

**BIOACTIVITY OF AQUEOUS EXTRACT OF *Vernonia amygdalina*
AND *Peperomia pellucida* ON *Meloidogyne incognita*
INFECTING TWO TELFAIRIA ACCESSIONS**

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ABSTRACT

Pot and field trials were conducted at the Teaching and Research farm of University of Ilorin, Nigeria to determine the efficacy of aqueous extracts of *Vernonia amygdalina* and *Peperomia pellucida* in the management of Root-knot nematode, *Meloidogyne incognita* infecting two accessions of *Telfairia occidentalis* Hook. F. Pots were inoculated with galled roots of *Celosia argentea* one week before planting to increase the initial nematode population. The pot trial was set up in a Completely Randomized Design with five replicates while the layout for the field experiment was a Randomized Complete Block Design replicated four times. Transplanted two-week old seedlings in the pots were inoculated with 10g of infected *Celosia* galled root before application of treatment whereas the field was naturally infected. Treatment was applied a week after transplanting and repeated six weeks after transplanting. Results from the study revealed that treated plants in both trials had significantly higher number of branches, vine length and number of pods. Also, the population density and galling of roots were significantly reduced in treated plots to 3 and 4 against the control which has a gall rating of 7 and 6 respectively in pot and field. While the improved yield and reduction in nematode population could be traced to the treatments used, the tolerance of the accessions cannot be discountenanced.

Keywords: Botanicals, root-knot nematode, *Telfairia occidentalis*, accessions, seedlings

INTRODUCTION

Telfairia occidentalis Hook. F. (Fluted pumpkin) is a leafy vegetable that is consumed by millions of indigenous people in Nigeria (Okonwu et al., 2018). In Igbo, it is called 'Ugu', Yoruba 'Egusi-iroko', and in Edo State, Uwmekhen (Ehiagbonare, 2008). The fruit is a fluted figure and that is the reason it is referred to as fluted pumpkin. Fluted pumpkin is grown mainly for the leaves which constitute an important component of the diet in many West African countries (Omoyeni et al., 2015).

Other edible parts apart from leaves include young succulent shoot and seeds (Odiaka et al., 2008). The leaves are useful in treating convulsion (Okonwu et al., 2018). It is also found useful in Ethno-medicine where it is used in the treatment of anemia. The seeds can be eaten whole, ground or fermented into "Ogiri" which serve as condiments for making soap and sauce (Ogbonna, 2009). It can be used in the cookie formulations and marmalade manufacturing (Fagbemi et al., 2005). Seeds are in high demand for nursing mothers because of their lactating-promoting

properties (Arowora et al., 2017). Fluted pumpkin is also a good source of iron vegetable to man (Sanusi et al., 2008).

However, one of the major constraints to the production and yield of fluted pumpkin in Nigeria is root-knot nematode *Meloidogyne* spp (Osei et al., 2013; Izuogu et al., 2009). Root-knot nematodes are plant-parasitic nematodes from the genus *Meloidogyne*. The nematodes invade host plant roots where they start to feed, causing abnormal root morphology and loss of root function (Daramola et al., 2013). Typically, *Meloidogyne* spp feeding will cause roots to swell up forming the characteristic root knots or galls from which the root knot nematode gets its name (Coyne et al., 2018). The quality of plant products is also affected by *Meloidogyne* spp (Bello et al., 2020).

Synthetic pesticides have been used over the years in managing root-knot nematode infection in plants; nevertheless, they may also cause harmful effects on crops, the humans that consume the crops and on the environment (Ndakidemi et al., 2016). Synthetic pesticides sprayed into plants, leach to underground water and some of these compounds also get into marine water (Sharma et al., 2012). They also reach destination other than their target species, including non-target species (Gill and Garg, 2014). In human, the result of exposure to synthetic chemicals ranges from mild skin irritation to birth defects, tumors, genetic changes, nerve disorders, endocrine disruption and even death in severe cases (Martinou et al., 2014). Furthermore, a particular pathogen strain may develop resistance to a particular synthetic pesticide, thereby making it ineffective (Ndakidemi et al., 2016). Considering the numerous hazardous effects of these chemicals, they are gradually being phased out and the use of management strategies of plant origin as alternative is fast gaining ground. Botanicals serve as a safer means of protecting plants against stress caused by pathogens. *Vernonia amygdalina* and *Peperomia pellucida* are examples of botanicals that contain anti-microbial properties because of the presence of bio-active ingredients in them.

The objective of this study therefore was to investigate the bioactivity and nematicidal potentials of *Vernonia amygdalina* and *Peperomia pellucida* in the management of root-knot nematode infecting two accessions of *Telfairia occidentalis*.

MATERIALS AND METHODS

The pot experiment was carried out at the screen house of Crop Protection, University of Ilorin while the field experiment was carried out on the Teaching and Research Farm of University of Ilorin in the savanna agro-ecological zone. It is located on Latitude 8° 24' N and 8° 36' longitude 4° 10'E of the equator. The nursery site was Faculty of Agriculture pavilion of the University.

Pot trial

Using the method of Gautam and Goswami (2002), sandy-loam top soil was collected around the premises of University of Ilorin and sterilized in a drum at 60°C for 24 hours. The sterilized soil was later distributed into perforated plastic buckets and placed on elevated flat blocks to prevent re-infestation by microorganisms. The buckets were kept inside the screen house to cool down until they were ready to use.

The experiment was set out in a Completely Randomized Design (CRD). Ten gram of galled root of *Celosia argentea* which had been estimated to contain 500 second stage juveniles (j2) was incorporated into the each pot to serve as initial nematode population.

Two accessions of the *Telfairia occidentalis* seedlings were transferred from the nursery and transplanted out separately in a Randomized Complete Block Design a week after incorporation of galled roots. The transplanting was done manually from the crates with cutlass. Each seedling was watered immediately after transplanting.

Field experiment

Land preparation

The farm land was ploughed, harrowed and ridged, a plot size of 44 x 26 m was mapped out for the experiment. The plot was sprayed

with pre-emergence herbicides (Paraquat and Atrazine) at the rate of 200 ml per application with the aid of a knapsack sprayer.

Each seedling of *Telfairia* accession was planted in a Randomized Complete Block Design (RCBD) with four replicates and alley of 1m each between plots and blocks to prevent treatment interference.

Soil assay

The initial nematode population was also determined. The extraction was conducted using the Barmann's tray method as described by Whitehead and Hemming (1965). Root-nematode were identified and counted using a binocular stereomicroscope. Samples of the soil nematode suspension were collected in specimen bottles and then taken to Nematology unit of International institute of Tropical Agriculture (IITA), Ibadan for confirmation of the nematode identity.

Also, 200ml of soil samples were taken randomly from the field at a depth of 15cm for physico-chemical properties before planting to determine the Nitrogen, Phosphorus, Potassium, Calcium, Sodium and Magnesium present in the soil. Samples were sent to the Department of Crop Sciences at Landmark University, Omuaran. Both nematode and physic-chemical analysis were repeated at the end of the experiment to determine the final soil assay.

Cultural practices

Weeding of the plots was done regularly to reduce competition for nutrient or serve as alternative host for pathogens. Staking was done to support the plant and to expose the leaves to sunlight. The plot was regularly watered during the dry season. The experiment was terminated exactly 16 weeks after transplanting. Roots were rated at harvest.

Preparation of aqueous extract

One kilogram each of air-dried ground *Vernonia amygdalina* and *Peperomia pellucida* was soaked in four liters of hot water for 24 hours. They were thereafter sieved and sufficient quantities needed were prepared using the same procedure before pot and field application. Each of the treatment was

extracted separately this way (Izuogu *et al.*, 2016). For each plant stand, 100 ml of aqueous extract each of *V. amygdalina* and *P. pellucida* was applied to the root with the aid of a syringe. The treatment was applied two times; one week after transplanting and six weeks after transplanting. The control plots did not receive any treatment.

Phytochemical analyses

The phytochemical analyses of *Vernonia amygdalina* aqueous extract was carried out at the department of Chemistry Laboratory, University of Ilorin to determine the bioactive constituents in *V. amygdalina*.

Procedure for phytochemical screening

Test for alkaloids: An aliquot of five milliliters of the extract was warmed with 2% tetratosulphate (V1) acid (H_2SO_4) for two minutes then filtered, followed by addition of few drops of Dragendoff's reagent to the filtrates. Orange red precipitate indicated the presence of alkaloids (Prashant *et al.*, 2011).

Test for saponins: Two milliliters of distilled water was added to about two milliliters solution of the extract. The solution was shaken and warmed inside a water bath. Foaming of the solution indicated the presence of saponins (Prashant *et al.*, 2011).

Test for flavonoids: Five milliliters of dilute ammonia solution was added to two milliliters solution of each extract followed by addition of concentrated H_2SO_4 . A yellow coloration was observed and that indicated the presence of flavonoids (Obasi *et al.*, 2011).

Test for Cardiac Glycosides: Five milliliters of solution extract was added to two milliliters of glacial acetic acid containing one drop ferric chloride solution, subsequently. One milliliters of concentrated H_2SO_4 was gently added along the side of the test-tube. A brown ring at the interface indicated the presence of Cardiac Glycosides (Prashant *et al.*, 2011).

Test for tannins: Two milliliters solution

of extract was boiled in Ten milliliters of distilled water and then filtered; this was followed by the addition of six drops of ferric chloride to the filtrate. A light brown ring at precipitate was taken as evidence for the presence of tannins (Prashant *et al.*, 2011).

Test for anthraquinones: About five milliliters of the extract was mixed with ten milliliters of benzene and then filtered. Five milliliters of 10% ammonia solution was then added to the filtrate and shaken. The presence of pink, red or violet colour was an indication for the presence of anthraquinones (Obasi, *et al.*, 2011).

Gall rating as described by Bridge and Page, (1980)

0 (No knots on roots), 1 (Few small knots, difficult to find), 2 (Small knots only but clearly visible. Main roots clean), 3 (Some larger knots visible, main roots clean), 4 (Larger knots predominate but main roots clean), 5 (50% of roots affected, knotting on some main roots, reduced root system), 6 (Knotting on main roots), 7 (Majority of main roots knotted), 8 (All main roots, including tap root, knotted. Few clean roots visible), 9 (All roots severely knotted. Plant usually dying), 10 (All roots severely knotted, No root system, Plant usually dead)

Data collection and analysis

Data were collected number of leaves, vine length, shoot weight, pod yield, soil nematode population, physicochemical and phytochemical analyses. All numerical data were subjected to analysis of variance (ANOVA) using GENSTAT statistical

package 12th edition and significant means were separated using Fisher's protected LSD at $\alpha=0.05$.

RESULTS

The effect of *Vernonia amygdalina*, *Peperomia pellucida* and the control on number of leaves is presented in table 1. In the pot trial, result showed that plants treated with botanicals performed significantly better than the control from week 4 with *V. amygdalina* and *P. pellucida* having 26.3 and 25.7 respectively while the control had 24.6. The trend was maintained till the end of the experiment at sixteenth week after planting (WAP) where *V. amygdalina* and *P. pellucida* had a significantly higher mean number of leaves of 40.5 and 39.1 while the control had 24.2. Field result showed there was no significant difference among the botanicals and the control at week 2, week 4 and week 6 after planting. Nevertheless, at 8 WAP, *V. amygdalina* had mean number of 47 while *P. pellucida* had 41.1 which was significantly higher than the control which had a mean number of 33.6. Similar pattern to the pot trial was observed from 8 WAP till the rest of the experiment as the plots treated with botanicals have significantly higher number of leaves. Results from both pot and field trials also showed that *V. amygdalina* and *P. pellucida* are not significantly better than each other in respect to number of leaves. However, *V. amygdalina* seems to be slightly better even if it was not significant.

Table 1 : Effect of *Vernonia amygdalina* and *Peperomia pellucida* on number of leaves of *Telfairia occidentalis* infected with *Meloidogyne incognita*

	Weeks after planting							
Treatments	2	4	6	8	10	12	14	16
Pot trial								
<i>V.amygdalina</i>	17.9	26.3 ^a	31.5 ^a	32.4 ^a	37.3 ^a	40.5 ^a	40.5 ^a	40.5 ^a
<i>P.pellucida</i>	18.2	25.7 ^a	29.8 ^a	30.4 ^a	31.9 ^b	38.2 ^b	37.9 ^b	39.1 ^a
Control	18.0	24.6	25.6 ^b	25.1 ^b	26.0 ^{bc}	25.5 ^c	25.6 ^b	24.2 ^b
S.E	1.1	1.5	1.9	3.4	3.2	3.2	3.1	34.3
Level of Sig.	N.S							
Field trial								
<i>V.amygdalina</i>	17	27.2	34	47.4 ^a	61.3 ^a	73.4 ^a	99.6 ^a	99.6a
<i>P.pellucida</i>	18.4	25.1	30.2	41.3 ^a	58.7 ^a	68.3 ^a	86.5ab	87.1ab
Control	15.6	23.4	28	33.6	41.3 ^b	49.2 ^b	61.1c	64.2c
S.E	3	1.1	1.4	3.2	3.6	4.1	5.3	6.8
Level of Sig.	N.S	N.S	N.S					

Means within column followed by the same letter(s) are not significantly different $P \leq 0.05$; N.S = Not significant; S.E= Standard Error

The effect of two accessions of *Telfairia occidentalis* on mean number of leaves is shown in table 2. It was observed from the result that there was no significant difference between the accessions during the pot trial. Although accession 1 was slightly better with mean number of 31.4 at 6 WAP, however, the difference was not significant to that of accession 2 that had 29.7. At 16 WAP which is the end of the experiment, accession 1 and accession 2 had 43.7 and 42.4 respectively which

showed that both accessions were not significantly better than each in respect to number of leaves. In the field trial, accessions 1 and accession 2 were not significantly better than each other from 2 WAP to 16 WAP. At 16 WAP, accession 1 had 89.0 while accession 2 had 87.0 which were not significantly better than each other. The observation from the field experiment was also similar to the pot trial.

Table 2: Effect of two accessions of *Telfairia occidentalis* on mean number of leaves

Accession	Weeks after planting							
	2	4	6	8	10	12	14	16
Pot trial								
Accession 1	17.3	24.3	31.4	33.0	37.4	40.8	43.1	43.7
Accession 2	17.5	24.1	29.7	30.9	36.9	39.2	42.4	42.4
S.E	0.9	1.9	1.7	1.6	2.4	2.8	3.6	4.4
LOS	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Field trial								
Accession 1	18.1	26.0	35.0	45.0	60.0	71.5	89.0	89.0
Accession 2	17.0	27.0	33.0	43.4	58.5	69.6	87.0	87.0
S.E	0.96	1.4	1.6	2.8	3.9	4.2	5.8	6.4
Level of significance	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

WAT = Weeks After Transplanting. N.S = Not significant; S.E= Standard Error

The effect of *V. amygdalina*, *P. pellucida* and the control is presented in table 3. Results of pot trial revealed that at 2 WAP, *P. pellucida* treatment had the highest vine length of 93.4cm which was not significantly better than *V. amygdalina* (90.9cm). However, both treatments performed significantly better than the control with a length of 81.1cm. At 6 WAP, *P. pellucida* (128.6cm) performed significantly better than other treatment while *V. amygdalina* (117.7cm) was significantly better than the control (87.6cm). At 8 WAP, there was no significant difference between *V. amygdalina* and *P. pellucida*, however, both botanicals were significantly better than control. The trend was the same to 16 WAP where there was no significant difference between *V. amygdalina* and *P. pellucida* with vine lengths of 140.3cm and 145.9cm respectively; whereas, control had 92.1cm.

Field trial also showed that both botanical treatments performed better than control. Nevertheless, at 4 WAP *V. amygdalina* treatment had a length of 91.6cm which was significantly better than *P. pellucida* (91.0cm). *P. pellucida* on the other hand was significantly better than control (58.4cm). Meanwhile, at 10 WAP, *P. pellucida* had a vine length of 172.4cm which was significantly better than *V. amygdalina* (149.8cm) and control (76.3cm). At 12 WAP to the end of the experiment, *V. amygdalina* and *P. pellucida* were not significantly different from each other but performed significantly better than control.

Table 3: Effect of *Vernonia amygdalina* and *Peperomia pellucida* on vine length of *Telfairia occidentalis* infected with *Meloidogyne incognita* (cm)

Treatments	Weeks after planting							
	2	4	6	8	10	12	14	16
Pot trial								
<i>V. amygdalina</i>	90.9 ^a	115.0 ^a	117.7 ^b	129.7 ^a	139.6 ^a	144.0 ^a	139.6 ^a	140.3 ^a
<i>P. pellucida</i>	93.4 ^a	128.6 ^a	128.2 ^a	135.3 ^a	141.8 ^a	149.0 ^a	145.9 ^a	145.9 ^a
Control	81.1 ^b	63.5 ^b	87.6 ^c	94.7 ^b	93.0 ^b	91.7 ^b	91.4 ^b	92.1 ^b
S.E	7.9	12.8	14.3	16.5	16.8	18.4	18.8	19.4
Level of Sig.								
Field trial								
<i>V. amygdalina</i>	61.3 ^a	91.6 ^a	94.7 ^a	127.5 ^a	149.8 ^b	168.1 ^a	181.4 ^a	184.2 ^a
<i>P. pellucida</i>	52.3 ^a	81.0 ^b	83.9 ^b	125.8 ^a	172.4 ^a	173.7 ^a	187.9 ^a	187.9 ^a
Control	45.2 ^b	58.4 ^c	82.8 ^c	50.8 ^b	76.3 ^c	86.1 ^b	93.5 ^b	94.1 ^b
S.E	4.8	6.2	9.2	11.6	11.9	13.3	15.2	17.1
Level of Sig.								

WAP = Weeks After Planting; WAT = Weeks After Transplanting. Means within column followed by the same letter(s) are not significantly different
 $P \leq 0.05$; N.S = Not significant; S.E= Standard Error

Table 4 shows the effect of two accessions of *Telfairia occidentalis* on vine length. It was revealed from the result that both accessions were not significantly better than each other in the pot trial from 2 WAP to 16 WAP.

The trend was the same in the field experiment. It was also observed that the vine length of accession 1 was slightly better than accession 2, although the difference were not significant.

Table 4: Effect of two accessions of *Telfairia occidentalis* on vine length

Accession	Weeks after planting							
	2	4	6	8	10	12	14	16
Pot trial								
Accession1	89	113.7	128.1	132	132.4	137.8	143.9	144
Accession2	780.4	118.1	123.6	128.2	131.9	135.4	140.1	141
S.E	6.4	10.5	12.6	13.5	13.7	14.6	15.2	15.7
LOS								
Field trial								
Accession								
1	59.3	85.4	113.6	133.3	148.9	176.3	204.3	205.4
Accession								
2	54.5	70.3	108.2	127.5	143.6	172.1	199.8	201.4
S.E	4.7	10.2	12.9	13.6	15.4	16.1	18.4	21.7
LOS								

WAP = Weeks After Planting; WAT = Weeks After Transplanting. Means within column followed by the same letter(s) are not significantly different
 $P \leq 0.05$; N.S = Not significant; S.E= Standard Error

The effect of treatments on number and weight of pods is reported in table 5. Results of pot trial showed that there was no significant difference between *V.amygdalina* and *P.pellucida* in respect to number of pods. However, both botanicals were significantly better than control. Whereas in the field trial, the mean number of pods in *V.amygdalina* is 3.3 which is significantly higher than those treated with *P.pellucida* (2.4). Notwithstanding, *P.pellucida* performed significantly better than control (1.6).

In respect to weight of pod, pot trial revealed that *V.amygdalina* and *P.pellucida* were not significantly better than each other but performed significantly better than control. On the other hand, field trial showed that the weight of *V. amygdalina* (7.2kg) was significantly better *P.pellucida* (3.8kg). Even so, the weight of *P.pellucida* was significantly better than control (2.0kg)

Table 5: Effect of treatments on number and weight of pods/plant

Treatments	Pot		Field	
	Number	Weight(kg)	Number	Weight(Kg)
<i>V.amygdalina</i>	1.0 ^a	1.3 ^a	3.3 ^a	7.2 ^a
<i>P.pellucida</i>	1.1 ^a	1.0 ^a	2.4 ^b	3.8 ^b
Control	0.4 ^b	0.5 ^b	1.6 ^c	2.0 ^c
S.E	0.1	0.1	0.9	1.8

Means within column followed by the same letter(s) are not significantly different $P \leq 0.05$; N.S = Not significant; S.E= Standard Error

The effect of two accessions of telfairia is shown in table 6. Result revealed that there was no significant difference between the two accessions in respect to number of pods during pot and field trials. Similarly, there was no significant difference in

weight of pods during the pod trial. However, the field trial showed that accession 1 had a significantly better weight of 7.5kg than accession 2 with weight of 3.6kg.

Table 6: Effect of two accessions of *Telfairia occidentalis* on number and weight of pods/plants

Treatments	Pot		Field	
	Number	Weight(Kg)	Number	Weight(Kg)
Accession 1	2.0	2.4	4.0	7.5 ^a
Accession 2	1.9	2.3	3.5	3.6 ^b
S.E	0.1	0.2	0.3	1.1
	NS	NS	NS	

Means within column followed by the same letter(s) are not significantly different $p \leq 0.05$; N.S = Not significant; S.E= Standard Error

The initial nematode population (INP), final nematode population (FNP) and root gall index is reported in table 7. In the pot trial, it was observed from that there was a significant reduction in population of nematode in plants treated with *V.amygdalina* and *P.pellucida*; whereas an increase in population number was noticed in the control with final population of 954.0 from 500. Also, it was discovered that *V.amygdalina* performed significantly better than *P.pellucida* by causing a reduction of the nematode population to 165 while *P.pellucida* reduced the population to 192.0. Meanwhile, both botanicals had root gall index of 3 which

was not significantly better than each other but significantly better than control with gall index of 7.0.

Result of field trial was also similar to pot trial. *V.amygdalina* and *P.pellucida* performed significantly better than control by reducing the INP from 1000 to 278.0 and 296.0 for *V.amygdalina* and *P.pellucida* respectively. In contrast, there was an increase in nematode population in the control from INP of 1000 to FNP of 2086. Although both botanicals performed better than control, yet, *V.amygdalina* also performed significantly better than *P.pellucida*.

Table 7: The soil nematode population and root gall index of telfiaria during pot and field trial

Treatments	Pots trial			Field trial		
	INP(10g)	FNP	Root gall index	INP	FNP	Root gall index
<i>V.amygdalina</i>	500	165.0 ^a	3.0 ^a	1000	278.0 ^a	3.0 ^a
<i>P. pellucida</i>	500	192.0 ^b	3.0 ^a	1000	296.0 ^b	4.0 ^a
Control	500	954.0 ^c	7.0 ^b	1000	2086.0 ^c	6.0 ^b
S.E		34.0	1.2	37.3	35.1	1.0

Means within column followed by the same letter(s) are not significantly different $p \leq 0.05$; N.S = Not significant; S.E= Standard Error. INP = Initial Nematode Population. FNP = Final Nematode population.

The result of phytochemical screening of *V.amygdalina* and *P.pellucida* is reported in table 8. In *V.amygdalina*, the phytochemicals detected were; alkaloids, saponins, tannins, flavonoids, cardiac glycosides and anthraquinones. Whereas,

the phytochemicals detected in *P.pellucida* were; alkaloids, saponins, tannins and flavonoids. It was observed that cardiac glycosides and anthraquinones were absent in *V.amygdalina*.

Table 8: Phytochemical test of *Vernonia amygdalina* and *Peperomia pellucida*

Phytochemicals	<i>Vernonia amygdalina</i>	<i>Peperomia pellucida</i>
Alkaloids	+	+
Saponins	+	+
Tannins	+	+
Flavonoids	+	+
Cardiac glycosides	+	-
Anthraquinones	+	-
Present (+), absent (-)		

The initial and final nutrient present in the soil is presented in table 9. Result showed that nitrogen (N), sodium (Na), potassium (K⁺), calcium (Ca), magnesium (Mg) and phosphorus (P) were present in the soil. There was a reduction in the amount of Na from 0.40mg/kg to 0.30mg/kg nutrients at the end of the experiment. Similarly, there

were also a reduction in the amount of Ca, Mg and P. However, the amount of K available was increased from 0.10mg/kg in initially 1 to 0.30 mg/kg in accession 1. Also, accession 2 increased from 0.20mg/kg to 0.30mg/kg in the final analysis

Table 9: Initial and Final nutrients present in the soil

Treatment	Nutrients present in the soil (mg/kg)					
	Na ⁺	K ⁺	Ca ⁺⁺	Mg ⁺⁺	P	N
Initial						
accession 1	0.40	0.10	0.10	0.10	48.20	0.10
accession2	0.40	0.20	0.10	0.10	49.20	0.10
Final						
accession1	0.30	0.30	0.00	0.00	34.30	0.10
accession2	0.30	0.30	0.00	0.00	36.20	0.10

Keys:N= Nitrogen, Na⁺=Sodium, K⁺ = Potassium, Ca⁺⁺=Calcium, Mg⁺⁺ = Magnesium, P = Phosphorus, S.E= Standard Error

RESULTS AND DISCUSSION

This study revealed a sharp distinction in the response of *Telfairia occidentalis* accessions to aqueous extracts of *V. amygdalina* and *P. pellucida* as against the untreated plants (control). Plants treated with aqueous extracts performed significantly better than the control with respect to number of leaves, vine length and weight of pods in both pot and field trials (as showed in the table above). The performance of both botanical extracts could be attributed to their ability to suppress the population of nematodes that could have invaded the vascular tissue of the plant and establish a feeding site thereby disrupting cellular activities

(Neeraj *et al.*, 2017). Notably, there was reduction in nematode population in treated plants which is in contrast to the control, where there was an increase in population density of root-knot nematode. Izuogu *et al.* (2010), had reported that high population of nematodes (*Meloidogyne* spp) had adverse effect on plant growth and yield.

Furthermore, the presence of secondary metabolites such as alkaloids, tannins, saponin and flavonoids in the extract of *V. amygdalina* and *P. pellucida* could have enhanced anti-microbial properties of the botanicals, causing suppression of the female root-knot nematodes from multiplying their eggs due to the

nematostatic or nematotoxic effect of the bio-active compounds present in the treatments used (Olajide *et al.*, 2018; Sani *et al.*, 2012). This is also similar to the observation of Ibrahim and Srour (2013), when they reported the nematicidal ability of saponins to reduce egg shell permeability and make unhatched juvenile susceptible. Oyedunmade and Izuogu (2011), also noted the ability of aqueous extract of botanicals to inhibit nematode from hatching. Moreover, this study is also in line with the report of Baba *et al.* (2018), on the importance of aqueous extracts of *Lantana camara* as well as aqueous extracts of *Parkia biglobosa* in inhibiting *Meloidogyne incognita* eggs from hatching. Similarly to our investigation, they also reported the presence of alkaloids, tannin, saponin and flavonoid in the botanicals they tested. This could also be the reason the gall rating of treated plants was significantly lower than that of control.

It was also observed from the results that there were no significant differences between accessions 1 and 2 with respect to growth and yield in both trials. However, accession 1 performed slightly better than accession 2 during the experiment. The performance of Accession 1 could possibly be attributed to the presence of more female plants. Females plants of *T. occidentalis* produce more leaves (Ogbonna, 2009), hence, they have larger meristematic region and this will enable them utilize higher light energy and producing luxuriant shoot growth as implicated by longer vines (Chukwura and Nguru, 2010). Also, accession 1 could also have the inherent gene to gene to withstand field conditions than accession 2. The results also showed that both accessions were susceptible to root-knot nematode infestation. However, the level of tolerance

of accession 1 could be said to be higher because they recorded higher yield in pod weight under field trial. Some *Telfairia* accessions have been observed to be very susceptible but quite tolerant and productive. A similar observation was reported by Izuogu and Oluwatayo (2013), when they noted high susceptibility of an accession of *Telfairia* that exhibited high level of tolerance to *Meloidogyne incognita* and produced high vegetative yield.

The physico-chemical analysis of the soil showed a similar pattern in the ways both accessions used up the nutrients; there were reductions in the quantity of nitrogen, phosphorus and calcium present. The reduction showed that accession1 and accession2 had taken up more of the nutrient available. This showed the importance of the nutrients to the plants. Nitrogen is a major building block for protein (Swan, 1971), Calcium regulates the transport of other nutrients into plant, while all the energy transfer in plant cell is critically dependent on Phosphorus. In contrast, the quantity of Potassium was increased.

CONCLUSION

The experiment has shown that the use of aqueous extracts of *V. amygdalina* and *P. pellucida* could be effective in the management of root-knot nematode infecting *Telfairia occidentalis*. This is based on the facts that treated plants from the experiment had lower nematode population, higher growth and yield parameters in contrast to the untreated plants. The bio-active constituents of the extracts are also environmental friendly, hence, could be used in place of synthetic chemicals that have residual effect on plant, soil, underground water and human beings. We therefore recommend the use of

these botanicals in nematode infested fields planted with the tested *Telfairia* accessions 1 and 2. However, in root-nematode endemic field, accession 1 treated with *V. amygdalina* or *P. pellucida* seems more compatible with promises of higher yield.

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