

Effects of pendimethalin and hand weeding on vegetative growth of cowpea accessions

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Abstract

A field study on the effects of pre- and post-emergence application of herbicide (pendimethalin) on the vegetative growth of five accessions of cowpea (TVU-9092, TVU-16265, TVU-16320, TVU-16323 and TVU-16421) was conducted between June and August 2018. Pendimethalin was applied both as pre- and early post-emergence herbicide and followed by two hand weeding at 4 and 8 weeks after sowing (WAS). The cowpea accessions responded differently to the weed control methods. Growth and development increased with the age of cowpea in all the vegetative parameters studied. TVU-16323 produced the highest number of leaves (30, 30) at 4 weeks after sowing respectively in the control cowpea plants. This was followed by (29) in pre-emergence application of herbicide at 0.125 kg/ha for TVU-9092, while the lowest number of leaves was (8.00) in TVU-16265 in the control plants. Plant height was highest (23.17 cm) in TVU-9092 with 0.125 kg/ha post-emergence herbicide application in TVU-9092, followed by TVU-16265 (23.00 cm) with 0.25 kg/ha pre-emergence application, while TVU- 9092 with 0.25 kg/ha pre-emergence application recorded the lowest of the parameter (5.50 cm).. Cowpea accession TVU-16265 with 0.25 kg/ha post-emergence herbicide application had the highest leaf area (105.83 cm²), followed by TVU-16265 with 0.125 kg/ha pre-emergence application (105.08 cm²), while TVU-16421 with 0.125 kg/ha pre-emergence application was the lowest (16.67 cm²). Stem girth was highest in TVU-16421 control plants (9.43

mm), followed by TVU-9092 with 0.125 kg/ha pre-emergence application (9.21 mm), while TVU-16421 with 0.125 kg/ha pre-emergence application recorded the lowest (1.92 mm). Shoot fresh weights were higher in the control plants of TVU-16323 (24.77 g) and TVU-9092 (22.15 g) than in the other treatments. TVU-16320 with 0.250 kg/ha pre-emergence application recorded the lowest shoot fresh weight (1.31 g). Post-emergence application of pendimethalin at 0.125 kg/ha produced the highest shoot dry weight (5.22 g) in TVU-9092, followed by post-emergence application at 0.250 kg/ha in TVU-16421 (4.97 g), while post-emergence application at 0.125 kg/ha in TVU-16421 and the control plants of TVU-9092 had the lowest shoot dry weights of 0.25 g.

Keywords: Herbicide, Leaves, Plant height, Shoot weight, Stem girth

Introduction

Cowpea, *Vigna unguiculata* (L.) Walp, is one of the most important grain legumes in many countries of the tropics particularly Asia and Africa (Asiwe, 2009; Osipitan, 2017). FAO, (2012) describe cowpea as the most important crops to the livelihoods of millions of relatively poor people in less developed countries of the tropics and likewise, it was regarded as the most economically important indigenous African legume crop by Ugbe *et al.* (2016). About 87% of annual cowpea production is undertaken in Africa, 10% in the Americas, and the rest in Europe and Asia (Ugbe *et al.*, 2016).

Cowpea is adapted to warm weather and requires less rainfall than most crops thus, suited for semiarid regions of the lowland tropics and subtropics, with limited amount of rainfall (Higuera, 2001). It can be planted as sole crop or intercropped with other crops especially cereals such as millet or maize as commonly done in Nigeria. Cowpeas are relatively drought tolerant and thus offer farmers a means to reduce their exposure to weather risk. Cowpea fixes 80% nitrogen for its growth demand from the atmosphere (Asiwe *et al.*, 2009), thereby reducing nitrogen fertilizer demand and cost for the crop. When intercropped with cereal or other crop, the companion crop also benefit from the fixed nitrogen from root nodules and residual nitrogen from decayed vegetative part such as leaf, root and stem.

Cowpea is a very vital crop which is widely cultivated in many parts of Nigeria, however, with increasing population over the years, the demand for the crop had gone up but the production has not improved (Agwu, 2001; Wakili, 2018). The grain of cowpea is used throughout Nigeria and other parts of the semi-arid sub-Saharan Africa as a food source. Cowpeas can provide a relatively inexpensive source of high quality protein for both humans and animals, and its leaves and stems are fed to cattle. The grains contain 25% protein, and several vitamins and minerals (Mbata *et al.*, 2000). All parts of the crop are rich in nutrients and fibre and are used in Africa, where humans consume the young leaves, immature pods and seeds, and the mature dried seeds. The stems, leaves, and vines serve as animal feed and are often stored during the dry season. In addition, cowpeas offer important benefits to its producers who are often resource poor farmers. It is a good food security crop as it mixes well with other recipe (Muoneke *et al.*, 2012).

Weed competes with cowpea like any other crops for space, nutrients, water and light. Weeds conveniently serve as alternative hosts of various insect pests and pathogens. Weeds have the ability to intercept light rays through its leaf canopy thereby reducing photosynthetic activity. Ugbe *et al.*, (2016) reported reduction in nutrient availability to crop as a result of slow rate of leaf development due to weed competition for light. The aim of this study is to determine the effects of early application of herbicide and subsequent hand weeding on the vegetative performance of 5 cowpea accessions. The objectives are to investigate the effects of pendimethalin on number of leaves, leaf area, stem height, stem girth and fresh and dry weights of shoot.

Materials and Methods

Description of experimental site

The experiment was conducted at the Botanical garden of the Department of Plant Biology, University of Ilorin, Kwara State, Nigeria during the rainy season between June and August, 2018. The site of the study area is located on latitude 8° 24' N and 8° 36' N and longitude 4° 10' E and 4° 36' E. University of Ilorin is located in Guinea savanna agroecological zone of Nigeria. The city has a tropical climate with average annual temperature of 26.5 °C and rainfall of 1217 mm (World Site Atlas, 2018).

Experimental layout and land preparation

The land used for the experiment was cleared and ridges were prepared manually using hand hoe. The treatments were allotted in a randomized block design (RBD).

The experiment comprised of the early application of herbicide (Pendimethalin) followed by two hand weeding of cowpea plots at 4 and 8 (WAS). Five accessions of cowpea (TVU-9092, TVU-16265, TVU-16320, TVU-16323 and TVU-16421) were obtained from the International Institute of Tropical Agriculture, Ibadan, Oyo State, Nigeria.

Pendimethalin was applied as pre-emergence (PE) at planting and as Early post-emergence (EPOE) followed by two hand weeding at 4 and 6 Weeks after sowing. Two concentrations (0.125 and 0.250 Kg/ha) of the herbicide were used. The vegetative parameters were taken between 2 and 8 WAS of the period of the experiment. Each treatment was replicated thrice without any treatment allotted to the control plots which were left weedy throughout the period of the experiment.

Seed Sowing and Pendimethalin application

Sowing of seed was done by direct manual seeding at a depth of 5 cm at the rate of one seed per hole. Watering was carried out at an interval of 2-3 days as required when there was no rainfall. Pre-emergence (PE) application of pendimethalin was done immediately after the seeds were sown while the early post-emergence (EPOE) herbicide treatment was applied at 10 days after the emergence of crop seedlings. Application of pendimethalin was with the aid of a 25-Litre knapsack sprayer.

Data collection and Analysis

Data collection was done at two weeks interval after emergence of cowpea seedlings. Three plants were randomly selected from each treatment as replicates per plot for data collection. Data were collected on above ground (shoot) vegetative growth parameters such as, number of leaves, plant height, leaf area, stem girth, shoot fresh and dry weight.

Data analysis

The data collected from the study were analyzed by Analysis of Variance (ANOVA) using statistical package for social sciences (SPSS: version 16.0). Means were separated by Duncan Multiple Range Test (DMRT) at ($p \leq 0.05$).

Results and discussion

Number of leaves in cowpea

Number of leaves in cowpea increased with age of the crop. At 2 WAS, TVU-16323 had the highest (9.00) number of leaves in the early post emergence pendimethalin treated plot at 0.125 kg/ha. This was followed by the control of TVU-16265. However, the untreated TVU-16323 plots produced (30.00) number of leaves at 4 and 6 WAS followed by (28.00) in the untreated plots of TVU-9092 which were statistically significant at $p \leq 0.05$ (Table 1). These three cowpea accessions produced large number of leaves and may be of great importance for fodder production. This observation is in agreement with the earlier report of Fayinminnu and Adesiyan, (2010) who variously observed similar results in cowpea under different weed management techniques.

Table 1: Effect of pendimethalin application on number of leaves of five cowpea accessions

Var/Conc (kg/ha)	2 WAS		4 WAS		6 WAS	
	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.
TVU-9092						
Control	6.00 ^{ab}	6.00 ^{bc}	25.00 ^{ab}	25.00 ^{ab}	28.00 ^{ab}	28.33 ^{ab}
0.125	4.00 ^b	7.00 ^{abc}	22.00 ^{bc}	19.00 ^{bcd}	28.00 ^a	23.00 ^{abc}
0.250	6.00 ^{ab}	6.00 ^{bc}	18.00 ^{bc}	20.00 ^{bcd}	24.00 ^{abcd}	23.00 ^{bc}
TVU16265						
Control	8.00 ^a	8.00 ^{ab}	20.00 ^{bc}	20.00 ^{bcd}	22.00 ^{bcd}	23.00 ^{bc}
0.125	5.00 ^b	8.00 ^{ab}	18.00 ^{bc}	18.67 ^{bcd}	17.00 ^e	18.00 ^{cde}
0.250	7.00 ^{ab}	7.00 ^{abc}	20.00 ^{bc}	17.00 ^{cd}	19.00 ^{de}	14.00 ^e
TVU-16320						
Control	6.00 ^{ab}	6.00 ^{abc}	15.00 ^c	15.00 ^{cd}	21.00 ^{cde}	21.00 ^{cd}
0.125	6.00 ^{ab}	7.00 ^{ab}	15.00 ^c	18.00 ^{bcd}	18.00 ^{de}	22.00 ^{bc}
0.250	5.00 ^b	5.00 ^c	15.00 ^c	14.00 ^d	21.00 ^{cde}	18.00 ^{cde}
TVU-16323						
Control	7.00 ^{ab}	7.00 ^{abc}	30.00 ^a	30.00 ^a	30.00 ^a	30.00 ^a
0.125	6.00 ^{ab}	9.00 ^a	21.00 ^{bc}	25.00 ^{ab}	27.00 ^{abc}	24.00 ^{abc}
0.250	7.00 ^{ab}	6.00 ^{abc}	23.00 ^{ab}	21.00 ^{bcd}	19.00 ^{de}	20.00 ^{cde}
TVU-16421						
Control	7.00 ^{ab}	7.00 ^{abc}	18.00 ^{bc}	18.00 ^{bcd}	19.00 ^{de}	19.00 ^{cde}
0.125	6.00 ^{ab}	7.00 ^{abc}	18.00 ^{bc}	18.00 ^{bcd}	16.00 ^e	15.00 ^{de}
0.250	5.00 ^{ab}	7.00 ^{abc}	21.00 ^{bc}	23.00 ^{abc}	16.00 ^e	23.00 ^{bc}

Mean along the same column with similar letter(s) are not significantly different at (P<0.05) level of significance.

Plant height

Plant height like other vegetative parameters increased with age in all the cowpea accessions. At 2 WAS plant height was highest in the control of TVU-16320 (9.67 cm) and followed by TVU-16323 in 0.250kg/ha EPOE (8.67 cm) and least in TVU-9092 in 0.250kg/ha PE (5.50 cm) (Table 2). Plant height was highest in the untreated TVU-16320 (14.67 cm) at 4 WAS followed by TVU-16323 with 0.125kg/ha PE (13.33 cm) and least in TVU-16320 with 1.25kg/ha EPOE (9.67 cm) (Table 2). At 6 WAS, TVU-9092 with 0.125kg/ha EPOE recorded the highest plant height (23.17 cm) and followed by TVU-16265 with 0.250kg/ha PE (23.00 cm). All these plant height values were statistically significant at $P \leq 0.05$. These

observations were in agreement with the earlier report of Olorunmaiye, (2008) on the responses of cowpea varieties to different weed control methods.

Table 2: Effect of pendimethalin application on plant height (cm) of five cowpea accessions

Var/Conc(kg/ha)	2 WAS		4 WAS		6 WAS	
	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.
TVU-9092						
Control	6.50 ^b	6.50 ^{cd}	12.67 ^{ab}	12.67 ^{ab}	16.33 ^{cd}	16.63 ^{def}
0.125	6.83 ^b	6.50 ^{cd}	10.83 ^b	12.67 ^{ab}	21.50 ^{ab}	23.17 ^a
0.250	5.50 ^b	6.00 ^{cd}	10.17 ^b	12.17 ^{ab}	22.00 ^a	16.67 ^{cdef}
TVU-16265						
Control	7.33 ^{ab}	7.33 ^{bcd}	11.83 ^{ab}	11.83 ^{ab}	19.33 ^{abc}	19.33 ^{abcde}
0.125	7.17 ^{ab}	6.00 ^{cd}	11.83 ^{ab}	11.00 ^{ab}	21.33 ^{ab}	19.67 ^{abcd}
0.250	6.50 ^b	6.67 ^{bcd}	11.00 ^b	11.83 ^{ab}	23.00 ^a	17.33 ^{bcdef}
TVU-16320						
Control	9.67 ^a	9.67 ^a	14.67 ^a	14.67 ^a	20.00 ^{abc}	20.00 ^{abcd}
0.125	7.83 ^{ab}	5.67 ^d	13.00 ^{ab}	9.67 ^b	19.83 ^{abc}	14.33 ^f
0.250	6.83 ^b	5.67 ^d	12.67 ^{ab}	10.17 ^b	18.33 ^{abcd}	15.50 ^{ef}
TVU-16323						
Control	7.67 ^{ab}	7.67 ^{abcd}	12.83 ^{ab}	12.83 ^{ab}	17.00 ^{bcd}	17.00 ^{cdef}
0.125	7.50 ^{ab}	7.67 ^{abcd}	13.33 ^{ab}	12.67 ^{ab}	14.67 ^d	19.67 ^{abcd}
0.250	6.83 ^b	8.67 ^{ab}	11.17 ^{ab}	12.17 ^{ab}	18.33 ^{abcd}	20.33 ^{abcd}
TVU-16421						
Control	8.00 ^{ab}	8.00 ^{abc}	12.33 ^{ab}	12.33 ^{ab}	20.60 ^{abc}	20.67 ^{abc}
0.125	6.00 ^b	6.50 ^{bc}	9.83 ^b	11.50 ^{ab}	19.33 ^{abc}	22.83 ^a
0.250	6.83 ^b	8.00 ^{abc}	10.33 ^b	12.00 ^{ab}	21.67 ^{ab}	21.17 ^{ab}

Mean along the same column with similar letter(s) are not significantly different at (P<0.05) level of significance.

Leaf area

At 2 WAS, TVU-9092 with 0.250kg/ha PE produced the highest leaf area (33.00 cm²) and followed by TVU-9092 in 0.125 kg/ha PE (32.17 cm²). Leaf area of TVU-16421 in 0.125kg/ha PE (16.67 cm²) was the least (Table 3). At 4WAS highest leaf area value of (105.08cm²) was obtained in the pendimethalin pre-emergence treatment at 0.125kg/ha in the cowpea accession TVU16265 which was followed by (100.67 cm²) in the

untreated accession of TVU-9092 and least (45.25 cm²) in TVU-16323 in the post emergence treatment of pendimethalin at 0.250kg/ha. Highest leaf area value (105.83cm²) at 6WAS was obtained in TVU-16265 at 6WAS in the early post-emergence application of pendimethalin at 0.125kg/ha. This was followed by (101.58 cm²) in the control of accession TVU-16421 and least (51.33 cm²) in TVU-16323 in the pre-emergence pendimethalin treatment at 0.250kg/ha. All these leaf area values were statistically significant at (P<0.05) level of significance (Table 3). These observations agree with an earlier report of Sunday and Udensi, (2013) who reported increase in plant growth in cowpea treated with pre-emergence herbicides.

Table 3: Effect of pendimethalin application on leaf area (cm²) of five cowpea accessions

Var/Conc(kg/ha)	2 WAS		4 WAS		6 WAS	
	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.
TVU-9092						
Control	29.92 ^{abc}	29.92 ^a	100.67 ^{ab}	100.67 ^a	92.17 ^a	92.17 ^{abc}
0.125	32.17 ^{ab}	29.50 ^a	60.00 ^{cd}	73.08 ^{abc}	93.42 ^a	79.92 ^{bcd}
0.250	33.00 ^a	29.17 ^a	79.33 ^{abcd}	77.58 ^{abc}	81.58 ^a	81.92 ^{abcd}
TVU-16265						
Control	24.83 ^{bc}	24.83 ^a	63.17 ^{cd}	63.17 ^{abc}	75.67 ^{ab}	75.67 ^{bcd}
0.125	25.08 ^{bc}	22.33 ^a	105.08 ^a	65.67 ^{bc}	93.25 ^a	105.83 ^a
0.250	25.17 ^{bc}	22.83 ^a	60.17 ^{cd}	67.00 ^{bc}	98.33 ^a	69.42 ^{cd}
TVU-16320						
Control	23.67 ^{cd}	23.67 ^a	67.83 ^{cd}	67.83 ^{abc}	77.50 ^{ab}	77.50 ^{bcd}
0.125	24.33 ^c	26.33 ^a	60.75 ^{cd}	58.50 ^{bc}	75.58 ^{ab}	65.00 ^d
0.250	26.83 ^{abc}	26.42 ^a	86.25 ^{abc}	45.25 ^c	80.42 ^a	79.17 ^{bcd}
TVU-16323						
Control	22.67 ^{cd}	22.67 ^a	77.33 ^{bcd}	77.33 ^{abc}	77.00 ^{ab}	77.00 ^{bcd}
0.125	25.42 ^{bc}	27.83 ^a	59.75 ^{cd}	68.67 ^{abc}	73.92 ^{ab}	75.58 ^{bcd}
0.250	22.67 ^{cd}	26.83 ^a	75.83 ^{bcd}	56.00 ^{bc}	51.33 ^b	63.92 ^d
TVU-16421						
Control	22.67 ^{cd}	22.67 ^a	70.25 ^{cd}	70.25 ^{abc}	101.58 ^a	101.58 ^{ab}
0.125	16.67 ^d	26.25 ^a	54.50 ^d	83.50 ^{ab}	74.17 ^{ab}	87.67 ^{abcd}
0.250	22.42 ^{cd}	30.50 ^a	61.83 ^{cd}	84.58 ^{ab}	86.00 ^a	99.00 ^{ab}

Mean along the same column with similar letter(s) are not significantly different at (P<0.05) level of significance.

Stem girth

At 2WAS, application pendimethalin as pre-emergence herbicide did not show significant difference among the treatments; however, the highest and lowest values of stem girth were recorded in TVU-16265 with 0.25 kg/ha (2.74 mm) and TVU-16421 with concentration 0.250 kg/ha (1.92 mm). Varieties TVU-16323 and TVU-16320 recorded the highest and lowest stem girths (2.89 and 1.92 mm) respectively when pendimethalin was applied as post-emergence at the concentration of 0.125 kg/ha. These values were statistically significant ($P \leq 0.05$).

At 4 WAS, pre-emergence application of pendimethalin resulted in highest stem girth in variety TVU-9092 (5.07 mm) while the TVU-16320 recorded the lowest stem girth (3.34 mm) at 0.125 kg/ha of pendimethalin. When pendimethalin was applied as early post-emergence accessions TVU-16421 and TVU-16320 recorded the highest and lowest stem girth values of (5.65 and 3.72 mm) respectively with at pendimethalin concentration of 0.25 kg/ha and were significantly different at ($P < 0.05$) level of significance (Table 4). At 6 WAS, the control of TVU-9092 and TVU-16421 with 0.25 kg/ha produced the highest and lowest stem girth values of (8.35 and 5.81 mm) respectively when pendimethalin was applied as pre-emergence. However, application of pendimethalin as post-emergence herbicide produced the highest stem girth in value (7.68mm) in TVU-16421, while the lowest stem girth value (5.81 mm) was recorded in TVU-16320 at concentration of 0.25 kg/ha (Table 4).

At 8 WAS, the highest (9.43 mm) stem girth value was obtained in TVU-16421 control and was not significantly different from other treatments except TVU-16320 at the pre-emergence treatment concentration of 0.125 kg/ha (7.02 mm). When pendimethalin was applied as post-emergence herbicide, there was no significant difference at ($P \leq 0.05$) level of significance among the treatments. However, the highest and lowest stem girth values (9.43 and 7.04 mm) respectively were recorded in the control of TVU-16421 and TVU -16323 at concentration of 0.250kg/ha.

These observations showed that stem girth may not be significantly affected by the herbicide concentration. This finding is in harmony with earlier report Sunday and Udensi (2013) who worked on pre-emergence herbicides evaluation for the control of weed in cowpea. The results here

also agreed with the observations of Ugbe *et al.*; 2016 who reported increased cowpea establishment in plot treated with Galex.

Table 4: Effect of pendimethalin application on stem girth (mm) of five cowpea accessions.

Var/Conc(kg/ha)	2 WAS		4 WAS		6 WAS		8 WAS	
	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.
TVU-9092								
Control	2.65 ^a	2.65 ^{abc}	4.81 ^{ab}	4.81 ^{abc}	8.35 ^a	8.35 ^a	8.22 ^{ab}	8.22 ^a
0.125	2.57 ^a	2.29 ^{abc}	5.07 ^a	4.56 ^{bc}	7.91 ^{abc}	7.51 ^{abc}	9.21 ^{ab}	8.28 ^a
0.250	2.25 ^a	2.43 ^{abc}	4.34 ^{abc}	4.53 ^{bc}	7.57 ^{abcd}	7.29 ^{abc}	8.87 ^{ab}	8.25 ^a
TVU-16265								
Control	2.23 ^a	2.23 ^{abc}	3.81 ^{abc}	3.81 ^{bc}	6.30 ^{cde}	6.30 ^{bc}	8.80 ^{ab}	8.80 ^a
0.125	2.10 ^a	2.14 ^{bc}	4.33 ^{abc}	3.96 ^{bc}	7.36 ^{abcde}	7.15 ^{abc}	8.47 ^{ab}	8.19 ^a
0.250	2.74 ^a	2.19 ^{abc}	4.01 ^{abc}	3.96 ^{bc}	8.17 ^{ab}	6.81 ^{abc}	7.52 ^{ab}	8.11 ^a
TVU-16320								
Control	2.53 ^a	2.53 ^{abc}	3.76 ^{abc}	3.76 ^{bc}	7.03 ^{abcde}	7.03 ^{abc}	8.17 ^{ab}	8.17 ^a
0.125	2.41 ^a	1.95 ^c	3.34 ^c	4.25 ^{bc}	6.50 ^{cde}	6.75 ^{abc}	7.02 ^b	8.60 ^a
0.250	2.35 ^a	2.18 ^{abc}	4.35 ^{abc}	3.72 ^c	6.55 ^{bcde}	5.81 ^c	7.56 ^{ab}	8.82 ^a
TVU-16323								
Control	2.71 ^a	2.71 ^{ab}	4.62 ^{abc}	4.62 ^{bc}	6.95 ^{abcde}	6.95 ^{abc}	7.64 ^{ab}	7.64 ^a
0.125	2.53 ^a	2.89 ^a	4.35 ^{abc}	4.83 ^{ab}	7.07 ^{abcde}	7.63 ^{ab}	8.05 ^{ab}	9.08 ^a
0.250	2.32 ^a	2.47 ^{abc}	3.54 ^{bc}	4.20 ^{bc}	6.22 ^{de}	6.80 ^{abc}	7.10 ^{ab}	7.04 ^a
TVU-16421								
Control	2.47 ^a	2.47 ^{abc}	4.22 ^{abc}	4.22 ^{bc}	7.54 ^{abcd}	7.54 ^{ab}	9.43 ^a	9.43 ^a
0.125	1.92 ^a	1.96 ^c	4.01 ^{abc}	3.81 ^{bc}	6.64 ^{bcde}	6.29 ^{bc}	8.21 ^{ab}	7.21 ^a
0.250	2.35 ^a	2.45 ^{abc}	3.65 ^{bc}	5.65 ^a	5.81 ^e	7.68 ^{ab}	7.63 ^{ab}	8.77 ^a

Mean along the same column with similar letter(s) are not significantly different at (P<0.05) level of significance.

Shoot fresh and dry weights

At 2 WAS, pre-emergence application of pendimethalin resulted in highest shoot fresh weight in variety TVU-16421 of the untreated plot (1.85 g) which was significantly different from all other treatments. Highest (1.95 g) fresh weight of cowpea at 2 WAS was obtained at the early post emergence pendimethalin application at 0.250kg/ha and also statistically significant (Table 5). The least fresh weight value (1.31 g) at 2WAS was

obtained in the cowpea accession TVU-16320 treated with pendimethalin at 0.250kg/ha. Both fresh and dry weights were increased significantly at 4 WAS and highest (24.77 and 4.55 g) respectively (Table 5). These observations of increase in fresh and dry weight in cowpea may be as a result of the weed control methods. This agrees with the earlier report of Sunday and Udensi (2013) who observed over 70% weed suppression and higher performance of cowpea treated with pre-emergence herbicides augmented with two hoe weeding. It also agrees with the earlier report by Haruna and Usman (2013) who worked on the effect of varying phosphorous rates in the yield of cowpea varieties in Lafia, Nasarawa State of Nigeria. Adequate weeding will reduce competition on available nutrients in the soil.

Table 5: Effect of pendimethalin application on shoot fresh and dry weights (g) of five cowpea accessions.

Var/Conc	Shoot fresh weight				Shoot dry weight			
	2 WAS		4 WAS		2 WAS		4 WAS	
	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.	Pre Emer.	Post Emer.
TVU-9092								
Control	1.59 ^{ab}	1.59 ^{ab}	22.15 ^{ab}	22.15 ^{ab}	0.25 ^c	0.25 ^c	4.27 ^{abc}	4.27 ^{abcd}
0.125	1.51 ^{ab}	1.36 ^b	17.46 ^{bcd}	16.17 ^{cd}	0.34 ^{bc}	0.26 ^c	2.74 ^{def}	5.22 ^a
0.250	1.55 ^{ab}	1.95 ^a	21.37 ^{abc}	12.88 ^{efg}	0.34 ^{bc}	0.38 ^{bc}	2.09 ^{ef}	1.79 ^f
TVU-16265								
Control	1.35 ^{ab}	1.35 ^b	16.58 ^{cd}	16.58 ^{cd}	0.30 ^c	0.30 ^{bc}	3.26 ^{cd}	3.26 ^{cd}
0.125	1.70 ^{ab}	1.64 ^{ab}	14.45 ^{def}	15.01 ^{def}	0.27 ^c	0.42 ^{ab}	2.59 ^{def}	2.62 ^{def}
0.250	1.59 ^{ab}	1.62 ^{ab}	11.90 ^{defg}	11.71 ^{efg}	0.43 ^{abc}	0.32 ^{bc}	2.28 ^{ef}	2.27 ^{ef}
TVU-16320								
Control	1.59 ^{ab}	1.59 ^{ab}	10.95 ^{efg}	10.95 ^{fg}	0.36 ^{abc}	0.36 ^{bc}	2.52 ^{def}	2.52 ^{ef}
0.125	1.62 ^{ab}	1.44 ^{ab}	11.93 ^{defg}	12.82 ^{efg}	0.36 ^{abc}	0.33 ^{bc}	2.65 ^{def}	2.78 ^{def}
0.250	1.31 ^b	1.65 ^{ab}	13.39 ^{defg}	9.42 ^g	0.25 ^c	0.34 ^{bc}	4.95 ^a	3.50 ^{bcd}
TUV-16323								
Control	1.78 ^{ab}	1.78 ^{ab}	24.77 ^a	24.77 ^a	0.44 ^{abc}	0.44 ^{ab}	4.55 ^{ab}	4.55 ^{abc}
0.125	1.70 ^{ab}	1.62 ^{ab}	8.22 ^g	14.64 ^{def}	0.55 ^{ab}	0.56 ^a	2.82 ^{def}	4.60 ^{abc}
0.250	1.65 ^{ab}	1.93 ^a	9.40 ^{fg}	18.39 ^{bcd}	0.57 ^a	0.35 ^{bc}	1.72 ^f	4.55 ^{abc}
TVU-16421								
Control	1.85 ^a	1.85 ^{ab}	16.11 ^{cd}	16.11 ^{cd}	0.39 ^{abc}	0.39 ^{bc}	3.67 ^{bcd}	3.67 ^{abcd}
0.125	1.45 ^{ab}	1.56 ^{ab}	8.24 ^g	11.74 ^{efg}	0.26 ^c	0.25 ^c	1.98 ^f	2.17 ^{ef}
0.250	1.36 ^{ab}	1.74 ^{ab}	12.67 ^{defg}	20.58 ^{abc}	0.42 ^{abc}	0.56 ^a	3.23 ^{cd}	4.97 ^{ab}

Mean along the same column with similar letter(s) are not significantly different at ($P < 0.05$) level of significance.

Conclusion

Pendimethalin applied both as pre and early post emergence did not have any negative effects on the five cowpea accessions studied. However, there were instances where cowpea from control plots appeared to have significantly increased vegetative parameters than the treated plots in some accessions. Supplementing pendimethalin with two hand weeding provided season long weed control in cowpea plots. As much as hand weeding give good result there will be limitation to farmers level of cowpea production due to small land areas for farming. Pre-emergence application of pendimethalin will be adequate for weed control in cowpea.

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