at $p \leq 0.00$. Crude protein had strong negative significant correlation with the crude fibre ($r= - 0.51^{**}$) at $p \leq 0.00$ and the carbohydrate content ($r= - 0.84^{**}$) at $p \leq 0.00$ (Table 183). The crude fibre had a strong significant positive correlation with the carbohydrate content ($r= 0.82^{**}$) at $p \leq 0.00$ (Table 183). Table 184 presents the correlation coefficient between copper content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession in the first rainy season (2016). Copper content of the shoot of the vegetable accession correlated significantly positive with the copper content of the root ($r=0.86^{**}$) at $p \leq 0.00$ (Table 184). There were significant negative correlation between the moisture content and the ash content ($r= -0.78^{**}$) at $p \leq 0.00$, the crude fibre content ($r= - 0.47^{**}$) at $p \leq 0.00$, the carbohydrate content ($r = - 0.44^{**}$) at $p \leq 0.01$, significant positive correlation with the fat and oil content ($r=0.39^{**}$) at $p \leq 0.01$ and the crude protein at ($r=0.52^{**}$) at $p \leq 0.00$ (Table 184).

The ash content of the vegetable had significant negative correlation with the fat and oil content ($r= - 0.61^{**}$) at $p \leq 0.00$, the crude protein content ($r= - 0.83^{**}$) at $p \leq 0.00$, significant positive correlation with the crude fibre content ($r=0.73^{**}$) at $p \leq 0.00$ and the carbohydrate content($r=0.74^{**}$) at $p \leq 0.00$. There was a significant positive correlation between the fat and oil content of the vegetable accession and the crude protein ($r =0.76^{**}$) at $p \leq 0.00$, significant negative correlation with then crude fibre ($r= - 0.73^{**}$) at $p \leq 0.00$ and with the carbohydrate content ($r= - 0.82^{**}$) at $p \leq 0.00$ (Table 184). Significant negative correlation were obtained between the crude protein content and the crude fibre content ($r= -0.89^{**}$) and $p \leq 0.00$ and with the carbohydrate content ($r= -0.96^{**}$) at $p \leq 0.00$. Crude fibre content of the vegetable accession had significant positive correlation with the carbohydrate content ($r=0.84^{**}$) at $p \leq 0.00$ (Table 184).

Table 183:. Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NG/OA/11/08/039 and the proximate content in the second dry season (2016).

	CuS	CuR	Moisture content	Ash content	Fat and oil content	CrudeProtein content	Crude fibre content	CHO content
CuS Pearson Correlation	1	0.72**	-0.17	0.09	-0.11	-0.01	0.12	0.10
Sig.(2tailed)		0.00	0.28	0.58	0.53	0.97	0.48	0.54
N								
CuR Pearson Correlation		1	0.25	0.25	-0.26	-0.14	0.34	0.26
Sig.(2tailed)			0.12	0.12	0.11	0.41	0.03	0.11
N								
Moisture Pearson Correlation			1	-0.15	0.01	0.10	-0.05	-0.16
Sig.(2tailed)				0.37	0.96	0.54	0.75	0.34
N								
Ash Pearson Correlation				1	-0.96**	-0.88**	0.78**	0.98**
Sig.(2tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil Pearson Correlation					1	0.86**	-0.74**	-0.96**
						0.00	0.00	0.00
Sig.(2tailed)								
N								
Protein Pearson Correlation						1	-0.51**	-0.84**
Sig.(2tailed)							0.00	0.00
N								
Fibre Pearson Correlation							1	0.82**
Sig.(2tailed)								0.00
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed)

CuS=cadmium in shoot. CuR=cadmium in root. CHO=carbohydrate

Table 185 presents the correlation coefficient between copper content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession in the second rainy season (2017). Copper content of the shoot of the vegetable accession correlated significantly positive with the copper content of the root (r=0.86**) at p≤ 0.00 (Table 185). There were significant negative correlation between the moisture content and the ash content (r= -0.78**) at p≤ 0.00, the crude fibre content (r= - 0.47**) at p ≤ 0.00, the carbohydrate content (r = - 0.44**) at p≤ 0.01, significant positive correlation with the fat and oil content (r=0.39**) at p≤0.01 and the crude protein at r=0.52** and p≤ 0.00 (Table 185).

The ash content of the vegetable had significant negative correlation with the fat and oil content (r= - 0.61**) at p≤ 0.00, the crude protein content (r= - 0.83**) at p≤ 0.00, significant positive correlation with the crude fibre content (r=0.73**) at p≤0.00 and the carbohydrate content (r=0.74**) at p≤0.00. There was a significant positive correlation between the fat and oil content of the vegetable accession and the crude protein (r=0.76**) at p≤0.00, significant negative correlation with then crude fibre (r= - 0.73**) at p≤0.00 and with the carbohydrate content (r= - 0.82**) at p≤ 0.00 (Table 185). Significant negative correlation were obtained between the crude protein content and the crude fibre content (r= -0.89**) at p≤ 0.00 and with the carbohydrate content (r= -0.96**) at p ≤0.00. Crude fibre content of the vegetable accession had significant positive correlation with the carbohydrate content (r=0.84**) at p≤0.00 (Table 185).

Table 184 : Correlation coefficient between copper content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession first rainy season (2016).

	Cu S	Cu R	Moisture content	Ash content	Fat and oil content	Crude protein content	Crude fibre content	Carbohydrate content
Cu S Pearson Correlation	1	0.86**	-0.03	-0.18	0.26	0.02	-0.18	0.04
Sig. (2-tailed)		0.00	0.88	0.28	0.11	0.90	0.26	0.80
N								
Cu S Pearson Correlation		1	-0.21	-0.07	0.23	0.12	-0.22	-0.06
Sig. (2-tailed)			0.20	0.68	0.16	0.47	0.17	0.72
N								
Moisture content Pearson Correlation			1	-0.78**	0.39**	0.52**	-0.47**	-0.44**
Sig. (2-tailed)				0.00	0.01	0.00	0.00	0.01
N								
Ash content Pearson Correlation				1	-0.61**	-0.83**	0.73**	0.74**
Sig. (2-tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil content Pearson Correlation					1	0.76**	-0.73**	-0.82**
						0.00	0.00	0.00
Sig. (2-tailed)								
N								
Crude protein content Pearson Correlation						1	-0.89**	-0.96**
							0.00	0.00
Sig. (2-tailed)								
N								
Crude fibre content Pearson Correlation							1	0.84**
								0.00
Sig. (2-tailed)								
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed), * correlation is significant at the 0.05 level (2-tailed). Cu S=copper content in shoot. Cu R=copper content in root.

Table 185 : Correlation coefficient between copper content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession in the second rainy season (2017)

	Cu S	Cu R	Moisture content	Ash content	Fat and oil content	Crude protein content	Crude fibre content	Carbohydrate content
Cu S Pearson Correlation	1	0.86**	-0.03	-0.18	0.26	0.02	-0.18	0.04
Sig. (2-tailed)		0.00	0.88	0.28	0.11	0.90	0.26	0.80
N								
Cu S Pearson Correlation		1	-0.21	-0.07	0.23	0.12	-0.22	-0.06
Sig. (2-tailed)			0.20	0.68	0.16	0.47	0.17	0.72
N								
Moisture content Pearson Correlation			1	-0.78**	0.39**	0.52**	-0.47**	-0.44**
Sig. (2-tailed)				0.00	0.01	0.00	0.00	0.01
N								
Ash content Pearson Correlation				1	-0.61**	-0.83**	0.73**	0.74**
Sig. (2-tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil content Pearson Correlation					1	0.76**	-0.73**	-0.82**
Sig. (2-tailed)						0.00	0.00	0.00
N								
Crude protein content Pearson Correlation						1	-0.89**	-0.96**
Sig. (2-tailed)							0.00	0.00
N								
Crude fibre content Pearson Correlation							1	0.84**
Sig. (2-tailed)								0.00
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed), * correlation is significant at the 0.05 level (2-tailed). Cu S=copper content in shoot. Cu R=copper content in root

Table 186 shows the correlation between copper in shoot , root and the proximate composition of *Amaranthus hybridus* NGBO 125 in the first dry season (2015). The copper concentration of the shoot of the accession had strong significant positive correlation with the copper content of the root (r= 0.72**) at $p \leq 0.00$, the moisture content (r= 0.35**) at $p \leq 0.00$, the fat and oil content (r= 0.52**) at $p \leq .00$ and the crude protein content (r=0.73**) at $p \leq 0.00$, strong significant negative correlation with the crude fibre content (r = - 0.74**) at $p \leq 0.00$, the carbohydrate content (r= -0.73**) at $p \leq 0.00$ and with the ash content (r= -0.36*) at $p \leq 0.02$ (Table 186). Copper concentration of the root of the accession had strong significant positive correlation with the moisture content (r= 0.55**) at $p \leq 0.00$, the fat and oil content (r= 0.40**) at $p \leq 0.01$ and crude protein content of the accession (r= 0.65**) at $p \leq 0.00$, strong significant negative correlation with the crude fibre content (r = - 0.67**) and $p \leq 0.00$ and the carbohydrate content (r= -0.66**) at $p \leq 0.00$ (186). The moisture content of the accession had a significant positive correlation with fat and oil content (r= 0.26*) at $p \leq 0.04$, significant negative correlation with the crude fibre content (r= - 0.54 **) at $p \leq 0.00$ and the carbohydrate content (r= - 0.29*) at $p \leq 0.04$. The ash content of the accession had strong positive significant correlation with the crude protein content (r= 0.60**) at $p \leq 0.00$, crude fibre content (r= 0.54**) at $p \leq 0.00$, the carbohydrate content (r= 0.59**) at $p \leq 0.00$ and a strong negative significant correlation with the fat and oil content (r= - 0.45**) at $p \leq 0.00$ (Table 186). The fat and oil content of the accession had a strong significant positive correlation with the crude protein content (r= 0.87**) at $p \leq 0.00$ and negative correlation with the crude fibre (r= -0.80**) at $p \leq 00$ and carbohydrate content (r= - 0.88**) at $p \leq 0.01$ (Table 186).

There were strong negative significant correlation between the crude protein content, the crude fibre content (r= -0.91**) at $p \leq 0.00$ and the carbohydrate content (r= -1.00**) at $p \leq 0.00$ (Table 186). The crude fibre of the accession had a strong significant positive correlation with the carbohydrate content (r= 0.91**) .at $p \leq 0.00$ (Table 186). Table 187 shows the correlation coefficient between the copper of the shoots, roots of *Amaranthus hybridus* accession NGBO125 and the proximate content in the second dry season (2016). Copper content in the shoot of *Amaranthus hybridus* accession NGBO125 had significant positive correlation with the copper content of the root (r=0.71**) at $p \leq 0.00$ (Table 187).

Table 186: Correlation between copper of shoot , root and the proximate composition of *Amaranthus hybridus* NGBO 125 in the first dry season (2015).

	Cu shoot	Cu root	Moisture Content	Ash content	Fat and oils content	Crude protein content	Crude fibre content	Carbohydrate content
Cu shoot Pearson Correlation	1	0.72**	0.35**	-0.36*	0.52**	0.73**	-0.74**	-0.73**
Sig		0.00	0.00	0.02	0.00	0.00	0.00	0.00
Cu root Pearson Correlation		1	0.55**	-0.29	0.40**	0.65**	-0.67**	-0.66**
Sig			0.00	0.08	0.01	0.00	0.00	0.00
Moisture content Pearson Correlation			1	-0.07	0.26*	0.24	-0.54**	-0.29*
Sig				0.58	0.04	0.06	0.00	0.04
Ash content Pearson Correlation				1	-0.45**	0.60**	0.54**	0.59**
Sig					0.00	0.00	0.00	0.00
Fat and oils content Pearson Correlation					1	0.87**	-0.80**	-0.88**
Sig						0.00	0.00	0.00
Crude protein Pearson Correlation						1	-0.91**	-1.00**
Sig							0.00	0.00
Crude fibre content Pearson Correlation							1	0.91**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

The ash content of the accession was significantly negative correlated with the crude fat and oil content (r= - 0.84**) at p≤0.00, the crude protein content (r= -0.67**) at p≤0.00, significant positive correlation with the crude fibre (r= 0.95**) at p≤0.00 and the carbohydrate content (r=0.98**) at p≤0.00 suggesting no interaction between the ash content of the accession, the fat and oil and the crude protein but a strong interaction and the same imput with the crude fibre (Table 187). The fat and oil content had significant positive correlation with the crude protein fibre (r=0.54**) at p≤0.00, significant negative correlation with the crude fibre (r = -0.87**) at p≤0.00 and the carbohydrate content (r = - 0.89**) at p≤0.00. Crude protein content had a significant negative correlation with the crude fibre (r = -0.72**) at p≤0.00 and the carbohydrate content (r = - 0.69**) at p ≤0.00. The crude fibre content correlated significantly positive with the carbohydrate content indicating strong interaction from the same imput (r = 0.96**) at p≤0.00 (Table 187). Table 188 shows the correlation coeffient between cadmium content of *Amaranthus hybridus* accession NGO125 and the proximate content of the vegetable accession in the first rainy season (2016).

There were significant positive correlation between the cadmium content of the shoot, the cadmium content of the root (r=0.33*) at p ≤0.04, the ash content (r=0.48**) at p ≤0.00, the crude fibre (r=0.37**) at p ≤ 0.00, the carbohydrate content (r=0.38*) at p ≤0.02, significant negative correlation with the moisture content (r= - 0.33*) and the crude protein content (r= - 0.44**) at p ≤0.01 (Table 188). The cadmium content of the root had significant positive correlation with the ash content (r=0.61**) at p≤0.00, the crude fibre (r=0.43**) and p ≤ 0.01, the carbohydrate content (r=0.42**) at p ≤ 0.01, significant negative correlation with the moisture content (r= - 0.38*) at p≤0.02 and the crude protein (r= - 0.53**) at p ≤0.00 (Table 188). There were significant negative correlation between the moisture content of the accession, the ash content (r = – 0.78**) at p ≤0.00, the crude fat and oil content (r= - 0.40**) at p ≤0.01, the crude fibre (r= - 0.46**) at p ≤0.00, the carbohydrate content (r= - 0.44**) at p ≤0.01 and a significant positive correlation with crude protein (r=0.52**) at p ≤0.00 (Table 188).

Table 187: Correlation Coefficient between the copper of the shoots, roots of *Amaranthus hybridus accession NGBO125* and the proximate content in the second dry season(2016).

	CuS	CuR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
CuS Pearson Correlation	1	0.71**	0.15	-0.08	0.07	0.07	-0.12	-0.16
Sig.(2tailed)		0.00	0.35	0.96	0.70	0.70	0.47	0.33
N								
CuR Pearson Correlation		1	0.13	0.01	-0.12	0.15	-0.11	-0.02
Sig.(2tailed)			0.42	0.96	0.49	0.59	0.87	0.91
N								
Moisture Pearson Correlation			1	0.10	0.00	-0.13	0.17	0.09
Sig.(2tailed)				0.55	0.98	0.43	0.48	0.57
N								
Ash Pearson Correlation				1	-0.84**	-0.67**	0.95**	0.98**
Sig.(2tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil Pearson Correlation					1	0.54**	-0.87**	-0.89**
Sig.(2tailed)						0.00	0.00	0.00
N								
Protein Pearson Correlation						1	-0.72**	-0.69**
Sig.(2tailed)							0.00	0.00
N								
Fibre Pearson Correlation							1	0.96**
Sig.(2tailed)								0.00
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

CuS=cadmium in shoot. CuR=cadmium in root. CHO=carbohydrate

There were significant negative correlation between the ash content, the fat and oil content (r= - 0.61**) at $p \leq 0.01$, the crude protein (r= - 0.83**) at $p \leq 0.00$, significant positive correlation with the crude fibre (r= -0.73**) at $p \leq 0.00$ and the carbohydrate content (r= 0.73**) and the $p \leq 0.00$ (Table 188). The fat and oil content had significant negative correlation with the crude fibre (r= - 0.73**) at $p \leq 0.00$, the carbohydrate content (r= - 0. 82**) at $p \leq 0.00$ and a significant positive correlation with the crude protein (r= 0.76**) at $p \leq 0.00$. The crude fibre had significant negative correlation with the crude protein (r = - 0.89**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.96) at $p \leq 0.00$ (Table 188).

Table 189 presents the correlation between copper content of *Amaranthus hybridus* NGO125 and the proximate content of the vegetable accession in the second rainy season (2017). Copper content of the shoot had a significant negative correlation with the ash content (r = - 0.34*) at $p \leq 0.03$ (Table 188). Cu content of the root had a significant correlation with the crude protein content (r = - 0.44*) at $p \leq 0.00$ and a significant negative correlation between the moisture content , the ash content (r= - 0.70**) at $p \leq 0.00$, the crude fibre (r = - 0.78**) at $p \leq 0.00$, a significant positive correlation with the crude crude fat and oil content (r= 0.47**) at $p \leq 0.00$, the crude protein content (r= 0.54**) at $p \leq 0.00$ and the carbohydrate content (r= 0.41**) at $p \leq 0.03$ were recorded (Table 189). Ash content of the accession had a significant negative correlation with the crude protein content (r= – 0.52**) at $p \leq 0.01$ and a significant positive correlation with the the crude fibre (r=0.88**) at $p \leq 0.00$ (Table 189). There was a significant positive correlation between the crude fat and oil content nd the crude protein content (r = 0.49**) at $p \leq 0.04$ ** (Table 189). Significant negative correlation between the crude protein and the crude fibre content (r= - 0.40*) at $p \leq 0.\ 02$ was recorded.

Table 188: Correlation between cadmium content of *Amaranthus hybridus NGO125* and the proximate content of the vegetable accession in the first rainy season (187).

	CdS	CdR	Moisture.	Ash	. Fat	Protein	Fibre	CHO
CdS Pearson Correlation	1	0.33*	-0.33*	0.48**	-0.30	-0.44**	0.37**	0.38*
Sig. (2-tailed)		0.04	0.04	0.00	0.06	0.01	0.00	0.02
N								
CdR . Pearson Correlation		1	-0.38*	0.61**	-0.28	-0.53**	0.43**	0.42**
Sig. (2-tailed)			0.02	0.00	0.09	0.00	0.01	0.01
N								
Moisture Pearson Correlation			1	-0.78**	-0.40**	0.52**	-0.46**	-0.44**
Sig. (2-tailed)				0.00	0.01	0.00	0.00	0.01
N								
Ash Pearson Correlation				1	-0.61**	-0.83**	0.73**	0.74**
Sig. (2-tailed)					0.01	0.00	0.00	0.00
N								
Fat and oil Pearson Correlation					1	0.76**	-0.73**	-0.82**
Sig. (2-tailed)						0.00	0.00	0.00
N								
. Crude fibre Pearson Correlation						1	-0.89**	-0.96**
Sig. (2-tailed)							0.00	0.00
N								
Crude protein Pearson Correlation							1	0.84**
Sig. (2-tailed)								0.00
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

**correlation is significant at the 0.01level (2-tailed). correlation is significant at the 0.05level (2-tails)

Table 190 shows the correlation between copper in shoot , root and the nutritional content of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season (2015). The copper concentration of the shoot of the accession had strong positive significant correlation with the copper content of the root (r=0.77**) at $p \leq 0.00$, the crude fat and oil content (r= 0.54**) at $p \leq 0.00$, the crude protein content of the accession (r= 0.75**) at $p \leq 0.00$, strong significant negative correlation with the ash content (r= - 0.34*) at $p \leq 0.03$, the crude fibre content (r= - 0.72**) at $p \leq 0.00$ and carbohydrate content (r= - 0.70**) at $p \leq 0.00$ (Table 190). The copper concentration of the root had strong significant positive correlation with the moisture content of the accession (r= 0.57**) at $p \leq 0.00$, the crude fat and oil content (r = 0.42*) at $p \leq 0.02$, the crude protein content (r = 0.67**) at $p \leq 0.01$, strong significant negative correlation with the crude fibre (r = - 0. 67**) at $p \leq .00$ and the carbohydrate content (r= - 0.27*) at $p \leq 0.04$ (Table 190).

The moisture content of the accession had a significant positive correlation with the fat and oil content (r = 0.29*) at $p \leq 0.05$, significant negative correlation with crude fibre (r = - 0.49**) at $p \leq 0.00$ and carbohydrate content (r = - 0.27*) at $p \leq 0.04$ (Table 190). The ash content of the accession had strong significant positive correlation with the crude fibre content (r = 0.51**) at $p \leq .01$ and the carbohydrate content (r= 0.59 **) at $p \leq 0.00$, strong significant negative correlation with the fat and oil content (r = - 0.44*) at $p \leq 0.02$ and crude protein content (r= - 0.61**) at $p \leq 0.00$ (Table 190). The crude fat and oil content had strong significant positive correlation with the crude protein (r= 0.85**) at $p \leq 0.00$, crude fibre (r= 0.81**) at $p \leq 0.00$, and a strong significant negative correlation with the carbohydrate content (r= 0.83**) at $p \leq 0.01$ (Table 190). The crude protein had strong significant negative correlation with the crude fibre content (r= - 0.79**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.94**) at $p \leq 0.00$ (Table 190).

Table 189: Correlation between copper content of *Amaranthus hybridus* NGO125 and the proximate content of the vegetable accession in the second rainy season (2017).

	CuS	CuR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate content
CuS Pearson Correlation	1	0.07	-0.18	-0.34*	0.19	0.18	-0.24	-0.21
Sig. (2-tailed)		0.69	0.27	0.03	0.24	0.28	0.13	0.19
N								
CuR Pearson Correlation		1	-0.24	0.19	-0.07	-0.44**	0.26	-0.18
Sig. (2-tailed)			0.14	0.24	0.68	0.00	0.11	0.27
N								
Moisture Pearson Correlation			1	-0.70**	0.47**	0.54**	-0.78**	0.41*
Sig. (2-tailed)				0.00	0.01	0.00	0.00	0.03
N								
Ash content Pearson Correlation				1	-0.30	-0.52**	0.88**	-0.14
Sig. (2-tailed)					0.06	0.00	0.00	0.40
N								
Fat and Oil Pearson Correlation					1	0.49**	-0.22	-0.28
Sig. (2-tailed)						0.00	0.17	0.09
N								
Crude Protein Pearson Correlation						1	-0.40*	0.01
Sig. (2-tailed)							0.02	0.96
N								
Crude Fibre Pearson Correlation							1	-0.39*
Sig. (2-tailed)								0.02
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05 level (2-tailed)

There was strong significant positive correlation between the crude fibre content and the carbohydrate content ($r= 0.94^{**}$) at $p \leq 0.01$ (Table 190). Table 191 shows the correlation coefficient between the copper of the shoots, roots of *Corchorous olitorius* accession NG/OA/Jun/09/002 and the proximate content in the second dry season (2016). There was significant positive correlation between the copper content of the shoot of *Corchorous olitorius* accession NG/OA/Jun/09/002 and the root ($r= 0.67^{**}$) at $p \leq 0.00$ (Table 191). The moisture content had significant positive correlation with the ash content ($r=0.58^{**}$) at $p \leq 0.00$, the crude fibre content ($r=0.79^{**}$) at a significant negative correlation ($r= - 0.70^{**}$) at $p \leq 0.00$ (Table 191). There was a significant negative correlation between the ash content, the crude protein content ($r = -0.48^{*}$) at $p \leq 0.00$ and a significant positive correlation with the crude fibre ($r=0.75^{*}$) at $p \leq 0.00$. The crude protein content correlated significantly negative with the crude fibre content ($r= - 0.83^{**}$) at $p \leq 0.00$ (Table 191).

Table 192 shows the correlation between copper content of *Corchorous olitorius* accession NG/OA/jun/09/002 and the proximate content of the vegetable accession in the first rainy season (2016). The copper content of the shoot had a significant positive correlation with copper content of the root at ($r=0.83^{**}$) at $p \leq 0.00$, significant negative correlation with the ash content ($r= - 0.49^{**}$) at $p \leq 0.00$ and the crude protein content ($r= - 0.33^{*}$) at $p \leq 0.04$ (Table 192). Cu content of the root was significantly negatively correlated with the ash content ($r= - 0.45^{*}$) at $p \leq 0.04$ and a significant negative correlation with the protein content ($r= - 0.33^{*}$) at $p \leq 0.04$ (Table 192). The moisture content had a significant negative correlation with the ash content ($r= - 0.33^{*}$) at $p \leq 0.04$, the crude fibre content ($r= -0.71^{**}$) at $p \leq 0.00$ and a significant positive correlation with the fat and oil content ($r=0.45^{**}$) at $p \leq 0.00$ (Table 192).

Table 190: Correlation between copper of shoot , root and the proximate composition of *Corchorus olitorius* accession NG/OA/Jun/09/002 in the first dry season (2015).

	Cu shoot	Cu root	Moisture content	Ash content	Fat n oils content	Crude protein	Crude fibre	Carbohydrate content
Cu shoot Pearson Correlation	1	0.77**	0.35	-0.34*	0.54**	0.73”	-0.72**	-0.70**
Sig		0.00	0.31	0.03	0.00	0.00	0.00	0.00
Cu root Pearson Correlation		1	0.55**	-0.29	0.40**	0.65”	-0.67**	-0.66”
Sig			0.00	0.08	0.01	0.00	0.00	0.00
Moisture content Pearson Correlation			1	-0.07	0.29*	0.24	-0.49**	-0.27*
Sig				0.58	0.05	0.61	0.00	0.04
Ash content Pearson Correlation				1	-0.44”	-0.61”	0.51**	0.59”
Sig					0.02	0.00	0.01	0.00
Fat n oil content Pearson Correlation					1	0.85**	0.81**	-0.83”
Sig						0.00	0.00	0.00
Crude protein content Pearson Correlation						1	-0.79**	-0.94”
Sig							0.00	0.00
Crude fibre content Pearson Correlation							1	0.94”
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

There were significant negative correlation between the ash content and the crude fat and oil (r= - 0.42**) at $p \leq 0.00$, the crude protein (r= - 0.32**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre content (r=0.58**) at $p \leq 0.00$ (Table 192). Fat and oil content had a significant positive correlation with the crude protein content (r=0.67**) at $p \leq 0.00$ and a significant negative correlation with the crude fibre content (r= - 0.64**) at $p \leq 0.00$ (Table 192). Crude protein content had a significant negative correlation with the crude fibre content (r= -0.69**) at $p \leq 0.00$ (Table 192). Table 193 presents the correlation between copper content of *Corchorous olitorius* NG/OA/jun/09/002 and the proximate content of the vegetable accession in the second rainy season (2017). The copper content in the root had significant negative correlation with the moisture content (r = - 0.32*) at $p \leq 0.05$, the crude protein content (r= 0.35*) $p \leq 0.02$ and a positive correlation with the crude fibre content (r= 0.38**) at $p \leq 0.02$ (Table 193). The moisture content of the accession had significant negative correlation with the ash content (r = - 0.54**) at $p \leq 0.00$, the crude fat and oil content (r= - 0.42 *) at $p \leq 0.01$ and a significant correlation with the crude protein content (r= 0.35*) at $p \leq 0.05$ (Table 193).

The ash content of the accession had significant negative correlation with the fat and oil content (r= - 0.44**) at $p \leq 0.00$, with the crude protein (r= - 0.37*) at $p \leq 0.02$ and a significant positive correlation with the crude fibre (r = 0.61**) at $p \leq 0.00$ and a significant positive correlation between the crude fat and oil content of the accession, the crude protein fibre (r= 0.60**) at $p \leq 0.00$, significant negative with crude fibre (r=0.65**) at $p \leq 0.00$ were recorded (Table 193). There was significant negative correlation between the crude protein content of the accession and the crude fibre at $p \leq 0.01$. There was a significant negative correlation between the crude protein content of the accession and crude fibre content (r= - 0.73**) at $p \leq 0.00$ (Table 193).

Table 191: Correlation Coefficient between the copper of the shoots, roots of *Corchorous olitorius* accession NG/OA/Jun/09/002 and the proximate content in the second dry season (2016).

	CuS	CuR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
CuS Pearson Correlation	1	0.67**	0.11	-0.16	0.02	0.01	0.01	0.07
Sig.(2tailed)		0.00	0.51	0.33	0.89	0.96	0.96	0.67
N								
CuR Pearson Correlation		1	0.19	0.04	0.04	-0.14	0.13	0.21
Sig.(2tailed)			0.25	0.84	0.79	0.40	0.45	0.21
N								
Moisture Pearson Correlation			1	0.58**	0.16	-0.70**	0.79**	0.13
Sig.(2tailed)				0.00	0.33	0.00	0.00	0.44
N								
Ash Pearson Correlation				1	0.20	-0.48**	0.75**	-0.20
Sig.(2tailed)					0.22	0.00	0.00	0.23
N								
Fat and oil Pearson Correlation					1	-0.05	0.09	-0.29
Sig.(2tailed)						0.77	0.58	0.07
N								
Protein Pearson Correlation						1	-0.83**	-0.14
Sig.(2tailed)							0.00	0.39
N								
Fibre Pearson Correlation							1	-0.08
Sig.(2tailed)								0.65
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).CuS=copper in shoot. CuR=copper in root. CHO=carbohydrate

Table 192: Correlation between copper content of *Corchorous olitorius* accession NG/OA/jun/09/002 and the proximate content of the vegetable accession in the first rainy season (2016) .

	Cu S	Cu R	Moisture content	Ash content	Fat and oil content	Crude protein	Crude fibre	Carbohydratecontent.
Cu S Pearson Correlation	1	0.83**	-0.04	-0.49**	-0.24	-0.33*	0.05	-0.23
Sig. (2-tailed)		0.00	0.83	0.00	0.14	0.04	0.78	0.17
N								
Cu R Moisture Pearson Correlation		1	0.03	-0.45*	-0.11	-0.33*	0.09	-0.02
Sig. (2-tailed)			0.86	0.04	0.52	0.04	0.60	0.90
N								
Moisture content Pearson Correlation			1	-0.33	0.45**	0.24	-0.71**	0.22
Sig. (2-tailed)				0.04	0.00	0.14	0.00	0.17
N								
Ash content Pearson Correlation				1	-0.42**	-0.32*	0.58**	0.01
Sig. (2-tailed)					0.00	0.05	0.00	0.96
N								
Fat and oil content Pearson Correlation					1	0.67**	-0.64**	0.21
Sig. (2-tailed)						0.00	0.00	0.19
N								
Crude protein Pearson Correlation						1	-0.69**	0.09
Sig. (2-tailed)							0.00	0.60
N								
Crude fibre Pearson Correlation							1	-0.12
Sig. (2-tailed)								0.46
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed). *correlation is significant at the 0.05level (2-tailed)

Table 194 shows the correlation between copper in shoot, root and the nutritional content of *Corchorus olitorius* NG/OA/04/010 in the first dry season (2015). Copper concentration of the shoot of the accession has strong positive significant correlation with the copper concentration of the root (r= 0.49*) at $p \leq 0.00$, the crude fibre content (r= 0.80**) at $p \leq 0.00$, significant negative correlation with the crude protein content (r= - 0.79**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.30*) at $p \leq 0.05$ (Table 194).There were significant negative correlation between the copper concentration of the shoot, the ash content (r= - 0.60**) at $p \leq 0.00$, the fat and oil content (r= - 0.49 *) at $p \leq 0.003$, the crude protein content (r= - 0 .46**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre (r= 0.72**) at $p \leq 0.00$ (Table 194). The moisture content of the accession had a significant positive correlation with the ash content (r= 0.29*) at $p \leq 0.05$ and a significant negative correlation with the carbohydrate content at r= - 0.33*) at $p \leq 0.04$ (Table 194).

There was a significant negative correlation between the ash content of the accession and the crude fibre content (r= - 0.44**) at $p \leq 0.01$(Table 194). The fat and oil content of the accession had a strong significant positive correlation with the crude protein content (r= 0.61** and $p \leq 0.00$ and a strong negative correlation with the carbohydrate content of the accession (r= - 0.80**) at $p \leq 0.00$ (Table 194). The crude protein content of the accession had a strong significant negative correlation with the crude fibre content (r= - 0.76**) at $p \leq 0.00$ (Table 194). The moisture content of the accession had a significant positive correlation with the ash content (r= 0.29*) at $p \leq 0.05$ and a significant negative correlation with the carbohydrate content (r= - 0.33*) at $p \leq 0.04$ (Table 194). There was a significant negative correlation between the ash content of the accession and the crude fibre content (r= - 0.44**) at $p \leq 0.01$(Table 194). The fat and oil content of the accession had a strong significant positive correlation with the crude protein content (r= 0.61**) at $p \leq 0.00$ and a strong negative correlation with the carbohydrate content of the accession(r= - 0.80**) at $p \leq 0.00$ (Table 194). The crude protein content of the accession had a strong significant negative correlation with the crude fibre content (r= - 0.76**) at $p \leq 0.00$ (Table 194).

Table 193: Correlation between copper content of *Corchorous olitorius* NG/OA/jun/09/002 and the proximate content of the vegetable accession in the second rainy season (2017) .

	CuS	CuR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate content
CuS Pearson Correlation	1	-0.13	-0.18	0.23	0.21	-0.23	0.21	0.04
Sig. (2-tailed)		0.44	0.28	0.17	0.16	0.16	0.21	0.80
N								
CuR Pearson Correlation		1	-0.32’	0.04	-0.25	-0.35’	0.38’	-0.02
Sig. (2-tailed)			0.05	0.81	0.12	0.02	0.02	0.92
N								
Moisture Pearson Correlation			1	-0.54’’	-0.42’’	0.35’	-0.26	-0.16
Sig. (2-tailed)				0.00	0.01	0.03	0.11	0.33
N								
Ash content Pearson Correlation				1	-0.44’’	-0.37’	0.61’’	0.01
Sig. (2-tailed)					0.00	0.02	0.00	0.97
N								
Fat and Oil Pearson Correlation					1	0.60’’	-0.65’’	0.05
Sig. (2-tailed)						0.00	0.00	0.75
N								
Crude Protein Pearson Correlation						1	-0.73’’	0.15
Sig. (2-tailed)							0.00	0.35
N								
Crude Fibre Pearson Correlation							1	-0.15
Sig. (2-tailed)								0.36
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 194: Correlation between copper of shoot, root and the proximate composition of *Cochorus olitorius* NG/OA/04/010 in the first dry season (2015).

	Cu shoot	Cu root	Moisture content	Ash content	Fat n oils content	Crude protein content	Crude fibre content	Carbohydrate content
Cu shoot Pearson Correlation	1	0.49**	-0.04	-0.20	-0.21	-0.79**	0.80**	-0.30*
Sig		0.00	0.82	0.21	0.21	0.00	0.00	0.05
Cu root Pearson Correlation		1	-0.06	-0.60**	-0.49*	-0.46**	0.72**	-0.25
Sig			0.73	0.00	0.03	0.00	0.00	0.12
Moisture content Pearson Correlation			1	0.29*	0.06	0.02	-0.15	-0.33*
Sig				0.05	0.74	0.90	0.35	0.04
Ash content Pearson Correlation				1	-0.23	-0.00	-0.44**	0.21
Sig					0.16	0.99	0.01	0.21
Fat n oils content Pearson Correlation					1	0.61**	-0.28	-0.80**
Sig						0.00	0.08	0.00
Crude protein content Pearson Correlation						1	-0.76**	0.20
Sig							0.00	0.22
Crude fibre content Pearson Correlation							1	-0.29
Sig								0.72
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 195 correlation coefficient between the copper of the shoots, roots of *Corchorus oiltorius* accession NG/OA/03/11/010 and the proximate content in the second dry season (2016). There was a significant positive correlation between the copper content of the shoot with the copper content of the root (r =0.33*) at $p \leq 0.04$ and a significant negative correlation with the fat and oil content (r = - 0.35*) at $p \leq 0.03$ (Table 195).The moisture content had significant negative correlation with the fat and oil content (r = -0.31* at $p \leq 0.05$, the crude fibre (r = -0.72**) at $p \leq 0.00$ and significant positive correlation with the crude protein fibre (r=0.41*) at $p \leq 0.03$ (Table 195). The fat and oil content correlated significantly positive with the crude protein content (r=0.35*) at $p \leq 0.03$ and a significant negative correlation with the carbohydrate content (r= -0.45*) at $p \leq 0.02$. The crude protein content had a significant negative correlation with the crude fibre (r= - 0.36*) at $p \leq 0.02$ and the carbohydrate content (r = -0.44*) at $p \leq 0.03$ (Table 195). Table 196 shows the correlation between copper content of *Corchorous olitorius* NG/AA/04/010 and the proximate content of the vegetable accession in the first rainy season (2016). Copper content of the shoot had significant positive correlation with the copper content of the root (r= 0.35*) and $p \leq 0.03$ and the crude fibre (r=0.33*) at $p \leq 0.04$ (Table 196).

There was significant positive correlation beween the copper content in the root of the accession, the ash content (r=0.53**) at $p \leq 0.00$, and the crude fibre content (r=0.46**) at $p \leq 0.00$, a significant negative correlation with the fat and oil content (r= - 0.51) at $p \leq 0.01$and significant negative correlation between the moisture content and the ash content (r= -0.53**) at $p \leq 0.00$ (Table 196). A significant negative correlation between the ash content and the fat and oil content (r = - 0.59**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre (r= 0.71**) at $p \leq 0.01$ were recorded (Table 196). A significant negative correlation between the fat and oil content and the crude fibre content (r= - 0.80**) at $p \leq 0.00$ and significant negative correlation between the crude protein content and the carbohydrate (r = - 0.95**) at $p \leq 0.00$ were recorded (Table 196) .

Table 195. Correlation Coefficient between the copper of the shoots, roots of *Corchorus oiltorius* accession NG/OA/03/11/010 and the proximate content in the second dry season (2016).

	CuS	CuR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
CuS Pearson Correlation	1	0.33*	0.11	0.03	-0.35*	-0.06	-0.09	0.28
Sig.(2tailed)		0.04	0.50	0.86	0.03	0.72	0.59	0.09
N								
CuR Pearson Correlation		1	0.13	-0.05	-0.19	-0.05	-0.16	0.10
Sig.(2tailed)			0.43	0.78	0.25	0.76	0.33	0.53
N								
Moisture Pearson Correlation			1	-0.17	-0.31*	0.41*	-0.72**	0.04
Sig.(2tailed)				0.26	0.05	0.03	0.00	0.83
N								
Ash Pearson Correlation				1	0.01	0.15	0.08	-0.05
Sig.(2tailed)					0.98	0.36	0.65	0.78
N								
Fat and oil Pearson Correlation					1	0.35*	0.13	-0.45*
Sig.(2tailed)						0.03	0.45	0.02
N								
Protein Pearson Correlation						1	-0.36*	-0.44*
Sig.(2tailed)							0.02	0.03
N								
Fibre Pearson Correlation							1	0.16
Sig.(2tailed)								0.33
N								
CHO Pearson Correlation								
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

CuS=cadmium in shoot. CuR=cadmium in root. CHO=carbohydrate

Table 196: Correlation between copper content of *Corchorous olitorius* NG/AA/04/010 and the proximate content of the vegetable accession first rainy season (2016).

	CuS	CuR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate content
CuS Pearson Correlation	1	0.35'	-0.06	0.17	-0.20	-0.18	0.33'	0.17
Sig. (2-tailed)		0.03	0.73	0.31	0.21	0.29	0.04	0.31
N								
CuR Pearson Correlation		1	-0.09	0.53''	-0.51''	0.06	0.46''	-0.18
Sig. (2-tailed)			0.59	0.00	0.01	0.70	0.00	0.28
N								
Moisture Pearson Correlation			1	-0.53''	0.23	0.16	-0.25	-0.15
Sig. (2-tailed)				0.00	0.16	0.32	0.12	0.38
N								
Ash content Pearson Correlation				1	-0.59''	-0.09	0.71''	-0.10
Sig. (2-tailed)					0.00	0.59	0.00	0.54
N								
Fat and Oil Pearson Correlation					1	0.00	-0.80''	-0.02
Sig. (2-tailed)						0.82	0.00	0.92
N								
Crude Protein Pearson Correlation						1	-0.19	-0.95''
Sig. (2-tailed)							0.25	0.00
N								
Crude Fibre Pearson Correlation							1	0.14
Sig. (2-tailed)								0.41
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 197 shows the correlation between copper content of *Corchorous olitorius* NG/AA/04/010 and the proximate content of the vegetable accession in the second rainy season.(2017) Copper content of the shoot had significant positive correlation with the copper content of the root (r = 0.33*) at $p \leq 0.00$ and the crude fibre (r=0.35*) at $p \leq 0.04$ (Table 197). There was significant positive correlation beween the copper content in the root, the ash content (0.53**) at $p \leq 0.00$, and the crude fibre content (r=.051**) at $p \leq 0.01$ and a significant negative correlation with the fat and oil content (r= 0.51**) at $p \leq 0.01$ (Table 197). A significant negative correlation between the moisture content and the ash content (r= - 0.53**) at $p \leq 0.00$ and a significant negative correlation between the ash content and the fat and oil content (r= - 0.59**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre (r= 0.71**) at $p \leq 0.00$ were recorded (Table 197). Significant negative correlation between the fat and oil content and the crude fibre content (r= - 0.88**) at $p \leq 0.00$ were recorded (Table 197). Significant negative correlation between the crude protein content and the carbohydrate (r= - 0.95**) at $p \leq 0.00$ (Table 197) . Table 198 shows the correlation between Lead of shoot , root and the nutritional content of *Amaranthus hybridus* NG/AA/03/11/010 and the proximate composition of the accession in the first dry season (2015).

The lead concentration of the root had negative correlation with the ash content (r= 0.61**) at $p \leq 0.00$, the fat and oil content (r= 0.63**) at $p \leq 0.00$, the carbohydrate content (r= 0.62**) at $p \leq 0.00$, significant negative correlation with the crude protein content (r= - 0.56**) at $p \geq 0.00$ and the crude fibre content (r= - 0.66**) at $p \leq 0.00$ (Table 198) . The ash content of the accession had strong positive significant correlation with the fat and oil content (r= 0.99**) at $p \leq 0.00$, the carbohydrate content (r=0.99**) at $p \leq 0.00$, strong significant negative correlation with the crude protein (r= - 0.88**) at $p \leq 0.00$ and with the crude fibre content (r=- 0.66**) and $p \leq 0.01$ (Table 198). The crude fat and oil content of the accession had strong significant positive correlation with the carbohydrate content of the accession (r= 0.99 **) at $p \leq 0.00$, significant negative correlation with the crude protein content (r= - 0.88**) at $p \leq 0.00$ and with fibre content (r= - 0.65**) at $p \leq 0.00$ (Table 198).

The crude protein content of the accession has a strong positive significant correlation with the crude fibre (r= 0.43**) at $p \leq 0.00$ and negative correlation with the carbohydrate content at $p \leq 0.01$. The crude fibre of the accession had a strong a significant negative correlation with the carbohydrate content (r= -0.62**) at $p \leq 0.00$ (Table 198). Table 199 presents the significant positive correlation of the Lead content in the shoot of *Amaranthus* hybridus accession NG/AA/03/11/010 in the second dry season (2016). The Pb content in the root (r=0.91**) at $p \leq 0.00$. The moisture content had a significant positive correlation with the fat and oil content (r=0.38*) at $p \leq 0.02$, the crude protein (r=0.59**) at $p \leq 0.01$, a significant negative correlation with crude fibre (r=- 0.65**) at $p \leq 0.00$ and carbohydrate content (r= - 0.65**) at $p \leq 0.00$ (Table 199). The ash content had a significant negative correlation with fat and oil content (r= - 0.97**) at $p \leq 0.00$, crude protein (r=-0.77**) at $p \leq 0.00$, significant positive correlation with the crude fibre (r= 0.86**0 at $p \leq 0.00$ and carbohydrate content (r= 0.87**) at $p \leq 0.00$ (Table 199). The fat and oil content had a significant positive correlation with the crude protein (r=0.80**) at $p \leq 0.00$, a significant negative correlation with crude fibre (r=0.90**) at $p \leq 0.00$ and the carbohydrate content (r=0.91**) at $p \leq 0.00$ (Table 199).

Crude protein content had a significant negative correlation with the crude content (r= -0.84**) at $p \leq 0.00$ and a significant positive correlation with the carbohydrate content (r= 0.85**) at $p \leq 0.00$. The crude fibre content had a significant positive correlation with the carbohydrate content (r=0.95**) at $p \leq 0.00$ (Table 199). Table 200 shows the correlation coefficient between Lead content of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content of the vegetable accession in the first rainy season (2016). The Lead content of the shoot had significant positive correlation with the Lead content of the root (r=0.62**) at $p \leq 0.00$, the ash content (r=0.67** at $p \leq 0.00$, the crude fibre content (r=0.58**) at $p \leq 0.00$, the carbohydrate content (r=0.66**) at $p \leq 0.00$, significant negative correlation with the moisture content (r= - 0.33*) at $p \leq 0.04$, the fat and oil content at (r= - 0.45**) at $p \leq 0.00$ and the crude protein content (r= - 0.66**) at $p \leq 0.00$ (Table 200).

Table 197: Correlation between copper content of *Corchorous olitorius* NG/AA/04/010 and the proximate content of the vegetable accession in the second rainy season (2017) .

	CuS	CuR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate Content
CuS Pearson Correlation	1	0.33’	-0.06	0.17	-0.20	-0.18	0.35’	0.17
Sig. (2-tailed)		0.03	0.73	0.31	0.21	0.29	0.04	0.31
N								
CuR Pearson Correlation		1	-0.09	0.53’’	-0.51’’	0.06	0.46’’	-0.18
Sig. (2-tailed)			0.59	0.00	0.01	0.70	0.00	0.28
N								
Moisture Pearson Correlation			1	-0.53’’	0.23	0.16	-0.25	-0.15
Sig. (2-tailed)				0.00	0.16	0.32	0.12	0.38
N								
Ash content Pearson Correlation				1	-0.59’’	-0.09	0.71’’	-0.10
Sig. (2-tailed)					0.00	0.59	0.00	0.54
N								
Fat and Oil Pearson Correlation					1	0.00	-0.80’’	-0.02
Sig. (2-tailed)						0.82	0.00	0.92
N								
Crude Protein Pearson Correlation						1	-0.19	-0.95’’
Sig. (2-tailed)							0.25	0.00
N								
Crude Fibre Pearson Correlation							1	0.14
Sig. (2-tailed)								0.41
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 198 : Correlation between Lead of shoot , root and the proximate composition of *Amaranthus hybridus* NG/AA/03/11/010 in the first dry season (2015).

	Pb shoot	Pb root	Moisture content	Ash content	Fat annd oil content	Crude protein content	Crude fibre	Carbohydrate content
Pb shoot Pearson Correlation	1	0.15	0.21	-0.07	-0.03	-0.11	0.18	0.05
Sig		0.36	0.20	0.66	0.87	0.50	0.26	0.79
Pb root Pearson Correlation		1	0.00	0.61”	0.63”	-0.56”	-0.66”	0.62”
Sig			0.98	0.00	0.00	0.00	0.00	0.00
Moisture content Pearson Correlation			1	-0.28	-0.28	0.10	0.18	-0.28
Sig				0.08	0.09	0.53	0.26	0.09
Ash content Pearson Correlation				1	0.99”	-0.88”	-0.66”	0.99”
Sig					0.00	0.00	0.00	0.00
Fat n oil content Pearson Correlation					1	-0.88”	-0.65”	0.99”
Sig						0.00	0.00	0.00
						1	0.43”	-0.88”
Crude protein content Pearson Correlation							0.01	0.00
Sig								
Crude fibre content Pearson Correlation							1	-0.62”
Sig								0.00
Carbohydrate content .								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 199. Correlation Coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content in the second dry season (2016).

	PbS	PbR	Moisture	Ash	Fat and oil content	CrudeProtein content	Crude fibre content	CHO content
PbS Pearson Correlation Sig.(2tailed) N	1	0.91** 0.00	-0.14 0.41	0.22 0.18	-0.25 0.18	-0.23 0.15	-0.28 0.08	0.16 0.34
PbR Pearson Correlation Sig.(2tailed) N		1	-0.22 0.17	0.19 0.24	-0.22 0.19	-0.26 0.11	0.26 0.12	0.16 0.33
Moisture Pearson Correlation Sig.(2tailed) N			1	-0.28 0.08	0.38* 0.02	0.59** 0.00	-0.65** 0.00	-0.63** 0.00
Ash Pearson Correlation Sig.(2tailed) N				1	-0.97** 0.00	-0.77** 0.00	0.86** 0.00	0.87** 0.00
Fat and oil content Pearson Correlation Sig.(2tailed) N					1	0.80** 0.00	-0.90** 0.00	-0.91** 0.00
Protein Pearson Correlation Sig.(2tailed) N						1	-0.84** 0.00	0.85** 0.00
Fibre Pearson Correlation Sig.(2tailed) N							1	0.95** 0.00
CHO Pearson Correlation Sig.(2tailed) N								1

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

The Pb content of the root had significant positive correlation with the ash content (r=0.54**) at $p \leq 0.00$, the crude fibre (r=0.54**) at $p \leq 0.00$, the carbohydrate content (r=0.44**) at $p \leq 0.00$, significant negative correlation with the moisture content (r= - 0.32*) at $p \leq 0.05$ and the crude protein (r= - 0.58**) at $p \leq 0.00$ (Table 200). Significant positive correlation was obtained between the moisture content of the vegetable accession, the fat and oil content (r=0.45**) at $p \leq 0.01$, the crude protein content (r=0.46**) at $p \leq 0.00$, significant negative correlation with the ash content (r= - 0.70**) at $p \leq 0.00$, the crude fibre (r= - 0.34*) at $p \leq 0.04$ and the carbohydrate content (r= - 0.42**) at $p \leq 0.01$. The ash content had a significant negative correlation with the fat and oil content (r= - 0.65**) at $p \leq 0.00$, the crude protein (r= - 0.84**) at $p \leq 0.00$, significant positive correlation with the crude fibre (r=0.71**) at $p \leq 0.00$ and the carbohydrate content (r=0.75**) at $p \leq 0.00$ (Table 200).

Crude fat and oil content had a significant positive correlation with the crude protein (r=0.78**) at $p \leq 0.00$, significant negative correlation with the crude fibre (r= - 0.75**) at $p \leq 0.00$ and the carbohydrate content (r= -0.86**) and $p \leq 0.00$ (Table 200). There were significant negative correlation between crude protein, the crude fibre (r= - 0.86**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.94**) at $p \leq 0.00$ and a significant positive correlation between the crude fibre and the carbohydrate content (r=0.80**) at $p \leq 0.00$ was recorded (Table 200).Table 201 shows the correlation between Lead content of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content of the vegetable accession in the second rainy season (2017). The lead content of the shoot of the accession had significant negative correlation with the moisture content (r= - 0.39**) at $p \leq 0.01$ and a significant positive correlation with the ash content (r=0.42**) at $p \leq 0.01$ (Table 201). Significant positive correlation between the Pb content of the root, the ash content (r=0.54*) at $p \leq 0.00$, with the crude fibre (r= 0.34*) at $p \leq 0.04$ and significant negative correlation with the crude protein at (r= - 0.42**) at $p \leq 0.01$ (Table 201). There was significant positive correlation between the moisture content, fat and oil (r=0.45**) at $p \leq 0.00$, the crude protein content (r=0.45**) at $p \leq 0.01$, significant negative correlation with the ash content (r= -0.62**) at $p \leq 0.00$, the percentage crude fat and oil content (r= - 0.33*) at $p \leq 0.04$ and crude fibre (r= - 0.40**) at $p \leq 0.01$ (Table 201). There were significant negative correlation between the ash content ash content , the fat and oil content (r= - 0.80**) at $p \leq 0.00$, the crude protein content (r= - 0.83**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre (r= 0.73**) at $p \leq 0.00$ (Table 201). The fat and oil content of the accession had a significant positive correlation with the crude protein fibre (r= 0.72**) at $p \leq 0.01$ and a significant negative correlation with the crude fibre (r=- 0.70**) at $p \leq 0.00$ (Table 201). The crude protein of the accession had a significant negative correlation with the crude fibre (r= - 0.89**) at $p \leq 0.000$ (Table 2017).

Table 202 presents the correlation between lead content of *Amaranthus hybridus* accession NG/AO/11/08/039 and the proximate content of the vegetable accession in the first dry season (2015). The Pb content of the shoot had significant negative correlation with the fat and oil content (r= - 0.37*) at $p \leq 0.02$, the crude protein content (r= -0.35*) at $p \leq 0.03$ and a significant positive correlation with the ash content (r= 0.35*) at $p \leq 0.05$ (Table 202). There were significant negative correlation between the moisture content, the ash content(r = - 0.80**) at $p \leq 0.00$, the crude fibre content (r= - 0.63**) at $p \leq 0.00$, significant positive correlation with the fat and oil content (r= 0.69**) at $p \leq 0.00$ and the crude protein content (r=0.44**) at $p \leq 0.01$ (Table 202).The ash content had significant negative correlation with the fat and oil content (r= - 0.78**) at $p \leq 0.00$, the crude protein content (r = -0.79**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre (r= 0.87**) at $p \leq 0.00$ (Table 202). A significant positive correlation was obtained between the fat and oil content and the crude protein (r= 0.67**) at $p \leq 0.00$ and a significant negative correlation with the crude fibre content (r= - 0.61**) at $p \leq 0.00$ (Table 202). Table 203 correlation coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NG/OA/11/08/039 and the proximate content second dry season (2016). Pb content in the shoot of *Amaranthus hybridus* accession NG/OA/11/08/039 had a significant positive correlation with the Pb content in the root (r= 0.92**) at $p \leq 0.00$. Pb content in the root correlated significantly negative with the crude fibre (r= - 0.32*) at $p \leq 0.05$. The Pb content of the root correlated significantly negative with the crude protein (r – 0.32*) at $p \leq 0.05$ (Table203). The ash content had significant negative correlation with the fat and oil content (r= - 0.96**) at $p \leq 0.00$, the crude protein content (r= - 0.88**) at $p \leq 0.00$, correlated significantly positive with the crude fibre (r=0.78**) at $p \leq 0.00$ and the carbohydrate content (r=0.99**) at $p \leq 0.00$ (Table 203).

Table 200: Correlation between Lead content of *Amaranthus hybridus* NG/AA/03/11/010 ,and the proximate content of the vegetable first rainy season (2016).

	PbS	PbR	Moisture content	Ash content	Fat and Oil Content	Crude Protein Content	Crude Fibre content	Carbohydrate content
PbS Pearson Correlation	1	-0.02	-0.39*	0.42**	-0.24	-0.24	0.18	0.20
Sig. (2-tailed)		0.92	0.01	0.01	0.15	0.11	0.27	0.22
N								
PbR Pearson Correlation		1	-0.28	0.54**	-0.17	-0.42**	0.34*	0.21
Sig. (2-tailed)			0.09	0.00	0.29	0.01	0.04	0.20
N								
Moisture Pearson Correlation			1	-0.62	0.33'	0.45**	-0.40*	-0.16
Sig. (2-tailed)				0.00	0.04	0.00	0.01	0.35
N								
Ash content Pearson Correlation				1	-0.60	-0.83**	0.73**	0.20
Sig. (2-tailed)					0.00	0.00	0.00	0.21
N								
Fat and Oil Pearson Correlation					1	0.72**	-0.70**	-0.18
Sig. (2-tailed)						0.00	0.00	0.25
N								
Crude Protein Pearson Correlation						1	-0.86**	-0.14
Sig. (2-tailed)							0.00	0.39
N								
Crude Fibre Pearson Correlation							1	0.19
Sig. (2-tailed)								0.28
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

The crude fat and oil content had significant positive correlation with the crude protein (r=0.86**) at p $\leq$0.00, significant negative correlation with the crude fibre (r= - 0.74**) at p $\leq$0.00 and the carbohydrate content (r= - 0.96**) at p$\leq$0.00. The crude protein had significant negative correlation with the crude fibre (r= - 0.51**) at p $\leq$0.00 and the carbohydrate content (r= - 0.84**) at p$\leq$0.00 and the crude fibre had a significant positive correlation with the carbohydrate content (r=0.82**) at p$\leq$0.00 (Table 203). Table 204 presents the correlation coefficient between lead content of *Amaranthus hybridus* accession NG/AO/11/08/039 and the proximate content of the vegetable accession in the first rainy season (2016) (Table 204).

There were significant positive correlation between the Lead content of the shoot, the Pb content of the root (r=0.58**) at p$\leq$ 0.00, the ash content (r=0.71**) at p$\leq$0.00, the crude fibre (r=0.61**) at p$\leq$ 0.00, the carbohydrate content (r=0.65**) at p$\leq$ 0.00, significant negative correlation with the moisture content (r= - 0.52**) at p $\leq$ 0.00, fat and oil content (r= - 0.54**) atn p$\leq$ 0.00 and the crude protein content (r= - 0.65**) at p$\leq$0.00 (Table 204). The Pb content of the root had significant negative correlation with the moisture content (r= - 0.51**) at p $\leq$ 0.00, the fat and oil content (r= - 0.31*) at p$\leq$0.02, the crude protein (r= - 0.64**) at p$\leq$0.00, significant positive correlation with the ash content (r=0.65**) at p$\leq$0.00, the crude fibre (r=0.56**) at p$\leq$0.00 and the carbohydrate content (r=0.50**) at p$\leq$ 0.00 (Table 204). The moisture content correlated significantly positive with the ash content (r=0.77**) at p$\leq$0.00, the crude fat and oil content at r=0.37* and p$\leq$ 0.02, the crude protein (r=0.51**) at p$\leq$0.00, negatively correlated with the crude fibre (r= -0.48**) at p$\leq$0.00 and the carbohydrate content (r= -0.42**) at p$\leq$ 0.00 (Table 204)

There were significant negative correlation obtained between the ash content, the crude fat and oil (r= -0.61**) at p$\leq$0.00, the crude protein (r= - 0.83**) at p$\leq$0.00, significant positive correlation with the crude fibre (r=0.75**) at p$\leq$ 0.00 and the carbohydrate content (r=0.73**) at p$\leq$ 0.00. The crude fat and oil content correlated positively with the crude protein (r=0.75**) at p$\leq$0.00, negatively with the crude fibre (r= - 0.74**) at p$\leq$ 0.00 and the carbohydrate content (r= - 0.82**) at p $\leq$0.00.

Table 201: Correlation between lead content of *Amaranthus hybridus* accession NG/AA/03/11/010 and the proximate content of the vegetable accession in the second rainy season (2017).

	PbS	PbR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate Content
PbS Pearson Correlation	1	0.07	-0.14	0.32*	-0.37*	-0.35*	0.24	0.28
Sig. (2-tailed)		0.66	0.38	0.05	0.02	0.03	0.14	0.08
N								
PbR Pearson Correlation		1	-0.16	0.09	-0.05	-0.21	0.14	-0.09
Sig. (2-tailed)			0.93	0.61	0.77	0.21	0.40	0.57
N								
Moisture Pearson Correlation			1	-0.80**	0.69**	0.44**	-0.63**	0.03
Sig. (2-tailed)				0.00	0.00	0.00	0.00	0.86
N								
Ash content Pearson Correlation				1	-0.78**	-0.79**	0.87**	0.10.
Sig. (2-tailed)					0.00	0.00	0.00	0.56
N								
Fat and Oil Pearson Correlation					1	0.67**	-0.61**	-0.30
Sig. (2-tailed)						0.00	0.00	0.13
N								
Crude Protein Pearson Correlation						1	-0.87**	0.02
Sig. (2-tailed)							0.00	0.93
N								
Crude Fibre Pearson Correlation							1	-0.17
Sig. (2-tailed)								0.31
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 202. Correlation Coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NG/OA/11/08/039 and the proximate content in the first dry season (2016).

	PbS	PbR	Moisture	Ash	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
PbS Pearson Correlation	1	0.92**	-0.11	0.27	-0.28	-0.30	0.10	0.23
Sig.(2tailed)		0.00	0.52	0.10	0.09	0.06	0.55	0.15
N								
PbR Pearson Correlation		1	-0.01	0.26	-0.29	-0.32*	0.12	0.24
Sig.(2tailed)			0.96	0.10	0.08	0.05	0.48	0.14
N								
Moisture Pearson Correlation			1	-0.15	0.01	0.10	-0.05	-0.16
Sig.(2tailed)				0.37	0.97	0.54	0.75	0.40
N								
Ash Pearson Correlation				1	-0.96**	-0.88**	0.78**	0.99**
Sig.(2tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil Pearson Correlation					1	0.86**	-0.74**	-0.96**
Sig.(2tailed)						0.00	0.00	0.00
N								
Protein Pearson Correlation						1	-0.51**	-0.84**
Sig.(2tailed)							0.00	0.00
N								
Fibre Pearson Correlation							1	0.82**
Sig.(2tailed)								0.00
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).

Table 204: Correlation coefficient between lead content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession in the first rainy season (2016) .

	Pb S	PbR	Moisture	Ash	Fat	Protein	Fibre	CHO
Pb S Pearson Correlation	1	0.58**	-0.52**	0.71**	-0.54**	-0.65	0.61**	0.65**
Sig. (2-tailed)		0.00	0.00	0.00	0.00	0.00	0.00	0.00
N								
Pb R Moisture Pearson		1	-0.51**	0.65**	-0.31	-0.64**	0.56**	0.50**
Correlation			0.00	0.00	0.02	0.00	0.00	0.00
Sig. (2-tailed)			1					
N								
Moisture Pearson Correlation				0.77**	0.37*	0.51**	-0.48**	-0.42**
Sig. (2-tailed)				0.00	0.02	0.00	0.00	0.00
N								
Ash Pearson Correlation				1	-0.61**	-0.83**	0.75**	0.73**
Sig. (2-tailed)					0.00	0.00		0.00
N							0.00	
Fat Pearson Correlation					1	0.75**	-0.74**	-0.82**
Sig. (2-tailed)						0.00	0.00	0.00
N								
Protein Pearson Correlation						1	-0.90**	-0.95**
Sig. (2-tailed)							0.00	0.00
N								
Fibre Pearson Correlation							1	0.85**
Sig. (2-tailed)								0.00
N								
CHO Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed),* correlation is significant at the 0.05level (2-tailed)

Significant negative correlation was obtained between the crude protein content and the crude fibre ($r=-0.90^{**}$) at $p \leq 0.00$ and a positive correlation with the carbohydrate content ($r=0.95^{**}$) at $p \leq 0.00$. Crude fibre correlated significantly positive with the carbohydrate content ($r=0.85^{**}$) at $p \leq 0.00$ (Table 204). Table 205 presents the correlation between lead content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession in the second rainy season. The Pb content of the shoot of the accession had significant negative correlation with the ash content ($r= -0.30^{**}$) at $p \leq 0.05$, crude fat and oil content ($r= -0.85^{**}$) at $p \leq 0.02$ and the crude protein content ($r= -0.38^{**}$) at $p \leq 0.03$ (Table 205). There was significant negative correlation between the moisture content of the accession, the ash content ($r = -0.83^{**}$) at $p \leq 0.00$, and the crude fibre content of the accession ($r= -0.61^{**}$) at $p \leq 0.00$, significant positive correlation with the fat and oil content ($r= 0.65^{**}$) at $p \leq 0.00$ and the crude protein content ($r= 0.48^{*}$) at $p \leq 0.00$ (Table 205).

There was significant negative correlation between the ash content of the accession, the fat and oil content ($r= -0.71^{**}$) at $p \leq 0.00$, crude protein ($r= -0.83^{**}$) at p and $p \leq 0.00$ and a significant positive correlation with the crude fibre ($r=0.80^{**}$) and $p \leq 0.00$ (Table 205). Significant positive correlation between the crude fat and oil content of the accession, the crude protein content ($r=0.63^{**}$) and $p \leq 0.00$ and a significant negative correlation with the crude fibre ($r= -0.65^{**}$) at $p \leq 0.00$ were recorded (Table 205). A significant negative correlation between the crude protein content and the crude fibre content at ($r= -0.83^{**}$) at $p \leq 0.01$ was recorded (Table 205). Table 206 shows the correlation between Lead in shoot, root and the nutritional content of *Amaranthus hybridus* NGB0125 in the first dry season (2015). The Pb concentration of the shoot had strong significant positive correlation with the Pb concentration of the root ($r= 0.50^{**}$) at $p \leq 0.00$, the moisture content ($r=0.57^{**}$) (Table 206). The Pb concentration of the root had strong positive significant correlation with the ash content ($r=0.43^{**}$) at $p \leq 0.00$, the crude fibre content ($r=0.56^{**}$) at $p \leq 0.00$, the carbohydrate content ($r=0.46^{**}$) at $p \leq 0.00$, strong significant negative correlation with the crude fat and oil content ($r= -0.56^{**}$) at $p \leq 0.00$ and the crude protein ($r= -0.54^{**}$) at $p \leq 0.01$ (Table `206).

The ash content of the accession had strong significant positive correlation with the crude fibre content (r=0.94**) at $p \leq 0.00$, the carbohydrate content of the accession (r=0.96**) at $p \leq 0.00$, had strong significant negative correlation with the fat and oil content (r= - 0.94**) at the crude protein fibre of the accession (r= - 0.66**) at $p \leq 0.00$ (Table 206). The crude fat and oil content of the accession had strong significant positive correlation with the crude protein content (r= 0.68**) at $p \leq 0.00$, strong significant negative correlation with the crude fibre content (r= - 0.97**) at $p \leq 0.00$ and carbohydrate content (r= - 0.98**) at $p \leq 0.00$ (Table 206). There were strong significant negative correlation between the crude protein content of the accession, the crude fibre content (r= - 0.75** at $p \leq 0.00$) and the carbohydrate content (r= - 0.68**) at $p \leq 0.00$ (Table 206). The crude fibre content of the accession had a strong significant negative correlation the carbohydrate content (r=0.98**) at $p \leq 0.00$ (Table 206).

Table 207 shows the correlation coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NGBO125 and the proximate content in the second dry season (2016) (Table 207). Pb content in the shoot of *Amaranthus hybridus* accession NGBO125 had a significant positive correlation with the Pb content in the shoot (r=0.90**) at $p \leq 0.00$. The ash content had negative significant correlation with the fat and oil content (r= - 0.83**) at $p \leq 0.00$, with the crude protein content (r= -0.67**) at $p \leq 0.00$, significant positive correlation with the crude fibre (r=0.95**) at $p \leq 0.00$ and with the crude fibre (r=0.95**) at $p \leq 0.00$ (Table 207). The crude fat and oil content correlated significantly positive with the crude protein (r=0.54**) at $p \leq 0.00$, negative significant correlation with the crude fibre (r= - 0.87**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.89**) at $p \leq 0.00$ (Table 207).

The crude protein had significant negative correlation with crude fibre (r = - 0.72**) at $p \leq 0.00$ and with the carbohydrate content (r = - 0.69**) at $p \leq 0.00$. The fibre content was significantly positively correlated with the carbohydrate content (r=0.96**) at $p \leq 0.00$ (Table 207).

Table 205: Correlation between lead content of *Amaranthus hybridus* NG/AO/11/08/039 and the proximate content of the vegetable accession in the second rainy season (2017).

	PbS	PbR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre Content	Carbohydrate content
PbS Pearson Correlation	1	0.07	-0.14	0.30*	-0.35*	-0.38*	0.24	0.28
Sig. (2-tailed)		0.66	0.38	0.05	0.02	0.03	0.14	0.08
N								
PbR Pearson Correlation		1	-0.16	0.09	-0.05	-0.21	0.14	-0.09
Sig. (2-tailed)			0.93	0.61	0.77	0.21	0.40	0.57
N								
Moisture Pearson Correlation			1	-0.83**	0.65**	0.48**	-0.61**	0.03
Sig. (2-tailed)				0.00	0.00	0.00	0.00	0.86
N								
Ash content Pearson Correlation				1	-0.71**	-0.83**	0.80**'	0.10.
Sig. (2-tailed)					0.00	0.00	0.00	0.56
N								
Fat and Oil Pearson Correlation					1	0.63**	-0.65**	-0.30
Sig. (2-tailed)						0.00	0.00	0.13
N								
Crude Protein Pearson Correlation						1	-0.83**	0.02
Sig. (2-tailed)							0.00	0.93
N								
Crude Fibre Pearson Correlation							1	-0.17
Sig. (2-tailed)								0.31
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 206 Correlation between Lead of shoot, root and the proximate composition of *Amaranthus hybridus* NGB0125 in the first dry season (2015).

	Pb concentration of shoot	Pb concentration of root	Moisture content	Ash content	fat and oils content	Crude protein content	Crude fibre content	Carbohydrate content .
Pb shoot Pearson Correlation	1	0.50**	0.57**	0.07	-0.09	-0.02	0.15	0.06
Sig		0.00	0.00	0.60	0.60	0.89	0.37	0.70
Pb root Pearson Correlation		1	0.07	0.43**	-0.56**	-0.54**	0.56**	0.43**
Sig			0.69	0.00	0.00	0.00	0.00	0.01
Moisture content Pearson Correlation			1	0.16	-0.17	-0.18	0.17	0.16
Sig				0.34	0.32	0.27	0.30	0.32
Ash content Pearson Correlation				1	-0.94**	-0.66**	0.94**	0.96**
Sig					0.00	0.00	0.00	0.00
Fat n oils Pearson Correlation					1	0.68**	-0.97**	-0.98**
Sig						0.00	0.00	0.00
Crude protein Pearson Correlation						1	-0.75**	-0.68**
Sig							0.00	0.00
Crude fibre Pearson Correlation							1	0.98**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 206. Correlation Coefficient between the Lead of the shoots, roots of *Amaranthus hybridus* accession NGBO125 and the proximate content in the second dry season (2016)

	PbS	PbR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
PbS Pearson Correlation	1	0.90**	-0.28	0.31	-0.19	-0.21	0.29	0.27
Sig.(2tailed)		0.00	0.09	0.06	0.30	0.20	0.08	0.09
N								
PbR Pearson Correlation		1	-0.24	0.37	-0.22	-0.16	0.26	0.25
Sig.(2tailed)			0.13	0.09	0.18	0.32	0.10	0.12
N								
Moisture Pearson Correlation			1	0.10	0.00	-0.13	0.12	0.09
Sig.(2tailed)				0.55	0.98	0.43	0.48	0.57
N								
Ash Pearson Correlation				1	-0.83**	-0.67**	0.95**	0.95**
Sig.(2tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil Pearson Correlation					1	0.54**	-0.87**	-0.89**
Sig.(2tailed)						0.00	0.00	0.00
N								
Protein Pearson Correlation						1	-0.72**	-0.69**
Sig.(2tailed)							0.00	0.00
N								
Fibre Pearson Correlation							1	0.96**
Sig.(2tailed)								0.00
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level (2 tailed). * correlation is significant at the 0.05 level(2 tailed) .PbS=cadmium in shoot. PbR=cadmium in root. CHO=carbohydrate

Table 208 shows the correlation coefficient between lead content of *Amaranthus hybridus* NGBO 125 and the proximate content of the vegetable in the first rainy (2016). Significant positive correlation between the Pb content of the shoot of the vegetable accession, the Pb content of the root (r=0.66**) at $p \leq 0.00$ and the ash content (r=0.32*) at $p \leq 0.05$ were recorded (Table 208) this implies that their imput source is similar. The Pb content of the root had significant negative correlation with the moisture content (r= -0.39*) at $p \leq 0.01$, the fat and oil content (r= - 0.34*) at $p \leq 0.04$, the crude protein content (r=- 0.57**) at $p \leq 0.00$ indicating their imput source from different activities, significant positive correlation with the ash content(r=0.56**) at $p \leq 0.00$, crude fibre content (r=0.47**) at $p \leq 0.00$ and the carbohydrate content (r=0.52**) at $p \leq 0.00$ (Table 208). The moisture content had significant negative correlation with the ash content (r= -0.78**) at $p \leq 0.00$, the crude fibre content (r= - 0.47**) at $p \leq 0.00$, the carbohydrate content at (r= -0.44**) at $p \leq 0.01$ indicating their input sources from different sources, significant positive correlation with the crude fat and oil content at (r=0.39*) at $p \leq 0.01$ and the crude protein content (r=0.52**) at $p \leq 0.00$ (Table 208) implying similar sources of inputs for the variables.

There were significant negative correlation between the ash content, the crude fat and oil (r= -0.61**) at $p \leq 0.00$, the crude protein content (r= - 0.83**) at $p \leq 0.00$, significant positive correlation with the crude fibre (r=0.73**) at $p \leq 0.00$ and with the carbohydrate content (r=0.74**) at $p \leq 0.00$.The fat and oil content had significant positive correlation with the crude protein content (r=0.76**) at $p \leq 0.00$, the crude fibre (r=0.73**) and a significant negative correlation with the the carbohydrate content (r= - 0.82**) at $p \leq 0.00$ (Table 208). Crude protein content correlated significantly negative with the crude fibre (r= - 0.89**) at $p \leq 0.00$ and with the carbohydrate content (r= -0.90**) at $p \leq 0.00$. Crude fibre had a significant positive correlation with the carbohydrate content (r=0.84**) at $p \leq 0.00$ (Table 208) which suggested that content of crude fibre in the vegetable accession was due to the content of crude protein in the accession .

Table 207: Correlation coefficient between lead content of *Amaranthus hybridus* NGO 125 and the proximate content of the vegetable in the first rainy season (2016).

	Pb S	Pb R	Moisture content	Ash content	Fat and oil content	Crude protein content	Crude fibre content	Carbohydrate content
Pb S Pearson Correlation	1	0.66**	-0.27	0.32*	0.14	-0.20	0.13	0.06
Sig. (2-tailed)		0.00	0.09	0.05	0.39	0.22	0.43	0.77
N								
Pb R Pearson Correlation		1	-.0.39*	0.56**	-0.34	-0.57	0.47**	0.52**
Sig. (2-tailed)			0.01	0.00	0.04	0.00	0.00	0.00
N								
Moisture content Pearson Correlation			1	-0.78**	0.39*	0.52**	-0.47**	-0.44**
Sig. (2-tailed)				0.00	0.01	0.00	0.00	0.01
N								
Ash cotent Pearson Correlation				1	-0.61	-0.83**	0.73**	0.74**
Sig. (2-tailed)					0.00	0.00	0.00	0.00
N								
Fat and oil content Pearson Correlation					1	0.76**	0.73**	-0.82**
Sig. (2-tailed)						0.00	0.00	0.00
N								
Crude protein content Pearson Correlation						1	-0.89**	-0.96**
Sig. (2-tailed)							0.00	0.00
N								
Crude fibre content Pearson Correlation							1	0.84**
Sig. (2-tailed)								0.00
N								
Carbohydrate content Pearson Correlation								1
Sig. (2-tailed)								
N								

**High significant correlation at the 0.01 level (2 tailed). * correlation is significant at the 0.05 level(2 tailed) .PbS=cadmium in shoot. PbR=cadmium in root. CHO=carbohydrate

Table 209 shows correlation between lead content of *Amaranthus hybridus* NGO 125 and the proximate content of the vegetable accession in the second rainy season (2017) (Table 209). The Pb content of the shoot had significant positive correlation with the Pb content of the root(r=0.51**) at $p \leq 0.00$, the ash content (r=0.54**) at $p \leq 0.00$, the crude fibre content (r=0.52**) at $p \leq 0.00$, significant negative correlation with the moisture content (r= - 0.48**) at $p \leq 0.00$, the carbohydrate content (r= - 0.33*) at $p \leq 0.05$ (Table 209). Pb content of the root had significant negative correlation with the moisture content (r= - 0.59**) at $p \leq .00$, the crude protein content (r = - 0.43*) at $p \leq 0.01$ and significant positive correlation with the ash content (r= 0.70**) at $p \leq 0.00$ and the crude fibre content (r= 0.58**) at $p \leq 0.00$ (Table 209). There was significant positive correlation between the moisture content of the accession, the crude fat and oil content (r=0.49**) at $p \leq 0.00$, the crude protein content (r= 0.58**) at $p \leq 0.00$, the carbohydrate content (r=0.38*) at $p \leq 0.02$, significant negative correlation with the ash content (r= - 0.76**) at $p \leq 0.00$ and the crude fibre (r= - 0.76**) at $p \leq 0.00$.

Significant negative correlation with the crude protein content (r= - 52**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre content (r= 0.88**) at $p \leq 0.01$(Table 209). Significant positive correlation between the crude fat and oil content of the accession and the crude protein (r=0.48**) at $p \leq 0.00$ (Table 209). The crude protein content had a significant negative correlation with the crude fibre content (r= - 0.43**) at $p \leq 0.00$ and a significant positive correlation with the carbohydrate content (r= 0.61**) at $p \leq 0.00$. There was significant negative correlation between the crude fibre content and the carbohydrate content (r= - 0.43**) at $p \leq 0.01$ (Table 209) .

Table 208: Correlation between lead content of *Amaranthus hybridus* NGO 125 and the proximate content of the vegetable accession in the second rainy season (2017).

	PbS	PbR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate content
PbS Pearson Correlation	1	0.51**	-0.48**	0.54**	0.14	-0.24	0.52**	-0.33*
Sig. (2-tailed)		0.00	0.00	0.00	0.40	0.14	0.00	0.04
N								
PbR Pearson Correlation		1	-0.59**	0.70**	-0.26	-0.43**	0.58**	-0.09
Sig. (2-tailed)			0.00	0.00	0.11	0.01	0.00	0.58
N								
Moisture Pearson Correlation			1	-0.76**	0.49**	0.58**	-0.76**	0.38*
Sig. (2-tailed)				0.00	0.00	0.00	0.00	0.02
N								
Ash content Pearson Correlation				1	-0.30	-0.52**	0.88**	-0.14
Sig. (2-tailed)					0.06	0.00	0.00	0.40
N								
Fat and Oil Pearson Correlation					1	0.48’’	-0.22	-0.28
Sig. (2-tailed)						0.00	0.17	0.09
N								
Crude Protein Pearson Correlation						1	-0.43’’	0.61’’
Sig. (2-tailed)							0.00	0.01
N								
Crude Fibre Pearson Correlation							1	-0.43’’
Sig. (2-tailed)								0.01
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05level (2-tailed)

Table 210 shows the correlation between cadmium in shoot , root and the nutritional content of *Corchorus olitorius* NG/OA/Jun/09/002 in the first dry season (2015). The lead concentration of the shoot of the accession had significant negative correlation with the percentage fat and oil (r= - 0.31*) at $p \leq 0$ .05 (Table 210). There were negative correlation between the cadmium concentration of the shoot , the ash content (r= - 0.51**) at $p \leq 0.00$, the carbohydrate content (r= - 0.84**) at $p \leq 0.00$, strong positive significant correlation with the percentage fat and oil (r= 0.73**) at $p \leq 0.00$, percentage crude protein (r= 0.85**) at $p \leq 0.00$ and the percentage crude fibre content (r= 0.80**) at $p \leq 0.00$ (Table 210).

The moisture content of the accession had significant positive correlation with the percentage crude fat and oil (r= 0.26**) at $p \leq 0.04$, negative correlation with the percentage crude fibre (r= - 0.54**) at $p \leq 0.00$ and the percentage carbohydrate content (r= -0.27*) at $p \leq 0.04$ were recorded (Table 210). The ash content had strong positive significant correlation with the percentage crude fat and oil (r= 0.45**) at $p \leq 0.00$, percentage crude fibre (r=0.54**) at $p \leq 0.00$, the percentage carbohydrate content (r=0.59**) at $p \leq 0.00$ and a strong negative correlation with the percentage crude protein (r= - 0.59**) at $p \leq 0.00$ (Table 210). The percentage crude fat and oil of the accession had a significant positive correlation with the percentage crude protein (r= 0.87**) at $p \leq 0.00$, the carbohydrate content (r= -0.88**) at $p \leq 0.00$ and a significant negative correlations with the percentage crude fibre (r = -0.80**) (Table 210). The percentage crude protein of the accession had strong significant negative correlation with the crude fibre at r= - 0.87** and $p \leq 0.00$ and the carbohydrate content (r= - 0.92**) at $p \leq 0.00$ (Table 209). Table 211 presents correlation coefficient between the Lead of the shoots, roots of *Corchorous olitorius* accession NG/OAJun/09/002 and the proximate content in the second dry season (2016). Lead content in the shoot of *Corchorous olitorius* accession NG/OAJun/09/002 had a significant positive correlation with the lead content in the root (r= 0.85**) at $p \leq 0.00$ (Table 211) .The Pb content in the root correlated significantly negative with the carbohydrate content (r = - 0.32*) at $p \leq 0.05$ (Table 211). Moisture content had a significant positive correlation with the ash content (r =0.58**) at $p \leq 0.00$, significant negative correlation with crude protein (r= - 0.70**) at $p \leq 0.00$ and the crude fibre (r= - 0.79**) at $p \leq 0.00$ (Table 211). The ash content was significantly positive correlated with the crude protein (r=0.48**) at

$p \leq 0.00$ and significant negative with the crude fibre ($r = -0.75^{**}$). The crude protein had a significant negative correlation with the crude fibre ($r = -0.83^{**}$) at $p \leq 0.00$ (Table 211). Table 212 presents coefficient Correlation between lead content of *Corchorus olitorius* NG/AO/jun/09/002 and the proximate content of the vegetable accession in the first rainy season (2016). The Lead content of the shoot of the vegetable accession had significant positive correlation with the Pb content of the root ($r = 0.34^{*}$) at $p \leq 0.03$, significant negative correlation with the moisture content ($r = -0.49^{**}$) at $p \leq 0.00$ and the fat and oil content ($r = -0.63^{**}$) at $p \leq 0.00$ (Table 212). The moisture content had significant negative correlation with the ash content ($r = -0.45^{**}$) at $p \leq 0.00$, the crude fibre ($r = -0.65^{**}$) at $p \leq 0.00$, the carbohydrate content ($r = -0.55^{**}$) at $p \leq 0.00$, significant positive correlation with the fat and oil content ($r = 0.82^{**}$) at $p \leq 0.00$ and the crude protein ($r = 0.52^{**}$) at $p \leq 0.00$ (Table 212). The ash content correlated significantly negative with the crude fat and oil content ($r = -0.56^{**}$) at $p \leq 0.00$ and positively with the crude fibre ($r = 0.67^{**}$) at $p \leq 0.00$. The crude fat and oil content correlated significantly negative with the crude fibre content ($r = -0.78^{**}$) at $p \leq 0.00$. The crude protein content had a significant negative correlation with the carbohydrate content ($r = -0.90^{**}$) at $p \leq 0.00$ (Table 212).

Table 213 shows the correlation between lead content of *Corchorus olitorius* NG/AO/jun/09/002 and the proximate content of the vegetable second second rainy (2017). There was significant positive correlation between Pb content of the shoot of the accession, the Pb content of the root ($r = 0.52^{**}$) at $p \leq 0.00$, the ash content ($r = 0.48^{**}$) at $p \leq 0.00$, with the crude fibre content ($r = 0.31^{**}$) at $p \leq 0.05$ and significant negative correlation with carbohydrate content ($r = -0.38^{**}$) at $p \leq 0.02$, significant negative correlation moisture content ($r = -0.50^{**}$) at $p \leq 0.00$, the fat and oil content ($r = -0.41^{**}$) at $p \leq 0.00$, the carbohydrate content ($r = -0.36^{**}$) at $p \leq 0.02$, a significant positive correlation with the ash content ($r = 0.63^{**}$) at $p \leq 0.00$, the crude protein ($r = 0.57^{**}$) at $p \leq 0.00$ and the crude fibre ($r = 0.57^{**}$) at $p \leq 0.00$ (Table 213). The moisture content of the accession had significant negative correlation with the ash content ($r = -0.80^{**}$) at $p \leq 0.00$, the crude protein ($r = -0.46^{**}$) at $p \leq 0.00$, the crude fibre ($r = -0.46^{**}$) at $p \leq 0.00$, positive correlation with the crude fat and oil content ($r = 0.50^{**}$) at $p \leq 0.00$ and carbohydrate content of the accession ($r = 0.55^{**}$) at $p \leq 0.00$ (Table

213). The ash content of the accession had significant negative correlation with the fat and oil content (r= -0.43**) at $p \leq 0.00$, the carbohydrate content (r=.-.0.55**) at $p \leq 0.00$, significant positive correlation the crude protein content (r= 0.60**) at $p \leq 0.00$ and the crude fibre (r=0.60**) at $p \leq 0.01$ (Table 213). Crude fat and oil had significant negative correlation with the crude protein (r= - 0.65**) at $p \leq 0.00$, the crude fibre (r= - 0.65**) at $p \leq 0.01$ and a significant positive correlation with the carbohydrate (r=0.34*) at $p \leq 0.05$ (Table 213). The crude protein content of the accession had significant negative correlation with the crude fibre (r=0.73**) at $p \leq 0.00$ the carbohydrate content (r= 0.38*) at $p \leq 0.02$ (Table 213). The crude fibre had a significant negative correlation with the carbohydrate content (r= - 0.48**) at $p \leq 0.00$ (Table 213).

Table 214 shows the correlation between Lead of shoot , root and the nutritional content of *Corchorus olitorius* accession NG/OA/04/010 in the first dry season (2015). Pb concentration of the shoot had a significant positive correlation with the Pb concentration of the root (r= 0.71**) at $p \leq 0.00$ (Table 214). Pb concentration of the root had strong negative correlation with the moisture content (r= - 0.47**) at $p \leq 0.00$, the ash content (r= - 0.37*) at $p \leq 0.02$ and crude fibre content (r= - 0.38*) at $p \leq 0.02$ (Table 214). The moisture content had significant positive correlation with the ash content (r=0.47**) at $p \leq 0.00$, strong significant negative correlation with the crude protein content (r= - 0.84**) at $p \leq 0.00$, the crude fibre content (r= - 0.82**) at $p \leq 0.00$ and the carbohydrate content (r= - 0.34*) at $p \leq 0.04$ (Table 214). The ash content of the accession had a strong positive correlation with the the crude fibre content (r= 0.77**) at $p \leq 0.00$, significant negative correlation with crude fat and oil content (r= -.0.47**) at $p \leq 0.00$ and crude protein content (r= - 0.48**) at $p \leq 0.00$ (Table 214). The fat and oil content had a significant positive correlation with the crude protein (r=0.55**) at $p \leq 0.00$ (Table 214). The crude protein of the accession had a negative correlation with the crude fibre (r=- 0.80**) at $p \leq 0.00$ (Table 214).

Table 209 : Correlation between cadmium of shoot , root and the proximate composition of *Corchorus olitorius*. NG/OA/Jun/09/002 in the first dry season (2015).

	Cd root	Cd root	Moisture content	Ash content	Fat n oil content	Crude protein	Crude fibre	Carbohydrate content
Cd shoot Pearson Correlation	1	-0.13	-0.17	0.26	-0.31*	-0.19	0.20	0.20
Sig		0.44	0.31	0.12	0.05	0.25	0.23	0.23
Cd root Pearson Correlation		1	0.17	-0.51**	0.73**	0.85**	0.80**	-0.84**
Sig			0.32	0.00	0.00	0.00	0.00	0.00
Moisture content Pearson Correlation			1	-0.07	0.26*	0.24	-0.54**	-0.27*
Sig				0.58	0.04	0.06	0.00	0.04
Ash content Pearson Correlation				1	0.45**	-0.59**	0.54**	0.59**
Sig					0.00	0.00	0.00	0.00
Fat n oil content Pearson Correlation					1	0.87**	-0.80**	-0.88**
Sig						0.00	0.00	0.00
Crude protein content Pearson Correlation						1	-0.87**	-0.92**
Sig							0.00	0.00
Crude fibre content Pearson Correlation							1	0.91**
Sig								0.00
Carbohydrate content								1

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 210. Correlation Coefficient between the Lead of the shoots, roots of *Corchorous olitorius* accession NG/OAJun/09/002 and the proximate content in the second dry season.(2016)

	PbS	PbR	Moisture content	Ash content	Fat and oil content	Crude Protein content	Crude fibre content	CHO content
PbS Pearson Correlation	1	0.85**	-0.26	0.12	-0.13	0.04	0.02	-0.24
Sig.(2tailed)		0.00	0.12	0.48	0.45	0.81	0.91	0.15
N								
PbR Pearson Correlation		1	-0.24	0.08	-0.11	0.07	0.01	-0.32*
Sig.(2tailed)			0.14	0.62	0.47	0.68	0.94	0.05
N								
Moisture Pearson Correlation			1	0.58**	0.16	-0.70**	-0.79**	0.13
Sig.(2tailed)				0.00	0.33	0.00	0.00	0.44
N								
Ash Pearson Correlation				1	0.20	0.48**	-0.75**	-0.20
Sig.(2tailed)					0.17	0.00	0.00	0.22
N								
Fat and oil Pearson Correlation					1	-0.05	0.10	-0.29
Sig.(2tailed)						0.77	0.55	0.07
N								
Protein Pearson Correlation						1	-0.83**	-0.14
Sig.(2tailed)							0.00	0.39
N								
Fibre Pearson Correlation							1	-0.08
Sig.(2tailed)								0.65
N								
CHO Pearson Correlation								1
Sig.(2tailed)								
N								

**High significant correlation at the 0.01 level(2 tailed). * correlation is significant at the 0.05 level(2 tailed).PbS=cadmium in shoot. PbR=cadmium in root. CHO=carbohydrate.

Table 211: Correlation coefficient between lead content of *Corchorus olitorius* NG/AO/jun/09/002 and the proximate content of the vegetable accession in the first rainy season (2016).

	Pb S	Pb R	Moisture content	Ash content	Fat and oil content	Crude protein content	Crude fibre content	Carbohydrate content.
PbS Pearson Correlation	1	0.34*	-0.49**	0.29	-0.63**	0.19	0.23	-0.07
Sig. (2-tailed)		0.03	0.00	0.07	0.00	0.24	0.16	0.69
N								
PbR Pearson Correlation		1	-0.17	0.30	-0.11	0.09	-0.06	-0.09
Sig. (2-tailed)			0.32	0.06	0.51	0.60	0.74	0.59
N								
Moisture Pearson Correlation			1	-0.45**	0.82**	0.52**	-0.65**	-0.55**
Sig. (2-tailed)				0.00	0.00	0.00	0.00	0.00
N								
Ash Pearson Correlation				1	-0.56**	-0.09	0.67**	-0.14
Sig. (2-tailed)					0.00	0.61	0.00	0.39
N								
Fat Pearson Correlation					1	0.05	-0.78**	-0.11
Sig. (2-tailed)						0.78	0.00	0.51
N								
Protein Pearson Correlation						1	0.20	-0.90**
Sig. (2-tailed)							0.22	0.00
N								
Fibre Pearson Correlation							1	0.21
Sig. (2-tailed)								0.20
N								
CHO Pearson Correlation								1
Sig. (2-tailed)								
N								

** correlation is significant at the 0.01level (2-tailed). * correlation is significant at the 0.05 level (2-tailed).

Table 212: Correlation between lead content of *Corchorus olitorius* NG/AO/jun/09/002 and the proximate content of the vegetable in the second rainy season (2017).

	PbS	PbR	Moisture content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate content
PbS Pearson Correlation	1	0.52**	-0.22	0.48**	-0.06	-0.15	0.31*	-0.38*
Sig. (2-tailed)		0.00	0.18	0.00	0.74	0.38	0.05	0.02
N								
PbR Pearson Correlation		1	-0.50**	0.63**	-0.41**	0.57**	0.57**	-0.36*
Sig. (2-tailed)			0.00	0.00	0.01	0.00	0.00	0.02
N								
Moisture Pearson Correlation			1	-0.80**	0.50**	-0.46**	-0.46**	0.55**
Sig. (2-tailed)				0.00	0.00	0.00	0.00	0.00
N								
Ash content Pearson Correlation				1	-0.43**	0.60**	0.60**	-0.55**
Sig. (2-tailed)					0.00	0.00	0.00	0.00
N								
Fat and Oil Pearson Correlation					1	-0.65**	-0.65**	0.34**
Sig. (2-tailed)						0.00	0.00	0.03
N								
Crude Protein Pearson Correlation						1	-0.73**	0.38*
Sig. (2-tailed)							0.00	0.02
N								
Crude Fibre Pearson Correlation							1	-0.48**
Sig. (2-tailed)								0.00
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

**correlation is significant at the 0.01level (2-tailed) .*correlation is significant at the 0.05 level (2-tailed)

Table 214 shows the correlation between Lead of shoot, root and the nutritional content of *Corchorus olitorius* accession NG/OA/04/010 in the second dry season (2016). Pb concentration of the shoot had a significant positive correlation with the Pb concentration of the root (r= 0.74**) at $p \leq 0.00$ (Table 214). Pb concentration of the root had strong negative correlation with the moisture content (r= - 0.41**) at $p \leq 0.00$, the ash content (r= - 0.34*) at $p \leq 0.02$ and crude fibre content (r= - 0.38*) at $p \leq 0.03$(Table 214). The moisture content of the accession had significant positive correlation with the the ash content (r= 0.45**) at $p \leq 0.00$, strong significant negative correlation with the crude protein content (r= - 0.87**) at $p \leq 0.00$, the crude fibre content (r= - 0. 80**) at $p \leq 0.00$ and with the carbohydrate content (r=0.34*) at $p \leq 0.04$ (Table 214) . The ash content of the accession had a strong positive correlation with the crude fibre content (r=0.70**) at $p \leq 0.00$, significant negative correlation with fat and oil content (r= - 0.44**) at $p \leq 0.00$ and crude protein content (r= - 0.49**) at $p \leq 0.00$ (Table 214). The fat and oil content had a significant positive correlation with the crude protein (r=0.58**) at $p \leq 0.00$ (Table 214). The crude protein of the accession had a significant negative correlation with the crude fibre (r= - 0.70**) at $p \leq 0.00$ (Table 214). Table 215 presents the correlation coefficient between lead content of *Corchorus olitorius* NG/AO/010 and the proximate content of the vegetable accession first rainy season.

There were significant positive correlation between the Lead content of the shoot, the Pb content of the root (r=0.34*) at $p \leq 0.03$, with the moisture content (r=0.49**) at $p \leq 0.00$ and a significant negative correlation with the crude fat and oil content (r= - 0.63**) at $p \leq 0.00$ (Table 215). Significant negative correlation were recorded between the moisture content, the ash content at (r= - 0.45**) at $p \leq 0.00$, the crude fibre content (r= - 0.65**) at $p \leq 0.00$, the carbohydrate content (r=-0.55**), positive significant correlation with the crude fat and oil content at r=0.82** and $p \leq 0.00$ and the crude protein content (r=0.52**) at $p \leq 0.00$. The ash content had a significant negative correlation with the crude fat and oil content (r= -0.56**) at $p \leq 0.00$ and a significant positive correlation with the crude fibre (r=0.67**) at $p \leq 0.00$ (Table 215). The fat and oil content significantly negatively correlated with the the crude fibre (r= - 0.78**) at $p \leq 0.00$. There was a significant negative correlation between the crude protein content and the carbohydrate content (r= - 0.90**) at $p \leq 0.00$ (Table 215).

Table 216 shows the correlation between lead content of *Corchorus olitorius* NG/AO/04/010 and the proximate content of the vegetable accession in the second rainy season (2017) (Table 216). There was significant positive correlation between the Pb content of the shoot of the accession, the Pb content of the root (r=0.55**) at $p \leq 0.00$ and the crude fibre (r=0.35**) at $p \leq 0.03$ (Table 216) . The moisture content of the accession had significant positive correlation with the fat and oil content (r=0.38**) at $p \leq 0.00$, crude protein content (r=0.34*) at $p \leq 0.04$ and carbohydrate content at (r= 0.55**) at $p \leq 0.00$ (Table 216) . The ash content of the accession had significant positive correlation with the fat and oil content (r=0.48**) at $p \leq 0.00$, the crude fibre content at r=0.78** and 0.00 and the carbohydrate content (r= 0.51**) and $p \leq 0.00$ (Table 216). The crude fat and oil content had significant positive correlation with the crude protein content (r=0.38*) at $p \leq 0.05$ and with the carbohydrate (r= 0.77** and $p \leq 0.00$ (Table 216).The crude fibre content had a significant positive correlation with the carbohydrate content (r=0.51**) at $p \leq 0.00$(Table 217) showing very strong interaction and the same imput.

Table 213: Correlation between Lead of shoot , root and the promixate composition of *Corchorus olitorius* accession NG/OA/04/010 in the first dry season (2015).

	Pb shoot	Pb root	Moisture content	Ash content	Fat n oils content	Crude protein content	Crude fibre content	Carbohydrate content
Pb shoot Pearson Correlation	1	0.71**	-0.08	-0.04	0.06	-0.05	-0.03	-0.07
Sig		0.00	0.64	0.79	0.73	0.77	0.86	0.69
Pb root Pearson Correlation		1	-0.47**	-0.37**	0.17	0.28	-0.38*	0.18
Sig			0.00-	0.02	0.30	0.09	0.02	0.28
Moisture content Pearson Correlation			1	0.47**	-0.21	-0.84**	-0.82**	-0.34
Sig				0.00	0.21	0.00	0.00	0.04
Ash content Pearson Correlation				1	-0.47**	-0.48**	0.77**	-0.25
Sig					0.00	0.00	0.00	0.12
Fat n oils content Pearson Correlation					1	0.55**	-0.28	-0.08
Sig						0.00	0.08	0.65
Crude protein content Pearson Correlation						1	-0.80**	0.20
Sig							0.00	0.22
Crude fibre Pearson Correlation							1	-0.29
Sig								0.07
Carbohydrate content								

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 214: Correlation between Lead of shoot , root and the promixate composition of *Corchorus olitorius* accession NG/OA/04/010 in the second dry season(2016).

	Pb shoot	Pb root	Moisture content	Ash content	Fat n oils content	Crude protein content	Crude fibre content	Carbohydrate content
Pb shoot Pearson Correlation	1	0.74**	-0.08	-0.04	0.06	-0.05	-0.03	-0.07
Sig		0.00	0.64	0.79	0.73	0.77	0.86	0.69
Pb root Pearson Correlation		1	-0.41**	-0.34**	0.17	0.28	-0.38*	0.18
Sig			0.00	0.02	0.30	0.09	0.02	0.28
Moisture content Pearson Correlation			1	0.45**	-0.21	-0.87**	-0.80**	-0.34*
Sig				0.00	0.21	0.00	0.00	0.04
Ash content Pearson Correlation				1	-0.44**	-0.49**	0.70**	-0.25
Sig					0.00	0.00	0.00	0.12
Fat n oils content Pearson Correlation					1	0.58**	-0.28	-0.08
Sig						0.00	0.08	0.65
Crude protein content Pearson Correlation						1	-0.71**	0.20
Sig							0.00	0.22
Crude fibre Pearson Correlation							1	-0.29
Sig								0.07
Carbohydrate content								

** High significant correlation at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 215: Correlation coefficient between lead content of *Corchorus olitorius* NG/AO/010 and the proximate content of the vegetable accessionin the first rainy season (2016).

	PbS	PbR	Moisture	Ash	Fat	Protein	Fibre	CHO
Pb S Pearson Correlation	1	0.34*	0.49**	0.29	-0.63**	0.19	0.23	0.07
Sig. (2-tailed)		0.03	0.00	0.07	0.00	0.24	0.16	0.69
N								
Pb R Pearson Correlation		1	-0.17	0.30	-0.11	0.09	-0.06	-0.09
Sig. (2-tailed)			0.32	0.06	0.51	0.60	0.74	0.74
N								
Moisture Pearson Correlation			1	-0.45**	0.82**	0.52**	-0.65**	-0.55**
Sig. (2-tailed)				0.00	0.00	0.00	0.00	0.00
N								
Ash Pearson Correlation				1	-0.56**	-0.08	0.67**	-0.14
Sig. (2-tailed)					0.00	0.61	0.00	0.39
N								
Fat Pearson Correlation					1	0.05	-0.78**	-0.11
Sig. (2-tailed)						0.61	0.00	0.51
N								
Protein Pearson Correlation						1	-0.20	-0.90**
Sig. (2-tailed)							0.22	0.00
N								
Fibre Pearson Correlation							1	0.21
Sig. (2-tailed)								0.20
N								
CHO Pearson Correlation								1
Sig. (2-tailed)								
N								

**High significant correlation at the 0.01 level (2 tailed). * correlation is significant at the 0.05 level(2 tailed) .PbS=cadmium in shoot. PbR=cadmium in root. CHO=carbohydrate

Table 216: Correlation between lead content of *Corchorus olitorius* NG/AO/04/010 and the proximate content of the vegetable accession in th second rainy season (2017).

	PbS	PbR	Moisture Content	Ash content	Fat and Oil Content	Crude Protein content	Crude Fibre content	Carbohydrate content
PbS Pearson Correlation	1	0.35*	0.01	0.31	-0.13	0.16	0.35*	0.07
Sig. (2-tailed)		0.03	0.96	0.06	0.44	0.32	0.03	0.68
N								
PbR Pearson Correlation		1	0.11	0.01	-0.17	0.08	0.01	-0.12
Sig. (2-tailed)			0.50	0.95	0.31	0.63	0.97	0.48
N								
Moisture Pearson Correlation			1	-0.13	0.38**	0.34**	0.04	0.36*
Sig. (2-tailed)				0.44	0.00	0.04	0.83	0.02
N								
Ash content Pearson Correlation				1	0.48**	0.17	0.78**	0.51**
Sig. (2-tailed)					0.00	0.31	0.00	0.00
N								
Fat and Oil Pearson Correlation					1	0.38*	0.01	0.77**
Sig. (2-tailed)						0.02	0.95	0.00
N								
Crude Protein Pearson Correlation						1	0.05	0.10
Sig. (2-tailed)							0.76	0.55
N								
Crude Fibre Pearson Correlation							1	0.51**
Sig. (2-tailed)								0.00
N								
Carbohydrate Pearson Correlation								1
Sig. (2-tailed)								
N								

,, correlation is significant at the 0.01level (2-tailed) ., correlation is significant at the 0.05 level (2-tailed). **High significant correlation at the 0.01 level (2 tailed). * correlation is significant at the 0.05 level(2 tailed).PbS=cadmium in shoot. PbR=cadmium in root. CHO=carbohydrate

CHAPTER FIVE

5.1 DISCUSSION

Moisture content and pH of the soil samples used to raise the vegetable accessions were slightly higher in the rainy seasons (slightly acidic) than in the dry seasons. The mean pH values of most of the soil samples analyzed in both seasons were slightly acidic. This is similar to pH the values reported for soil profiles of automobile mechanic waste dumps in Port Harcourt, Nigeria (Iwegbue *et al*., 2006) but higher (6.48-9.33) than finding of Akpofure. (2012) that recorded pH range of 5.4-6.3 and Ashraf, *et al*.(2011) that recorded a pH range of 4.8–7.2. pH is one of the factors that influence the bioavailability and the heavy metals transport in the soil. Heavy metal mobility decreases with increasing soil pH due to precipitation of hydroxides, carbonates or formation of insoluble organic complexes (Smith and Giller,1991). Low pH obtained for the soils in this work would support the availability of the nutrients required for plant growth, and the heavy metals may significantly, be available particularly those that can lead to plant contamination and toxicity, if they exceed nutritional requirement of plants. Low pH inhibits the microbial activities in soils such as nitrifying bacteria, by reducing the amount of available soil nitrogen required for plant growth (Sylvia *et al*., 1998) At low pH, the mobility of free metal cations and protonated anions increases due to the redox reactions of soil surfaces (Keepax *et al.*, 2011). Low acidic mean pH in the soils in the rainy season could be due to the basic cations that were forced off the soil colloids by the mass action of hydrogen ions from the rain as those attach to the colloids or acid rain which are usually caused by air pollution.

Sulphur dioxide (SO_2) and oxides of nitrogen and ozone usually originate from human activities such as combustion of burnable waste, fossil fuels in thermal power plants and automobiles. These substances (Sulphur dioxide (SO_2) and oxides of nitrogen and ozone) interact with reactants present in the atmosphere which result into acid deposition causing the release of protons, thereby, increasing the soil acidity, lowering of soil pH, leaching away nutrient cations and increasing the availability of toxic heavy metals sources. The pH obtained in this study was slightly acidic to neutral to moderately alkaline (6.48 to 9.33) which is within the results for dumpsites by other researchers (Gupta *et al.*, 2005;

Elaigwu *et al*., 2007; Uba *et al*., 2008). The soil pH values are within the range for the cultivation of such vegetables as reported by Intawongse and Dean (2006). The results of this study indicated lower bulk densities in the soils of the rainy season than in the dry seasons, this could be due to their fine texture and high organic matter content (Swarnam *et al*., 2004).

Organic matter in the rainy seasons were higher than in the dry season indicating that rainy seasons soils were rich in organic matter content. The high organic matter could be due to clay migration, water retention and localized micro-climate. It could also be due to the differences of litter decomposition rate in the vicinity, the deposition processes and low soil erosion (Shamsudheen *et al* 2005, Verma *et al*., 2007). The organic matter recorded in this study was higher than the report of Tsui *et al.* (2004) but lower than the findings of Obute *et al*. (2010) and Okalebo *et al*. (1993). The differences this could be due to seasonal variation, geograghical location or microbial activities in the soil. Organic matter plays an important role in soil structure, water retention, cation exchange and in the formation of complexes (Amusan *et al*., 2005). Higher organic matter content in the study sites than that of the Control may be due to the presence of garden waste, food waste and the higher proportions of paper and packaging materials since more than half of municipal waste usually consists of paper in other sites while the remaining half consists of garden waste, metals, glass and ash.

CEC shows the ability of the soils to absorb or release cations and, consequently, is an important parameter in sites contaminated by heavy metals. Cation Exchange Capacity was slightly higher in the rainy season than in the dry season but lower (3.59-8.63 cmol/kg dry soil) than the findings of Maji *et al*. (2005), Uba *et al*. (2008) and Ashraf, *et al*.(2012) with values greater than 17.00 cmol/kg dry soil. This could be due to low soil absorbing capacity of the soil and high soil pH. The available phosphate in the soil was higher in the rainy season than in the dry season. Nitrogen content in the soil was higher in the rainy seasons than the dry seasons. This could be due to higher microbial activities in the soil in the rainy season than in the dry season.

The result of this study showed that heavy metal contents of the soils varied significantly from site to site and and season to season. The soil pH seemed to play a major factor role in the load of Cd, Cu and Pb in the soil. An increased soil pH reduces the heavy metal contents of soils. The difference in the heavy metal content between seasons of the soils could be due to the geographical location, geogenic origin of each site and the anthropogenic activities in each site.

Sources of Cd content of the soil was higher in the dry seasons than in the rainy seasons this is contrary to the report of Oluyemi *et al*.(2008) which could have been due to seasonal variation and the anthropogenic activities of the factories where soils were collected (Coca cola Bottling Company, Forgo Battery Company and the International Tobacco Company, Ilorin), proximity of the soils to mechanic work shops, vehicular emission from roads, fertilizer application and herbicides pollution from agricultural chemicals. Cd contents of some soils in the study sites recorded values higher (4.67 mg/kg) than the maximum permissible limits in the dry seasons of agricultural soils (Cd – 1.4 mg/kg mg/kg) {CCME, 2007} and the European Unioun Standard, 2006, (3.0 mg/kg). However, the sources of Cd in the urban areas could be more from metal plating and lubricating oils. It could also be due to rough surfaces of the roads which increase the wearing of tyres, and run-offs from the roadsides, exhaust from factories and spillage from mechanic workshops.

Cu contents of soils in this study were observed to be lower (1.40-30.08 mg/kg) than the range of 1 to 40 mg/kg as normal Cu concentration in German soils, the European Union Standard, 2006 (140 mg/kg) and the range of 30 to 330 mg/kg in Costa Ricca soils (Kretzschmar *et al*.,1998). Cu content of the soils in this study were lower (1.40-30.08 mg/kg) than the findings of Fytianos and Zarogiannis (1999) and also to the finding of Akpofure (2012) that recorded Cu content of 301-714 mg/kg in dump soil in Effurun but higher than the soil quality cut-off criteria as defined by Smith (1981) in United Kingdom for contaminated land (1.4-10.00 mg/kg) and the finding of Oviasogie et al., 2007 who recorded a lower Cu value of soil (29.00 mg/kg). The differences in the findings could be due to the differences in the anthropogenic activities in the areas and could be attributed to the age of abandonment of the dump sites where the soil sample was collected (Badri and Aston, 1983).

The soil Pb contents in this study were lower (1.29-82.00 mg/kg) than the findings of Ogunyemi *et al*.(2003) where a value of 678.5mg/kg was reported for Pb in landfill soil in Ibadan in South-West which could be due to site location and the types of activities in the sites. But higher than the findings of Akpofure (2012) that recorded (0.9-4.2 mg/kg) in the dump soil in Effurun, this could be due to lead associated waste in the dump soil of Effurun compared with the soils of this study. It could also be due to the location of the sites and the anthropogenic activities of the sites. Lower Pb content were recorded in soils of the dry seasons than the rainy seasons which were lower than the permissible limit in agricultural soils. The study indicated that soils from some study areas such as Otte, Budo Egba, Mubo, Ojagboro, Olaolu and Coca cola recorded relatively higher values of all the metals than the other sites while some of the study farm soils could be best for vegetable cultivation because of their relatively low level accumulation of these heavy metals, areas such as the Control sites, Budo Abio, Eroomo and Odoore. Coca cola vegetable farm soil was proxy to Industries, therefore, high level of Cd and Pb might not be a surprise. For Otte, Budo Egba and Olaolu soils, they are along the road, therefore, are proned to vehicular emissions.

There are mechanic workshops around the farm land where the soils were collected, therefore, could be disposed to Pb discharge from mechanic workshops and application of fertilizer could contribute to the relatively high Pb content. The report equally showed that soils of the Control sites recorded relatively the lowest content of Pb which is similar to the submission of Oluyemi *et al*. (2008), which could be due to the Control site being far from dumpsites, mechanic workshops, industrial layouts, anthropogenic activities, agricultural practices and other forms of pollution. The concentrations of heavy metals in the studied soils were observed to vary according to the metal species and the season corroborating the report of Fifield and Oluyemi *et al*. (2008). Sites like Budo Abio, Eroomo and Odoore had relatively low Pb content, this result is similar to those of Rodriguez *et al*. (1982) who reported that accumulation of Pb above background levels takes place up to a distance of approximately 33 m from the road. This may lead to the suggestion that edible crops for human or animal consumption should be restricted within some particular distances to the road and every other activities. Motto *et al*. (1970) also found that most of the effects of Pb discharge from automobiles is confined within a zone 33 m wide, measured from the road edge. Ward *et al*. (1975), however, suggested a more conservative value of 100 m on either side of road before edible crops are planted. Pb contents of the soils in the study sites were all below (1.29-82.00 mg/kg) the permissible limit in agricultural soils (Pb – 300 mg/kg) (European Unioun Standard, 2006).

The study indicated that the phytoavailable heavy metals in the soils varied significantly from site to site and season to season, this is similar to the submission of Atayese *et al*.(2009). It was also revealed in this study that more Cd was more phytoavailable in the dry seasons than in the rainy seasons, this could be due to the influence of the pH and the Cation Exchange Capacity of the soil supporting Cd complexation in the dry seasons than in the rainy reasons. The lowest phytoavailable Cd was obtained for the Control soil, this could be due to the fact that the Control site was not being used for agricultural practices, therefore, there is little or no effect of fertilizer, pesticides, herbicides or other farm practices. It is far from the road, therefore, vehicular emission was minimal, far from industrial activities and from mechanic workshops, not a dumpsite and also far to a dumpsite, human activities around there are minimal therefore, not subjected to serious anthropogenic activities and pollution.

Some study sites like Ojagboro and Cocacola recorded frequent phytoavailable Cd than the other sites. It was observed from the study that soil Cd content was higher in the dry season than the rainy season with lowest values in the Control site in both seasons.

Cu was more phyto available in the rainy seasons than in the dry seasons. Cu was most phytoavailable in Ojagboro, Oyun, Olaolu and Coca cola respectively while the lowest were obtained from all from the Control site during all the growing seasons except in the second dry season where it was obtained from Oyun. This could be due to seasonal variation which could have been influsenced by some physicochemical properties like pH, organic content and Cation Exchenge Capacity of the soil which could support Cu fixation causing more dissociation of Cu in the soil. The results of this study also suggested that Cu in soils of Budo Abio, Eroomo and Odoore have mainly a geogenic origin

The lowest phytoavailable Pb was obtained for the Control site, this could be due to the fact that the Control site was not been used for agricultural practices, therefore, there is little or no effect of fertilizer, pesticides, herbicides or other farm practices, it is far from the road, therefore, vehicular emission was minimal, far from industrial activities, far from mechanic workshops, not a dumpsite and also far to a dumpsite, human activities around there are minimal therefore, not subjected to serious anthropogenic activities and pollution. Some study sites like Ojagboro and Cocacola recorded frequent phytoavailable Pb than the other sites which could be attributed to the location of the sites, the types of activities the site were proned to, the seasonal variation and the physicochemical properties of the soils in the sites. It was generally observed that Cd was more phytoavailable in the dry season than in the rainy season seasons while Cu and Pb were more phytoavailable in the rainy season than in the dry season. The reason could be due to seasonal variation which could have been supported by the soil physicochemical properties like the pH, soil organic matter and the Cation Exchange Capacity of the soil.

The study indicated that the heavy metals fractionation in the soils varied significantly also from site to site and season to season corroborating the submission of Diaz-de Alba *et al*. (2011). It also indicated that, Cd, Cu and Pb fractionation showed distinguish different loadings and mobilities of metals in soils collected in different areas this agreed to the conclusion of Zerbe *et al.* (1999).

It was observed from the study that all fractions of Cd were higher in the dry season than in the rainy season with lowest values in the Control site in both seasons. Result of the metal fractionation in the soil samples studied showed that Cd was mostly abundant in the exchangeable fraction and the abundance was lower in the residual fraction in the dry seasons. Low abundance of a metal in the residual phase compared with its abundance in other geochemical phases indicated higher mobility of the metal in the environment, this agreed with the submission of Ashraf, *et al*.(2012). This showed that Cd would easily be released to the environment and highly toxic. The result also indicated the high exchangeable Cd in Cocacola and the highest Cd bound to oxides in Ojagboro could have been due to the effect of the dumpsites with lots of Cd related municipal wastes in the site. Significant differences in the Cd fractionation in soils in the dry seasons was observed in this study, which could be due to the soil the variation in the soil physicochemical properties The highest exchangeable fraction of Cd and Cd bound to Carbon were obtained in Coca cola farm soil which could be due to the proximity of the site to industrial discharges, vehicular emission and mechanic workshop (anthropogenic activiies) which agreed to the submission of Haung *et al*. (2007). High content of these fractions could also be due to Cd in the site being present in mobile and available forms to soil and plants. The soluble and exchangeable metals (labile fraction) of Cd usually being considered as most hazardous Gupta *et al*. (2005); Maiz *et al*. (2000) was observed in the soils of Otte, Budo Egba, Ojagboro and Coca cola in the dry seasons than in the rainy seasons which would likely render the soils polluted by Cd. The highest concentration of Cd residual fractions of soils for Otte, Budo Egba, Ojagboro, Olaolu, Coca cola and Isale Aluko could be due geogenic origin and complexation of Cd with the soil sediments being released after degradation of organic matter which agreed to the submission of Cabral and Lefebvre. (1998).

The study showed Cu fractionation in the rainy seasons to be higher than in the dry seasons which could have been been due higher pH enhancing redox recaction and Cu complexation. Copper can easily complex with organic matters because of high formation of organic-Cu compounds and mostly abundant in the fraction bound to organics. Results showed high concentration of Cu bound to carbon for Ojagboro and Isale Aluko soil, this could have been due to the municipal content of the dumpsites around the sampled which was similar to the conclusion of Ramirez *et al*. (2005). Fractions of Cu bound to organics were higher in the rainy seasons than in the dry seasons which could have been due to the effect of high pH and soil organic matter enhancing the compleation and mobility of Cu in soil by redox reaction. Higher fraction of Cu bound to carbon than the other fractions suggested low degree of pollution in the environment. The high potential mobility of Cu showed that under strong oxidizing conditions, due to degradation of organic matter in the rainy season than in the dry season.

It was observed in the study that the lowest values in all the species of Pb in the both seasons were recorded in the Control site making Pb in the soil. Pb was readily extractability in the rainy seasons than in the dry seasons which may suggest potential phytoavailability and may create an environmental risk and potential health hazard of human exposure. Pb also showed highest concentration in the bound to carbonates and oxides, which are considered to be weakly bound and immobile and may be relatively labile with the aqueous phase thus possibly becoming more readily bioavailable at suitable pH which agreed to the submission of Ramirez, *et al*.(2005) .

Lead is mainly contained in the bound to carbon fraction in the soils of Otte, Budo Egba, Mubo, Oyun, Ojagboro and Olaolu probably because of its complexation with sediments being released after oxidation from sulfides to sulfates which are considered to be weakly bound and may be relatively labile with the aqueous phase thus possibly becoming more readily bioavailable at suitable environmental conditions. Thich agreed with the submission of Diaz-de Alba *et al*. (2011). Results showed the presence of higher Pb fractionation in soils of the Otte, Budo Egba, Ojagboro, Olaolu, Coca cola and Isale Aluko could have beeen due to their proximity to the Nigeria Bottling Company Industries and the majors roads discharging wastes which were mostly anthropogenic origin from industrial discharge, vehicular emission, mechanic worhshops, exhausts from FORGO Baterry factory and mining activities. The study also showed that the anthropogenic contribution to Pb concentrations in soils of Otte, Budo Egba, Mubo, Oyun, Ojagboro, Olaolu and Coca cola were higher compared to Budo Abio, Eroomo, Odoore area and the Control site.

The pollution index is degree of soil pollution for a metal and in the study, it varied depending on the type of metal, soil, and locality (Zango *et al*, 2013). It has been used to assess urban soil and permits a comparison of pollution levels between sites and at different times. The pollution index of soils in this study showed that even in areas with little industrialization, lack of adequate waste management controls could result in unusual high levels of heavy metals contamination of the soil as recorded in the soil of Ojagboro and Isale Aluko. Further work through biomonitoring of the sites may be essential in the long term to ensure an accurate assessment of the risks posed. The pollution index of the heavy metals in areas of study were found to be lower than many other reported ones but higher (0.43-5.19) than the submission of Zheng *et al*. (2006) that recorded pollution index 0.7. Pollution index range of Cd in this study was lower (0.00-3.11) than the finding of Majolagbe, *et al*. (2010) which recorded a higher range of (0.63-7.60) but higher than the values of the submission of Debnárová and Doleţa, 2010 (0.04-0.18) and Edori and Edori, 2012 (0.02-0.04). This could be due to the anthropogenic activities in the sites, the location, the agricultural practice or geological origin of the sites (Gazso, 2001).The study showed that Control soil was not polluted with Cd while other soils were polluted of Cd. Soils of the dry season were more Cd polluted than the rainy season soils.

Copper (Cu) pollution indices of the study sites were higher in the rainy season than in the dry season. This could be due to copper complexation with soil organic matter which made Cu more disposed for plant uptake in the form of Cu bound to organic fraction (Mediolla *et al*., 2008). The study showed higher Cu pollution range (0.86-9.00) than the submission of Majolagbe *et al*., 2014 (3.73-8.09) and Syed and Mohammad, (2012) that recorded the value 4.68 -7.72. The study suggested that studied soils ranged from uncontaminated to strongly/extremely contaminated with respect to Cu.

Lead in this study indicated lower pollution index range (0.65-5.19) than the finding of Majolagbe *et al*., 2014 (4.53-15.6). The result of the study showed low to moderate Pb pollution (Pi=1-8) (Mediolla *et al*., 2008).

The degree of heavy metal pollution in all the studied soils varied between low polluted and strongly polluted in respect of all the studied metals except for the soil of the Control site that showed no pollution to low pollution of Cd, Cu and Pb. The study also showed varied metal pollution form site. to site. Cd and Pb pollution indices of soils of Otte, Budo Egba, Mubo, Oyun, Olaolu and Cocacola were higher than other soils which could have been due to agricultural activities, vehicular emission, mechanic workshop pollution and industrial waste discharge in the sites where the soils were collected while soils collected from Budo Abio, Eroomo, Odoore and the Control soil had higher indices for Cu, this could have been connected to the municipal content of the dumpsites and geological origin of the soil. The study showed low Cd and Pb pollution in soils of Eroomo, Odoore and the Control soil.

Ecological potential risk of Cd in the study was observed to be higher (15.29-90.00) than the submission of Majolagbe *et al*., 2014 (1.9-21.2). This showed considerable Cd ecological potential risk.

Most of the study sites had Ecological potential Risk Index greater than 80 ($80 \leq Er < 160$) for Cd and Pb, which indicated that the areas have considerable potential ecological risk for Cd (Hakanson,1980) contrary to the findings of Nasr, *et al*. (2015) that recorded lower value than 40 for Cd and Pb but agreed with the report of Mirzaei *et al*. (2014). The difference could be due to location and difference in the activities of the sites. Vehicle emissions and other human activities could have contributed to the accumulation of Cd and Pb which agreed with the submission of Fatoba *et al*.(2012). (Pfeiffer *et al.*, 1991; Blake and Goulding, 2002; Zheng *et a*l., 2002).

Irrigated water sources are exposed to different anthropogenic activities such as domestic waste discharge, industrial waste, wastes from agronomic activities, burning of animal skin and remains (from nearby abattoir), refuse from poor wastes management and heavy vehicular activities on the bridge. In the dry season, the major factor is evaporation from water bodies, which can lead to an increase in the concentrations of contaminants as the dilution factor is removed In the rainy season, water from rainfalls could wash off heavy metals and other contaminants into the river or left as sediments on the bank of the river. This can lead to increase in the concentrations of heavy metals on the river banks (farm soils) (Anhwange *et al.*, 2009) and consequently taken up by the vegetables. Heavy metals content of the water bodies can be influenced by changes in the weather condition of a river catchment and the water chemistry.

The pH range of water used to irrigate the vegetable accessions in the dry seasons (6.42-6.93) were lower than in the rainy seasons (6.54-8.76) making the water slightly acidic in the dry seasons than in the rainy seasons which could be due to evaporation from water bodies caused by seasonal variation.The pH range of this study was slightly higher than WHO limit of pH (6.5-8.5), higher to the submission of Ahmed *et al*. (2010) (6.4) and Joshua *et al*. (2016) (7.2–7.7). Total Acid Value of the water in the dry seasons was higher than in the rainy seasons could be due to the lower pH. The turbidity of water samples were lower in the rainy seasons (3.20- 6.05 NTU) than in the dry seasons (4.64 - 7.13 NTU). These values were higher than the findings of Anhwange *et al. (*2009) (1.9–4.29 NTU). The difference in this result could be geological factors and different human activities in the sites.

Hardness of water in the dry seasons was higher in the dry seasons than in the rainy seasons.

Variation of heavy metals in the irrigated water sources suggested that these metals were not uniformly distributed in the study areas. It was showed in the study that Cd in the irrigation water sources was higher in the dry seasons than in the rainy seasons (0.00-0.09 mg/l). This may be hinged on the decrease level of in water in streams, rivers, wells and the sources of irrigation due to low rainfall which resulted into low dilution of chemicals in the water. Could also be due to the fact that, dry season exhibited several fold higher concentration of some heavy metals in the surface water compared to those found in the wet season. This is because of several fold dilution of the source effluent due to rainfall and other flow systems. This is similar to the submission of Ahmad *et al*., 2010 that recorded higher value in the dry season than in the rainy season (0.05-0.50 mg/l). Cd being high in the dry season water than in the rainy season could also be due to slightly acidic pH which seems to influence the concentration of these metals in natural unpolluted water and aids the adsorption of the heavy metals by forming metal oxides or hydroxides (Abdo, 2004).Cd in water of the study was contrary to the earlier findings obtained from other aquatic environments in Egypt (Issa *et al*., 1996, Abdel-Satar, 1998 and Goher, 2002) where higher values of Cd were recorded. Similar values of Cd content in the water for irrigation in the rainy season was reported by Ibrahim *et al*. (1999) but higher than the findings of Hassan and Omotayo.(2014) (0.03 mg/l). and Mondol, *et al*.(2011). Cd concentration of irrigated water in this study was higher than the value reported by Dilara and Syed. (2011) (0.00- 0.0022 mg/l), Anhwange *et al.* (2013) (0.0003–0.002 mg/l) and Ekere *et al.* (2014) (0.00-0.25 mg/l) but lower than the report of Adeel and Ruffat (2014) (1.29-5.18 mg/l). The differences in the findings could be due to the differences in regional hydro-geological conditions and the environmental background of the water sources. It was also observed in the study that, water used for Otte, Budo Egba, Ojagboro, Coca cola and Isale Aluko recorded higher values of Cd compared to other sites. This could be due to industrial activities, dumpsites containing Cd related wastes around the water sources, vehicular emission, oil spillages, proximity to mechanic workshops, excessive application of fertilizer, use of pesticides around such farm soils which could have resulted from the release of protons from the rain into soils causing increase in the soil acidity, lowering of soil pH, mobilizing and leaching away nutrient cations and increasing availability of toxic heavy metals in the soils.. The concentration of Cd of some of the water used for irrigation in this study were mainly above the permissible limits of FAO (1985) (Cd=Nil) suggesting the possibility of the irrigated vegetables of Cd pollution. Several other reports have suggested that a relatively low cadmium exposure may give rise to skeletal damage (Alfven et al, 2000: Mordberg *et al*., 2002).

However, the relative lower values of Cu for the water sources of irrigation in the dry season (0.00 mg/l) than the rainy season(1.68 mg/l) in this study may be attributed to its adsorption on large amounts of dissolved organic matter which could contain a large amounts of H_2S, could also be due to the dead and decay of plankton and precipitation of organic matter associated with Cu to the sediment which produced by sulfate reducing bacteria and anaerobic conditions which can also promote the precipitation of Cu as Copper sulphide (CuS). This is also similar to the report of Abdo (2002) and the report of Ahmed *et al*, 2010 (3.08- 12.82 mg/l) that reported higher Cu content in the irrigated water in the rainy season than the dry season. Cu content in the study had lower value than the submission of Hassan.and Omotayo. (2014) (1.90 mg/l) and Adeel and Ruffat (2014) (11.28-48.53 mg/l) but higher than the findings of Anhwange *et al.* (2013) (0.21–2.65 mg/l). Ekere *et al.* (2014) reported lower Cu content in irrigatiom water (0.20-0.45 mg/l) than this study.The concentration of Cu for some water used for irrigation in this study were mainly above the permissible limits of FAO (1985) (Cu=<1 mg/l.) in both seasons

The study also showed that Pb content in water (0.04-0.63 mg/l) was high in the dry season than in the rainy season. This is similar to the findings of Dilara and Syed. (2011) that recorded (0.023 and 3.65 mg/l) lower value in the dry season than in the rainy season but with higher values than the value in this study. Pb concentration in irrigated water in this study was higher than the findings of Hassan and Omotayo (2014) (0.09 mg/l), Anhwange *et al.* (2013) (0.002–0.042 mg/l) but lower than the submission of Ahmed *et al*.(2010) (68.76 mg/l) and Adeel and Ruffat (2014) (8.38-21.40 mg/l). Lower Pb content than the findings of Ekere *et al.* (2014) (0.38-3.04 hg/l) was also recorded in this study. The difference could be due to Pb in sediment was associated with the carbonate fraction and concentrates on the suspended matter (Laxon 1985), which mobilized from sediment to water as reported by Goher (1998). The Pb concentration of some water used for irrigation in this study were mainly above the permissible limits of FAO (1985) (Pb=0.01 mg/l) in both seasons. This suggested that this could pose a Pb- related health risk. Resent researches have shown long term lead exposure in children may lead to acute psychosis, low intellectual capacity, encephalopathy, low intelligemt quotient and concentration and difficulty in learning ability (WH0, 1995).

Investigated heavy metals in the shoots and roots of the vegetable accessions were seen to differ from specie to specie and from site to site. *Amarathus hybridus* NG/AA/03/11/010 had higher Cd content in the shoot than *Amaranthus hybridus* NGBO125. This could be due to the different abilities of the vegetable accessions to accumulate Cd. In the same vein, *Corchorus olitorius* NG/OA/04/010 accumulated Cd more than *Corchorus olitorius* NG/OA/Jun/09/002.

The study observed that *Amaranthus hybridus* accessions accumulated Cd than *Corchorus olitorius* accessions. The variations in Cd levels among the investigated vegetable accessions shoots can be explained in terms different in species, sorption of the metals to soil colloids and the pollution occasioned by anthropogenic activities which emanated from indiscriminate dumping of cadmium-containing wastes on the soil where these vegetables were raised, especially for the accessions of Otte, Budo Egba, Oyun Ojagboro Coca cola and Isale Aluko (Kachenko *et al.*, 2006). The result also showed that some study sites were highly polluted with Cd, which could have been due to the location of the areas around a huge concentration of industrial activities, vehicular emissions, mechanic workshops and high use of fertilizers.

Cd accumulation in the shoots of the accessions in second dry season was in the trend *Amaranthus hybridus* NG/AO/11/08/039≥ NG/AA/03/11/010 ≥ NGBO125 while it was *Corchorus olitorius* NG/OA/04/010 ≥ NG/OA/Jun/09/002 which was similar to the report of cadmium accumulation in fruits and leafy vegetables previously reported by Sobukola *et al*. (2009). It was observed that *A. hybridus* accessions accumulated Cd more than *Corchorus olitorius* accessions. *A. hybridus* NG/AA/03/11/010 had highest Cd accumulation than the other *A. hybridus* accessions while there were no significant differences in Cd content in the shoots of *Corchorus olitorius* NG/OA/04/010 and NG/OA/Jun/09/002 in the rainy seasons. The result implied that *C. olitorius* accessions had higher ability to accumulate Cd in the rainy seasons while *A. hybridus* accessions accumulated Cd more in the dry seasons. Cd accumulation was more in the vegetable shoots raised in Otte, Budo Egba,Oyun, Ojagboro, Coca cola and Isale Aluko soils.

The variations in Cd levels in the soils of the different sites can be explained in terms of different pollution load occasioned by vehicular emission, nearness to the mechanic workshops, fertilizer usage in the soils and industrial activities which emanate from indiscriminate dumping of lead-containing wastes in the soil which could have exposed the soils to aerial deposition in the form of metal-containing aerosols which were absorbed by vegetables. (Arora *et al.*, 2008; Yusuf and Oluwole, 2009; Iniobong *et al.*, 2012). Cd content of vegetables in this study were higher (0.00-0.53 mg/kg) than the findings of Ladipo and Doherty (2011) who reported reported lower concentrations for Cd in a range between 0.027-0.045 mg/kg for *T. occidentalis* (fluted pumpkin) across selected markets in Lagos, Nigeria. The difference in values may arise from geographical factors. This result was contrary to the findings of Sani. (1990) and Iguisi. (2002) All the vegetables showed significant differences in the heavy metal content. The result also indicated that there were significant differences in the Cd accumulation between species, accessions and seasons at $p \leq 0.05$. This findings agreed with the reports of Haw-tarn *et al.*(2004) and Yi *et al.* (2004). Various factors have been reported as sources of cadmium contamination in the vegetable accessions, prominent among them is the discharge of heavy cadmium-containing wastes into soils where these vegetables were raised.

The result indicated that Cd accumulation in the roots of *Corchorus olitorius* accessions was more than in the roots of *Amaranthus hybridus* accessions in the second dry season which showed that there were significant differences in the Cd accumulated from the soil by the roots at $p \leq 0.05$, therefore *Corchorus olitorius* accessions have the ability to exclude Cd than *Amaranthus hybridus* accessions in Otte, Ojagboro and Coca cola. This is similar to the findings of Harmanescu *et al.*(2011). Soils of Otte, Ojagboro and Coca cola were more contaminated with Cd than the other soils, therefore, not too suitable to grow vegetables. This may be attributed the location of these farms being located near Cd releasing sources such as industrial activities, mechanic workshops, vehicular emissions, fertilizer application, iron melting and oil spillages (Kirkhan, 1983; Lokeshwari and Chandrappa, 2006).

The levels of Cd in the shoots and roots of the vegetable accessions raised from the different farm soils in Ilorin metropolis were higher than those for control and this is in line with earlier reports of Madejon *et al*.(2003) and Oyedele *et al*.(1995). The concentrations of Cd in the accessions from the control sites were below the reported range of elemental content of plants. This finding agreed with the report of Fifield and Oluyemi *et al*. (2000).

The different copper content of the vegtable accessions showed that they have different accumulating capacities for Cu with Amaranthus being a better Cu accumulators. The high value for first dry season amaranth indicated that weather favours Cu accumulation which is contrary to the result of Lawal *et al*. (2011) with reported values in the range of 0.30 mg/kg and 7.50 mg/kg for Cu in different vegetables from some cultivated irrigated gardens in Kano metropolis, Nigeria and the report of Sharma *et al*.(2006) for vegetables grown in wastewater areas of Varanasi, India, and 4.54mg/kg to 39.99 mg/kg for some vegetables irrigated with waste water in Shahre Rey-Iran (Bigdeli *et al.*, 2008).

The result from this study (0.13-5.25 mg/kg) indicated that the Cu concentration in the shoots of the accessions were within the WHO/FAO, 1995 safe limit of (4-15 mg/kg). This is similar to the result of Uba and Uzairu (2008) who reported a value of 0.83 µgkg-1 in Amaranth in the dry season.

The different Cu concentrations observed in this study were lower than the range of 5 to 20 µgg-1 as the normal Cu content in plants (ICAR, 2006). The slight high value of Cu for rainy season *Amaranthus hybridus* accessions indicated that weather favours the accumulation of Cu, which compared well with 2.52mgkg-^{1} reported by Amusan *et al.* (2005). The results of this study also agreed with the findings of Sharma *et al.* (2006) who reported the Cu concentration as 2.25–5.42 mg kg^{-1} in vegetables grown in wastewater areas of Varanasi, India to be within the safe limit but higher than the findings of Anwanghe *et al*. (2013) who reported a lower concentration for copper in *T. triangulare* (0.05 mg/kg) and *A. hybridus* (0.12 mg/kg). The difference in the Cu concentration could be due to geographical factors.

In both seasons, the study reported that the maximum Cu content in the shoots of the accessions was below the National Agency for Food and Drug Administration and Control's (NAFDAC) maximum tolerable Cu concentration of 40 mg/kg in fresh vegetables. The variation in the Cu concentrations in the shoots of the vegetable accessions could be due to the soil and absorption capacity of each metal by the plant, which is altered by various factors such as plant species, metal species and seasonal variations, environmental, human interference, and the nature of the plant (Zurera *et al*., 1989). The results of this study agreed with the findings of Ogunyemi *et al*. (2003). The roots of *Amaranthus hybridus* accessions accumulated more Cu from the soil than the roots of *Corchorus olitorius* accessions therefore were better Cu accumulators. The results showed that the Cu concentration in the accessions varied with plant species and season. The values obtained for Cu in the soils of the vegetables were observed to be higher than the range of 1 to 40 μgg-1 as normal Cu concentration in German soils, but were within the range of 30 to 330 μgg-1 in Costa Ricca soils both reported by Yang *et al.* (2011).

The result for Pb in this study is contrary to those reported for *T. triangulare* (3.34 mg/kg) and *T. occidentalis* (2.65 mg/kg) (Ebong *et al*., 2007). The different Pb content in the vegetables in different sites can be linked to the nearness of the farm to mechanics workshops, industrial activities, release of lead-containing wastes and presence of waste such as batteries, fertilizer deposits, oil spillages and where there is a considerable amount of vehicular emission (Adeniyi, 1996; Okunola *et al*., 2007; Agunbiade and Fawale, 2009).

The result showed that some sites like the Control site least accumulated Pb. The variations in Pb levels among vegetable shoots studied can be explained in terms of pollution generated from fertilizer application, industrial activities, waste from mechanics worshop, indiscriminate dumping of lead-containing wastes in the soil where these vegetables were planted, especially for Otte, Budo Egba, Mubo, Ojagboro, and Coca cola areas. Pb bioaccumulation appears to be due to a direct deposition and foliar absorption more than the translocation from roots to the upper part of the vegetable species (Adeniyi, 1996; Okunola *et al*., 2007; Agunbiade and Fawale, 2009). It was observed that some areas were more Pb pollulated than others such areas were Otte, Budo Egba, Mubo, Oyun, Ojagboro, Olaolu, Coca cola and Isale Aluko. The high Pb accumulation can be attributed to the impact of urbanization, vehicular emission, industrialization and indiscriminate dumping of refuse, herbicides and other agro-chemicals which promote increase the level of toxic metal accumulation in vegetables (Kirkhan, 1983; Lokeshwari and Chandrappa, 2006).

The results showed that *Amaranthus hybridus* accessions accumulate Pb better than *Corchorus olitorius* accession this could be due to the fact that amaranthus has a way of accumulating metals in its tissues and or that aerial deposition may be a major source of contamination. The recent results(0.00-5.92 mg/kg) were contrary to that obtained by Sharmal *et al*.(2006) who reported Pb concentration as 17.54–25.00 mg kg^{-1} in vegetables grown in industrial areas but higher than the findings of Orisakwe *et al*. (2012) who reported lead concentration of 0.56 mg/kg in *T. occidentalis*.. Some of the results obtained in this study were above the recommended acceptable maximum range (0.1-5.0 mg/kg) proposed by the joint FAO/WHO Expert Committee on Food and were comparable with those available in the literature. Muchuweti *et al.* (2006) reported 6.77 mg kg^{-1} as the Pb concentration in vegetables irrigated with mixtures of wastewater and sewage from Zimbabwe which was higher than WHO safe limit (2 mg kg^{-1}). In Pb determination, the values obtained in this research work were much lower than those reported by Anthony and Balwant. (2009), but were around the 6.0 μgg- 1 standard set by Hong Kong (Haw-tarn *et al*., 2004; Yi *et al.*, 2004). The accumulation of heavy metals (Cd, Cu and Pb) in the accessions of some of the sample sites were higher than the WHO/FAO maximum permissible limits (Cd - 0.2, Cu – 70=80, Pb – 0.3mg/kg) but lower than the NAFDAC safe limits for Pb in fresh vegetables (2.00 mg/kg) while in Control site Pb concentration for all heavy metals was found to be below the maximum permissible limit.

This study also revealed that some study areas were more polluted with a particular metal than the other due to the prevailing anthropogenic activities in the areas. Based on this, all the study sites run the risk of pollution with Cd, Cu and Pb in the vegetable accessions. The results also indicated that the metal concentrations in shoots and roots varied with different soils, locations and vegetable types which was in agreement with the findings of Ni *et al.* (2002) and Yang *et al.*(2002). The levels of heavy metals in the vegetable accessions harvested from the soils of the other study sites were higher than those for Control sites, this is in agreement with earlier reports of Oyedele *et al.(*1995) and Madejon *et al.* (2003). This might be due to the selective absorption of the metals by various accessions. The Pb concentrations in the vegetable accessions for the Control site were within the reported range of elemental content of plants (Fifield and Oluyemi *et al.* 2003).

The Pb and Cd in vegetables in this study showed higher level of concentration than the maximum permissible limit as compared with the WHO and FAO (2007) but within the range of the reported by Abdulmojeed *et al.* (2011) (1.60±0.53mg/kg) in the vegetable samples obtained from the effluent irrigated gardens. According to the International organization like WHO and FAO, the Safe limit for the heavy metal like Cd is 0.30mg/kg (WHO and FAO; Codex Alimentarius Commission, 1984). Cadmium concentration in vegetable accessions in this study were higher than the permissible limit (WHO and FAO) which can result to several health risks such cancer, painful osteomalacia (bone disease), destruction of red blood cell and kidney damage and also affects several important enzymes. The results of this study is in agreement with the result of Mohammed and Khairia (2012), who reported lower Cu concentrations but higher concentration of Cd and Pb in vegetables than the maximum permissible limit. Hassan and Mosafaria (2013) reported higher concentrations of Cd (0.32 ± 0.58 mg/kg) but lower Cu concentration (28.86 ± 28.79mg/kg) in vegetable collected from industrial sites than the maximum permissible limit which also compared with the results of this study. Obvious differences in accumulation of heavy metals (Cd, Cu, and Pb) were found in the same vegetable species which may be attributed to the location, soil type and the irrigants.

The results obtained in this study compared well with some literature values of similar studies reports from similar studies (Erwin and Ivo, 1992; Pennington *et al.*,1995;Onianwa *et al*., 2001). Consequently, the general trend for the mean levels of the studied heavy metals in all vegetable accessions in the study sites in both dry and rainy seasons showed that the concentrations of Cu , Cd and Pb in all the study sites were of higher values than the Control sites in all the growing seasons. The observation is in agreement with the results from other studies elsewhere (Sawidis *et al*., 2001;Sharma *et al.,* 2006) which suggested that uptake of heavy metals by plants is proportional to their concentrations and availabilities in soils. The heavy metal contents in the roots of the accessions in this work were lower to the findings of Alloway (1995) and Fifield and Haines, 2000). Less Pb was bio accumulated by the vegetable accessions in the second rainy season than in the first rainy season this situation could be because most of heavy metals are less available to plants under alkaline conditions, than under acid conditions as reported by Hess (1971).

Cadmum Bioaccumulation coefficient of vegetables in this study showed the range of 0.00-3.10 (BAC≤0.5≥1) This suggested that the accessions ranged from poor Cd accumulators to hyper Cd accumulators.

The Cd transfer factor in this egetables in study showed a range of 0.02-0.76 (Tf≤0.5≥0.5) low Cd transfer which could pose fear of Cd related diseases Zhuang *et al .(*2009): Uwah *et al*.(2009). This study showed a TF>1 for Cd in some of the accessions which corroborated the works of Turner (1973) and Edwin and Howell (1993). Cd accumulation in the dry season than in the rainy season suggest that irrigated dry season vegetables may proned to Cd related diseases such as hypertension, arthritis, diabetes, anaemia, cancer, cardiovascular disease, cirrhosis, reduced fertility; hypoglycemia, headaches, osteoporosis, kidney disease, and strokes as it,s long term results (Lokeshappa *et al.*, 2012).

Cu bioaccumulation coefficients in this study were high in mostly all the sites and seasons. Cu BAC was higher in the rainy season (0.45-3.25) than in the dry season (0.21-3.04).It suggested that the vegetables were from good Cu accumulators to hyper Cu accumulator(TF≥0.5≥1). This implies that the consumption of the vegetables could Cu TF in this showed the range of 0.04-1.36 suggesting a Cu hyper accumulated condition of the vegetables (Alloway and Ayres, 1997). This portrays the vegetables unsuitable for consumption as lead to Cu related diseases such as upper gastrointestinal cancer (Turkdogan *et al*, 2002).

Lead bioaccumulation coefficient was observed high in both seasons with most of the vegetables being good Pb accumulators (BAC ≥0.5)) to hyper Pb accumulators (BAC≥1). This study showed higher Pb bioaccumulation value in the rainy seasons (0.00-1.92) than in the dry season (0.20-1.62) suggestion that vegetable in most of the sites in both season are unsuitable for consumption. The study showed Pb Transfer factor higher than 0.5 and higher than 1 in some vegetables in some of the sites in both seasons that corroborated the submission of Turner (1973) and Edwin and Howell (1995) that reported Tf for Pb≥1 (1.57-2.23) but agreed with the findings of Oyedele *et al*.(1995) who reported Pb Tf≥0.5. This indicated high Pb contamination of the vegetables, therefore, have a high risk of Pb related diseases such as hypertension, arthritis, diabetes, anaemia, cancer, cardiovascular disease, cirrhosis, reduced fertility; hypoglycemia, headaches, osteoporosis, kidney disease, and strokes (Lokeshappa *et al.,* 2012). Transfer factors of all the heavy metals in this study were lower to the findings of (Kloke *et al.*, 1984).

Proximate analysis involves the determination of the major components of food as moisture, ash, crude fat, crude protein, crude fiber, and carbohydrate (Ekwumemgbo *et al.*, 2014). The result showed that the studied vegetable accessions showed marked differences in their nutritional composition. Moisture content of any food is an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination (Uyoh *et al*, 2013). The results of this study were within the reported range of 0.83 to 90.30 % for Nigerian green leafy vegetables (Akubugwo *et al.*, 2007), but lower than the findings of Gopalan *et al*. (2007) (89 g/100 g), Chionyedua *et al*. (2009), and earlier percentages reported values for some Nigerian vegetables like *A. cruentus (*23.57 %), *C. olitorius (*15.58 %) *and C. argenta (*30.90 %) (Onwordi *et al*., 2009), with the moisture reported (22.50 %) by Adetuyi *et al.* (2011) and Nwachukwu *et al*.(2014) (88.47 g/100 g). The variations in the moisture content could have been due to different seasons of planting and harvest, and some other ecological factors peculiar to the study areas and to plant species (Nwofia *et al*., 2012).

Ash content was more in the accessions of *Amaranthus hybridus* than the accessions of *Corchorus olitorius*. The trend of the ash content between the accessions in the rainy seasons was irregular with the accessions of *Amaranthus hybridus* recording higher ash contents than the accessions of *Corchorus olitorius*. There were significant differences in the ash content of the vegetable species at $p \leq 0.05$ in the rainy seasons. The ash content of any sample is the measure of the mineral content of the food (Nnamani *et al*., 2009), that is, the measure of the non volatile inorganic constituents remaining after ashing (Ifon and Bassir, 1980). The *Amaranthus* accessions were shown to be richer sources of minerals than the Corchorous accessions. The values of ash content obtained are comparable to those reported for some leafy vegetables such as *A. hybridus*, *C. peps* and *G. africana* (Iheanacho and Udebuani, 2009), but higher than the results of Taiga *et al*. (2008) but lower than the findings of Adetuya *et al.* (2011) (7.19–9.63 g/100 g). The results showed that *Amaranthus hybridus* accessions contains higher ash content than the *Corchorus olitorius* accessions which is an indication that the *Amaranthus hybridus* would provide more essential valuable and useful minerals needed for body development than the accessions of *Corchorus olitorius*.

Crude fat and oil in the dry seasons was higher in the accessions of *Amaranthus hybridus* than *Corchorus olitorius* with the highest content obtained from *Amaranthus hybridus* NG/AA/03/11/010 of Isale Aluko site. It is indicated in this study that the accessions of *Corchorus olitorius* were of low crude fats and oil , therefore, are better for human health. It was shown that the accessions are of good dietary to human health by the content of crude fat and oil. Dietary fats function in the increase of palatability of food by absorbing and retaining flavors (Antia *et al.*, 2006). Crude Fat and oil are essential carbon sources for the biosynthesis of cholesterol and other steroids. The low crude fat and oil observed in the vegetable accessions make them good for human health (Rumeza *et al.*,2006). The result of the crude fat and oil content of the study were higher than the result reported by Okafor (2005) and Nnamani *et al*. (2009) and Nwachukwu *et al.* (2014 (0.18 g/100 g) but lower than the value reported by Adetuyi *et al*. (2011) (9.22–

10.57 g/100 g) but agreed with the report of Onwordi *et al*.(2009; Adeleke and Abiodun (2010) and Oulai *et al*.(2014). These values were within the values reported in some other leafy vegetable such as *Ocimum bass hybridus* which recorded the highest (10.38 ± 0.25 %) and water leaf recorded the lowest (3.55 ± 0.17 %) but lower than those reported by Nnamani *et al*. (2009).

Higher vaues of crude fibre contents were obtained in the rainy seasons than dry seasons with the highest content of crude fibre obtained from the accession of *Amaranthus hybridus* NGBO 125 of Ojagboro in the second rainy season while the lowest content was obtained in *Amaranthus hybridus* NG/AA/03/11/010 for Odoore in the second rainy season. Reports had shown the potential role of dietary fiber in human nutrition and it's contribution to the reduction of the incidence of certain diseases like diabetes, coronary heart disease, colon cancer, high blood pressure, obesity, and various digestive disorders (Ikewuchi and Ikewuchi, 2009). It has also been reported to alter the coronary environment in such a way as to protect against colorectal diseases (Ekumankama, 2008). It increases fecal bulk, which dilutes the increased colonic bile that occurs with high fat diet (Dillard and German, 2000; Zhao *et al.*, 2007).

Reports showed that fibre may have been involed in the binding of some essential trace elements leading to deficiency of some minerals such as iron and zinc when found in excess (Ekwumemgbo *et al.*, 2014). Results of the crude fibre in this work were lower than the findings of Onwordi *et al.* (2009); Adeleke and Abiodun, (2010); Oulai *et al*.(2014) and **A**kinnibosun *et al*.(2015) of *Amarantus hybridus* 10.38% but higher the findings of Adetuya *et al.* (2011) for *Amarantus hybridus* (1.6 g/100 g). These values are lower than those reported earlier for some Nigeria green vegetables (Rao and Newmark, 1998; Ishida *et al.*, 2000;). From the results of this study, fibre content in the accessions of *Amaranthus hybridus* were high compared with the values of the accessions of *Corchorus olitorius* which is an indication that consumption of *Amaranthus hybridus* accessions will enhance quick digestion and absorption processes in large intestine, which aids or stimulate peristalsis, thereby preventing constipation (Ogungbenle and Omosola, 2015).

Crude protein in the vegetable accessions in the first dry season were more in *Amaranthus hybridus* than the accessions *Corchorus olitorius.* This could be due to the variation in the plant species. The values obtained for the crude protein agreed with the report of 21.6 g/ 100 g in *Amaranthus incartus* (Asibey-Berko and Tayie, 1999), *amaranth* (21.33 g/ 100 g) (Hassan *et al.,* 2005), and the findings of Ogungbenle and Omosola (2015) that reported the crude protein content of Okra pod as (23.4 g/100 g). The reported crude protein content were also within the range of 20.48 to 41.66 g/100 g reported as protein content in green leafy vegetables by Grivetti and Ogle (1985) and Tiaga *et al.(*2008) and but higher than the findings on *Amaranthus* (6.1 g/100 g) by Nzikou *et al.* (2006) and on *Amaranthus hybridus* (12.86%) (Akinnibosun *et al*.,2011). According to Pearson (1976), plant food that provides more than 12% of its calorific value from protein is considered good source of protein.

The carbohydrate contents of this study (*A. hybridus* (60.18-75.76 %) and *C.olitorious (*64.00- 75.59 %)) were higher than 23.7 and 39.05% reported for *Amaranthus incurvatus and M. balsamina* leaves, respectively (Faruq *et al.*, 2002; Hassan and Umar, 2006). It is, however, similar to the reported values for *Corchorus tridens* (75.0% DW) and lower than the value of sweet potatoes leaves (82.8%) (Asibey-Berko and Tayie, 1999). Carbohydrate content in some of the accessions of some of the sites were higher to the findings of Akubugwo *et al.* (2007) who recorded carbohydrate content in *Amaranthus hybridus* (52.18%). Similar reports on this include: Ogbadoyi *et al*. (2006); Odukoya *et al*. (2007); Akubugwo *et al.* (2007) and Musaiger *et al.* (2008). The results from nutritional analysis showed that all the vegetable accessions were rich and having the recommended dietary allowances. Significant differences were observed in the moisture content, values of ash, crude fat and oil, crude fibre, total crude protein and carbohydrate content of the vegetable accessions. The rainy season samples possessed higher values of most of the nutritional content when compared with their corresponding dry season samples. The study indicated significant differences at $P < 0.05$ in the proximate composition of the vegetable accessions between the sites and seasons.

The positive correlation between physico chemical properties, heavy metals in water and soils, phytoavailable metals and proximate composition showed that there were strong associations or interactions among all these variables, and more over, they might have similar sources of input (Miller and Miller, 2000). It also to measured the degree of linear relationship between the variables, A strong significant correlation between two variables may be an occurrence of strong dependence of both variables on the same causal factor probably due to their common derivation from the stores in the basement complex which agreed with the report of Olutona *et al.* (2012). This study suggested a strong relationship between the soil physico chemical properties, soil metal content, water physico chemical properties, water metal content, vegetable metal contents and the vegetable proximate composition.

5.2: CONCLUSION

This study concluded that soil and water used for raising vegetables are sources of heavy metals pollution which can lead to health hazard. Farmers should therefore, be advised and encouraged to use treated waste water for irrigation. The concentrations of cadmium, copper and lead in some of the soil, water and vegetable samples investigated were above the WHO/EU/FAO values for the metals. It was observed that the concentration of Cd and Pb in some of the vegetable accessions were high even though within safe limits. Continuous consumption of the vegetables may not pose health hazards as a result of the present level of the heavy metals. However, bioaccumulation of the metals in the human body could be possible following prolonged ingestion due to their reported toxicities. Routine heavy metal assessment of food and soils should be carried out to monitor the quality of food especially for vegetables grown with irrigated water, in dumpsites, industrial areas and farmlands near the road.

5.3: RECOMMENDATIONS

This research work recommends to the dwellers of Ilorin metropolis, the farmers, governments and non governmental bodies whose responsibilities are to ensure the prevention of diseases such as those associated with water and food by providing portable and safe water to the communities and ensure that water used for irrigation during the dry season are safe for cultivation of vegetables.

i. It recommended that monitoring of heavy metals in water, soils and vegetables should be carried out frequently because of the regulation of the safety of lives.

ii. It recommended that constant monitoring of the quality of water sources for irrigation should be paramount to farmers and the Government so as to identify any alteration in the quality and mitigate outbreak of health disorders and the dangerous effects on the water sources.

iii. It recommended that farm land should be sited in areas far from anthropogenic activities

iv. The result of this study was be able to recommend the need for environmental monitoring of the vegetable farmsoils.

v. The study can be used as a tool for the farmers so that they may adopt such strategies which lead them to save the population by minimizing the problems related to metal toxicities.

5.4: CONTRIBUTIONS AND SIGNIFICANCES OF STUDY.

i. The result of this study, would provide a scientific basis for the sources of heavy metal pollution through the protection of the agronomic activities (soil and water) and the determination of reasonable policies concerning economic development in the wastewater in Ilorin metropolis and for the environmental protection of sources of water sources used for irrigation.

ii. The outcome of the study would provide baseline information on the status of vegetable farm soils in Ilorin metroplis.

iii. This study would provide the need to monitor the pollution status of the agricultural farmlands which would help in assessing the metal uptake by the vegetables and the possible heavy metal pathways

iv. This study would present important information about water and soil contamination in the study areas and provide systematic methods for the assessment of heavy metal contamination and the identification of contamination sources or routes in these areas.

v. It would help to understand the appropriateness of the water and soils in the farm soils in Ilorin metropolis for vegetable cultivation

vi. The study would provide basis for assessment and assurance of the quality check of the vegetables produced and consumed in Ilorin Metropolis which will serve as a control check and could be a useful reference or data to the Ministry of Health in case of any reported outbreak caused by vegetable consumption in Ilorin Metropolis

vii. The study would help to determine the best vegetable farm to buy safe vegetables.

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