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Performance of Cowpea (Vigna unguiculata (L) Walp*)* as Influence by Different Weed Control Methods

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Abstract
A field study was conducted during the late planting season of 2013 at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, to determine the effects of different methods of weed control on the growth and yield of cowpea. Different weed control methods (Weedy Check/Control Plot (T_1WC_1), Hand-Weeding at 20 and 40 Days after planting (DAP)(T_2WC_2), Hoe Weeding at 20DAP (T_3WC_3), Chemical Weeding at 20 DAP (T_4WC_4), Hoe Weeding at 20DAP + hand – weeding at 40DAP (T_4WC_s), Chemical Weeding at 20 DAP (T_4WC_6)) were compared for their efficiency to control various weed species in Owerri, Nigeria. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Cowpea seeds (Ife brown) were collected from the Department of Crop Science and Biotechnology of Imo State University, Owerri and planted at a distance of 50cm x 50cm. The post emergence herbicides (fusilade forte) used for chemical weed control was bought at Imo State Agricultural Development Programme Owerri (Imo ADP). The parameters measured were; types of weeds and their relative abundance, plant height (cm), stem girth (cm), number of branches/plant, number of leaves per plant, leaf area (cm^2), number of root nodules per plant, number of days to 50% flowering, plant biomass, number of pods per plant, number of pods per plot, pods weight per plot(g), 100 seed weight(g), pod yield (kg/ha), and seed yield (kg/ha) Predominant weed types observed in the cowpea plots were; *Aspilia Africana, Euphorbia heterophylla, Imperata cylindrical, Talinum triangulare , cyperus esculentus and Tridax procumbens.* Among different weed control methods, hoe weeding at 20DAP + hand weeding at 40DAP gave seed yield of 47.77kg/ha. This treatment (hoe weeding at 20DAP + hand weed at 40DAP) out performed others in terms of 100 seed weight (94.10g) which significantly different ($P<0.05$) from the records of the other treatments. On the basis of these results, Maximum seed yield 47.77kg/ha of cowpea (Ife brown)) was obtained with the application of hoe weeding at 20DAP + hand weeding at 40DAP.
Keywords: *weed biomass, herbicides, weed control, owerri, cowpea*

INTRODUCTION

Cowpea *(Vigna unguiculata (L) Walp)* is of great importance both as staple and fodder crop and it is also used as cover crop to prevent soil erosion and desertification (Singh and Ntare, 1985). Cowpea constitutes a valuable source of protein as well as rich amino acid profile (Ayodele and Yalwa, 2004) and it is one of the widely cultivated leguminous crops in the savannah region of West Africa (Steele, 1996). Cowpea *(Vigna unguiculata (L) Walp)* is a dicotyledoneae, belonging to the order *Fabales*, family *Fabaceae*, sub-family *Fabiodeae*, tribe *Phasioleae*, sub-tribe *Phasiolenae*, and genus *Vigna* (Singh, 1993, Paudulosi and Ng 2006). Like other legumes, cowpea forms a symbiotic relationship with a specific soil bacterium (Rhizobium) which makes atmospheric Nitrogen available to the plant by a process called Nitrogen fixation (Tutiana *et al.,* 2006). Thus, cowpea performs well under low soil nitrogen condition due to its capacity for fixing its own nitrogen (Tarawali *et al.,* 1996).

Obtaining a reliable statistics on cowpea area and production is rather difficult because most countries do not maintain separate record on cowpea (Singh *et al.,* 2007). In Nigeria, especially in the South Eastern region, the production of cowpea is not widespread due to some constraints such as diseases, insect pests and parasitic weeds low soil fertility coupled with the paucity of information on adapted varieties (Ogbuinya, 2006).

Yield loss in cowpea due to weeds has been reported to range from 41-80% (Li *et al.,* 2004), and

reduction in grain yield of cowpea over the entire period of growth has been found to be as high as 50-70% as a result of uncontrolled weeds (Medrano, 2002). There may atimes be a total crop failure due to a wide range of pests and pathogens that attack the crop at all stages (Emechebe *et al.,* 1983; Lagoke, 2000). Weeds are unwanted plants adapted to disturbed or undisturbed habitats (Goris *et al.,* 1991), and competes with crops for light, nutrient, water and space (Muzik, 2011). Cowpea yield are however low in most farms in Nigeria, with weeds constituting a major constraint to its successful production where uncontrolled weed growth has reduced cowpea growth and yield by as much as 50-80% in Nigeria (Nangju, 2003). The first 3-4 weeks of cowpea growth are critical for weed competition (Nangju, 2003; Akobundu, 2005). Bhan *et al. (*2003), reported that two hand-weeding within the first 5 weeks of cowpea growth are necessary to minimize weed competition and yield reduction. Therefore weed control decisions based on the economic threshold are attractive to farmers, consultants as well as weed scientists. Cowpea sown in rainfed season is infested by a number of weed species that compete with the crop right from germination to harvest, affecting the crop yield adversely (Yadov *et al.,* 1998). Thus to enhance crop yield and its effect on soil fertility, the control of weeds in rainfed crop is very important. The method of weeding such as hoeing, hand weeding and harrowing is expensive and labour is usually not available during peak work load (Khan *et al.,* 2000). Therefore the use of herbicides in cowpea to control weeds appear to be useful (Dadari, 2003; Silva, 2003), but herbicides are effective only against few weeds.

It is acknowledged that different studies and/or different methods of weeds control have been examined, but weeds continue to render havoc to the efforts geared towards increasing cowpea yield. So, there is need to make a comparative study of different weed management techniques in crop production and develop an integrated weed management approach, which should be efficient, cost effective and environmentally safe.

The present study therefore is aimed at examining the effects of combination of different methods of weed control on the growth and yield of cowpea (*Vigna unguiculata (L) Walp).*

MATERIALS AND METHODS

This experiment was carried out during the late planting season (August) of 2013 in the Teaching and Research Farm of Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, Imo State, Nigeria. Cowpea seed (Ife-brown) used for planting was collected from the Department of Crop Science and Biotechnology of Imo State University, Owerri. The dimension of the experimental area was 30m X 20m. The land area was manually cleared with machete, stumped and debris removed using rake. Spade and hoe were used to prepare the seed beds into fine tilt while measuring tape and rope were used in marking out the plots. The areas for the experiment were marked out into three blocks of 19.5m x 9.5m each with 1 meter alley apart between one block and another, while 0.5m alley was provided between one plot (bed) and another in each block. Each plot (bed) measured 2.5m x 2.5m in each block, thus there were 18 plots in each block, gave a total of 54 plots for the experiment.

The cowpea seeds (Ife brown) were sown in the second week of August, 2013 at the rate of one seed per hole at a depth of 2cm and planting distance of 50cm x 50cm. this gave a total of 25 cowpea seedlings per plot. The experiment was laid out in a Randomized Complete Block Design with three replications. Six weed control methods (treatments) were used in the study. These were: Weedy Check/Control Plot (T_1WC_1), Hand-Weeding at 20 and 40 Days after planting (DAP)(T_2WC_2), Hoe Weeding at 20DAP (T_3WC_3), Chemical Weeding at 20 DAP (T_4WC_4), Hoe Weeding at 20DAP + hand – weeding at 40DAP (T_4WC_s), Chemical Weeding at 20 DAP (T_4WC_6). The herbicide used, *Fusilade forte* was obtained from Imo State Agricultural Development Programme (Imo ADP), Input Unit Section and was applied at 2-3 leaf stage of the crop using Knapsack sprayer fitted with T-jet nozzle. Volume of spray was 2Lit/200 litre of water per hectare at a pressure of 207 kgp determined by calibration as described by Rao (1992). Spraying was done on a calm day after early dew on the crop has dried. Data were collected on the following growth and yield parameters; Plant height, Plant stems girth, Number of days to 50% flowering, Number of branches per plant, Number of leaves per plant, Number of root nodules per plant, Plant Leaf Area, Fresh plant Biomass, Types of weeds and their density recorded at 20, 40, and 60 days, Number of pods per plant, Pod Weight Per Plot, Number of seeds per pod Per Plot, Seed Weight, Seed Dry Weight Per Plot, and Seed Yield. Data collected were statistically analysed by using the analysis of variance (ANOVA) method of the statistical Analytical System (SAS) 15.0 while treatment means were separated using the Least Significant Difference (LSD) as applied by Onuh and Igwemma (2001).

RESULTS

Predominant Weed Types Present in the Plots

A total of 58 weed types, belonging to 40 genera, within 16 families, were identified throughout the study period (Table 1). About 45% of all the genera observed at the various treatments belonged to the families of *Poaceae* (7), *Cyperaceae* (3), *Euphorbiaceae* (3) and *Rubiaceae* (3). Eighteen weed types representing 31% of the total weed types were found in the six treatments, whereas 6 weed types (10%) and 3 weed types (5%) were found in

five and four treatment respectively. Also, 12 weed types (20%), 8 weed types (14%) and 11 weed types (19%) occurred in three, two and one treatment of the plots (Table 1). In addition, about sixty-six percent of the weed types encountered were broad leaves, 22% were grasses while sedges were about 10% and about 56% of the entire weed species were annual in life style. *Aspilia Africana, Euphorbia heterophylla, Imperata cylindrical, Amaranthus spinosus, Cyperus esculentus, Brachiaria deflexa, Eleusine indica, Crotolaria, Tridax procumbens, Vernonia galamensis* and *Commelina benghalensis* had the highest relative abundance in the cowpea plots trial.

However, there was highest number of weed species in unweeded plots compared to the other treatment plots. Chemical weeding at 20DAYS after planting (chemical weeding at 20 days after planting and at 40 DAP) contained less weed species as shown in Table 1. This result agreed with the earlier report of Adesina *et al.* (1998); Fadayomi and Olofintonye, (2005), Idu, (2003), who had earlier worked on similar herbicides as well as related crop that effects of herbicides on the mean number of weed species, broad leaf and grass weeds showed significant different at (P=0.05) in their means.

Also (hand – weeding at 20DAP and 40DAP) and (Hoe weeding at 20DAP + hand – weeding at 40DAP) contained less weed species compared with weedy check plot. This further buttressed the observation of Adesina *et al.* (1998) on the need for hand weeding support in weed control.

Plant Height(cm)

The application of different methods of weed control significantly improved the vegetative growth of cowpea, the height of the cowpea plant gradually increased in each of the weeding methods used. The highest (16.30cm^2) mean plant height at 20DAP was recorded from the plot that received chemical weeding at 20DAP and at 50Dap (T_6WC_6) and this showed significant difference ($P<0.05$) from the lowest (11.50cm) mean plant height of the unweeded plot (T_1WC_1) and the other treatment plots (Table 2).

At 40DAP the highest (22.44cm) mean plant height recorded from plots that were treated with chemical weeding at 20DAP of crop and at 50 DAP (T_6WC_6) which was not significantly different ($p<0.05$) from the 22.22cm mean plant height recorded from the plots that received hand weeding at 20 and 40 days after planting (T_2WC_2). These values were also statistically at par with the 21.00cm mean plant height recorded from the hoe weeding at 20 days after planting + hand-weeding at 40days after planting (T_5WC_5). However, the lowest (13.77cm) mean plant height was recorded from the weedy check (T_1WC_1) which showed significant difference ($p<0.05$) from the other treatment plots (Table 2).

However, at 60DAP the lowest plant height (20.10cm) was recorded from the un-weeded plot (T_1WC_1) which showed significant difference ($P<0.05$) from the other treatment plots, though T_4WC_4, T_5WC_5 and T_6WC_6 gave the highest (25.40cm, 26.70cm, and 27.30cm) mean plant height but they were statistically at par with each other respectively (Table 2).

Stem Girth (cm)

At 20, 40, and 60 days after planting the T_6WC_6 treated plots gave the highest (1.50cm, 2.45cm and 3.30cm) mean stem girth which was not significantly different from the mean stem girth recorded from the other plots except the (T_1WC_1) plots which gave 1.00cm, 1.48cm, and 2.40cm as the lowest mean stem girth and showed a significant difference ($p<0.05$) from other treatment plots (Table 2).

Number of Branches Per Plant

At 20 DAP, the highest (8.00) recorded from the T_4WC_4 (chemical weeding at 20DAP) and T_6WC_6 (chemical weeding at 20 DAP and 40 DAP) were at par with T_5WC_5 (Hoe weeding at 20 DAP + Hand weeding at 40 DAP) and was significantly different ($P<0.05$) from the mean recorded from the T_1WC_1 (6.60).

However, at 40DAP, number of branches per plant (14.60 and 14.30) recorded from the T_6WC_6 and T_5WC_5 treated plots did not show significant difference ($P<0.05$) from each other, but were significantly different from the lowest (8.30) mean number of branches per plant recorded from the T_1WC_1 treated plot.

At 60 DAP 23.44 was the highest mean number of branches per plant recorded from the T_5WC_5 treated plots however, it did not show significant difference from the 21.33 mean numbers of branches recorded from the T_6WC_6 treated plots. But it was significantly different ($p<0.05$) from the mean number of branches recorded from other plots. The lowest (12.88) mean number of branches was recorded from the weedy check plots (Table 2).

Number of Leaves

At 20 and 40 DAP the plots that received chemical weeding at 20DAP after planting (T_4WC_4) recorded 48.40 and 65.11 mean number of leaves which was statistically at par with the 49.00 and 66.88 mean number of leaves recorded from the T_6WC_6 treated plots. However, the T_5WC_5 treated plots gave the highest 50.40 and 69.11 mean number of leaves per plant which showed significant difference ($p<0.05$) from the other treatment plots while the T_1WC_1 treated plots gave the lowest 31.40 and 39.66 mean number of leaves per plant (Table 2). Also

at 60DAP mean number of leaves per plant (84.30 and 83.60) recorded from T_5WC_5 and T_6WC_6 treated plots did not show significant different ($P<0.05$) from the other treatment plot.

Leaf Area (cm^2)

At 20 DAP, mean leaf area (55.40cm^2, 48.90cm^2 and 55.20cm^2) from the T_4WC_4, T_5WC_5 and T_6WC_6 treated showed no significant difference from each other but were significantly different ($P<0.05$) from the other treatment plots.

At 40DAP plot that received Chemical weeding at 20DAP gave the different ($P<0.05$) from the lowest (50.70cm^2) mean leaf area recorded from the un-weeded plot (T_1WC_1) and the other treatment plots, but statistical at par with T_5WC_5 treatment plots.

At 60 DAP Leaf areas per plant (80.95cm^2 and 80.35cm^2) recorded from the T_5WC_5 and T_6WC_6 treated plots respectively did not show significant difference ($p<0.05$) from each other, however they were significantly different from the lowest (49.38cm^2) mean leaf area recorded from the T_1WC_1 treated plots while the highest (87.38cm^2) mean leaf area was recorded from the T_2WC_2 treated plots and was significantly different ($p<0.05$) from the means recorded from the other treatment plots (Table 3).

Number of Root Nodules /Plant:

The highest (21.11) mean number of root nodules were recorded from the T_5WC_5 treated plots. This did not show significant difference ($P<0.05$) from the mean recorded from the other treatment plots. However, the lowest (12.88), mean number of root nodules was recorded from the T_1WC_1 treated plots and this was significantly different from the means recorded from the other treatment plots (Table 3).

Number of days to 50% Flowering:

The highest number of days to flowering was recorded as 53.6 days from the T_1WC_1 (un-weeded plots). This was significantly different ($P<0.05$) from the least (40.0days) mean number of days to 50% flowering recorded from the plots of or treated with chemical weeding at 20DAP and 40 DAP (Table 3).

Plant Biomass:

T_6WC_6 treated plots yielded the highest (84.44g) mean plant biomass which was statistically at par with the 82.77g recorded from the T_4WC_4 treated plots. While the lowest (40.55) mean plant biomass was recorded from the T_1WC_1 treated plots (Table 3).

Number of Pods Per Plant

The highest (18.88) mean number of pods per plant was recorded from the T_5WC_5 treated plants which was significantly different from the means recorded from other plots. But it is statistically at par with the 18.77 mean number of pods recorded from the T_2WC_2 treated plots. The lowest (10.00) mean number of pods per plant was recorded from the T_1WC_1 treated plots (Table 4).

Number of Pods Per Plot

The T_5WC_5 treated plots gave the highest (475.22) mean number of pods per plot which was not significantly different ($p<0.05$) from the 468.22 mean number of pods recorded from the T_2WC_2 treated plots. However, it showed significant difference ($p<0.05$) from the other treated plots while the lowest (249.33) mean number of pods was recorded from the T_1WC_1 treated plots (Table 4).

Pods Weight/Plot (g)

The highest (829.00g) mean pod weight per plot was recorded from the T_2WC_2 treated plots this did not show significant difference ($p<0.05$) from the means recorded from other treatment plots while the T_1WC_1 treated plots which gave the lowest (411.22g) mean pod weight per plot (Table 4).

100 Seeds Weight(g)

Cowpea plants in the plot that received hoe weeding at 20 DAP + hand weeding at 40Dap (T_5WC_5) gave the highest (94.10g) mean 100 seed weight and this was significantly different ($P<0.05$) from the lowest (60.50g) recorded from the plants in the un-weeded plots and other treatments (T_2WC_2, T_2WC_2, T_4WC_4 and T_6WC_6) as shown in Table 4).

Pod Yield (kg/ha)

Pod yield was highest (1326.40kg/ha) in the plots that received T_2WC_2 treatment however, this did not show significant difference from the mean pod yields. (1312.89, 1309.32 and 1238.04kg/ha) recorded from the plots that received T_3WC_3, T_5WC_5 and T_4WC_4 treatments respectively. However, it showed significance difference

from the lowest (657.95kg/ha) mean pod yield recorded from the T_1WC_1 treated plots (Table 4).

Seed Yield (kg/ha)

The highest (47.77kg/ha) mean seed yield was recorded from the T_5WC_5 treated plots which showed significant difference ($p<0.05$) from other treatment plots except the T_2WC_3 treated plots which gave 46.66kg/ha. The lowest seed yield (25.55kg/ha) was recorded from the T_1WC_1 treated plots (Table 4).

DISCUSSION

Competition between weeds and crops is expressed by altered growth and development of both species. Results of the study have shown that the different weed control methods have significant effects on the growth and development of cowpea plant. It was observed that cowpea plots that received chemical weeding at 20DAP and at 40 days after planting (DAP) had the highest plant heights when compared to the weedy check plots. Also all the other weed control plots showed better performance in terms of plant height, stem girth and even in terms of stem branching than the weedy check plots. This poor performance in the development of cowpea plants in the weedy check plots can be directly associated with the degree of weed infestation as observed in the field. This can also be attributed to the inability of the cowpea plants to compete favourably in the presence of the various species of weed observed in the field. This observation is similar to the report of Tripathi and Singh (2001) who pointed out that cowpea usually face critical growth challenges in the presences of weeds.

However, this claim was further confirmed in the present study from the differences in the number of leaves and leaf area of cowpea plants which was observed to be very poor in the weedy check plots. Although, the number of leaves recorded in other weed control plots were significantly different, it was observed that plots treated with Hoe weeding at 20DAP + hand weeding at 40DAP gave the highest number of leaves per plant with a corresponding leaf area which was comparable to the highest leaf area recorded. The inability of the cowpea plants in the weedy check plots to produce more leaves and probably cover more areas could be attributed to its adaptive mechanism to the competitive growth condition according to Nangju (2003) who reported that weeds in greater densities posses great challenges to the growth of cowpea.

The potentials of the various weed control measures to control weed in cowpea can further be explained in the cowpea plant biomass recorded. The greater biomass recorded in the weed control plots especially the plots treated with chemical weeding at 20DAP of weeds and at 40DAP when compared with that of the weedy check showed that the presence of weed in the cowpea plots had deleterious effects on the growth and quality of the cowpea plant which is further seen in the developmental stages of the plant. In the present study it was observed that the presence of weed in the weedy check plots suppressed flowering and nodulation in cowpea. However, with the control of weed especially with chemical weeding at 20 days after planting was able to improve cowpea performance significantly and this is in support of the findings of Fadayomi (2001) who reported that weed control in cowpea using herbicide mixtures improved cowpea performance.

Furthermore, poor yield and yield parameters were observed from the weedy check plots which was significantly different from the yield and yield parameters observed from the treated plots generally. It was further observed that the highest number of pods were recorded from the hoe weeded plots at 20DAP + hand weeding at 40DAP. It was also observed that yield of cowpea was reduced on the weedy check plots when compared with the treatments plots.

However, the highest yield data in terms of pod formation was recorded from the plots treated with hand weeding at 20 and 40DAP. In this study, when weeds were controlled, the performance of cowpea was greatly enhanced leading to substantial grain yield increase over the no weeding treatments. Although the highest seed yield was recorded from the Hoe weeding at 20DAP + hand weeding at 40DAP treated plots while the lowest yield both in terms of pod and seed was observed from the weedy check plots. These differences between the weedy check and the treated plots could also be attributed to the deleterious effects of weed on crops. It can also be associated with the poor number of leaves and poor nodule formation which was earlier observed which according to Madukwe *et al.* (2008), was proportional to the yield performance of cowpea.

However, the economic analysis carried out on the cost and returns of adopting the various weed control methods showed that the returns on using the T_5WC_5 treatment was more profitable than the other methods. This is evident in the harvest index of 15% increase recorded from the T_5WC_5 treated plots.

CONCLUSION

On the basis of these results, it can be concluded that maximum seed yield kg/ha of cowpea (Ife brown) was obtained with T_5WC_5 (Hoe weeding at 20DAP + Hand weeding at 40DAP). Also there was a significant increase of 15% in harvest index of cowpea due to T_5WC_5. Similarly, the treatment (T_5WC_5) outperformed other treatments in terms of 100 seed weight (g), seed yield kg/ha, and harvest index. Therefore, there is need for commercial and home growers of cowpea to weed cowpea plots with Hoe and hand weeding at 20 and 40 days after planting with other good farm management practices.

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Table 1: Predominant Weed Species present on cowpea plots in Owerri, Nigeria

FAMILY	WEED TYPES	LIFE CYCLE	MORPHOLOGICAL GROUP	RELATIVE ABUNDANCE					
				T_1WC_1	T_2WC_2	T_3WC_3	T_4WC_4	T_5WC_5	T_6WC_6
Amaranthaceae	*Amaranthus spinosus L.*	A	B	0.302	0.021	0.014	0.048	0.080	0.030
Asteraceae	*Aspilia African (Pers.) C.O. Adams*	P	B	0.428	0.335	0.217	0.186	0.152	0.129
	Chromolacha odorata (L) R.M. kings	P	B	0.282	0.041	0.143	-	0.030	0.119
	Tridax procumbens L.	A	B	0.095	0.080	0.154	0.067	0.085	0.025
Cyperaceae	*Cyperus esculentus L.*	P	S	0.180	0.096	0.150	0.068	0.086	0.056
	C. rotundus L.	P	S	0.099	0.077	0.046	-	-	-
Euphorbiaceae	*Euphorbia heterophylla L*	A	B	0.129	0.120	0.118	0.135	0.154	0.093
	E. hirta L.	A	B	0.052	-	0.030	-	-	-
	Digitaria horizontalis willd	A	G	0.050	-	0.023	-	0.008	-
Portulacaceae	*Portulaca oleracea L.*	A	B	0.045	0.021	0.081	0.005	0.012	0.004
	Talinum triangulare (jarq) willd	P	B	0.025	0.034	0.092	0.015	0.075	0.020

NB: A = Annual weeds, P = Perennial weeds, S = Sedge, B = Broad leaf, G = Grass,

Table 2: Effects of Different Weed Control Methods on Mean Plant Height (cm), Mean Stem Girth (cm), Mean Number of Branches Per Plant, Mean Number of Leaves Per Plant and Mean Leaf Area Per Plant (cm^2) at 20, 40 and 60days After Planting (DAP).

	Mean plant height (cm)			Mean stem girth (cm)			Mean number of branches/plant			Mean No of leaves / plant			Mean leaf area/plant		
Treatments	20DAP	40DAP	60DAP	20DAP	40DAP	60DAP	20DAP	40DAP	60DAP	20DAP	40DAP	60DAP	20DAP	40DAP	60DAP
T_1WC_1	11.50^{c}	13.77^{d}	20.10^{c}	1.00^{b}	1.48^{b}	2.40^{c}	6.60^{c}	8.30^{cd}	12.88^{d}	31.40^{c}	39.66^{c}	60.60^{e}	27.20^{c}	50.70^{c}	55.38^{d}
T_2WC_2	13.30^{b}	22.22^{a}	24.60^{ab}	1.42^{a}	2.25^{a}	2.90^{ab}	7.00^{b}	9.60^{c}	20.20^{bc}	42.30^{ab}	55.88^{b}	67.00^{d}	40.90^{b}	63.70^{bc}	87.38^{a}
T_3WC_3	11.90^{c}	19.66^{bc}	23.90^{b}	1.40^{b}	2.11^{a}	2.80^{ab}	7.00^{b}	11.30^{bc}	18.66^{c}	36.60^{b}	58.33^{b}	70.60^{c}	35.80^{b}	68.20^{b}	76.08^{c}
T_4WC_4	15.10^{ab}	19.00^{c}	25.40^{a}	1.43^{a}	2.12^{a}	3.00^{a}	8.00^{a}	12.60^{b}	20.11^{bc}	48.30^{a}	65.11^{a}	76.30^{b}	55.40^{a}	75.30^{a}	73.22^{c}
T_5WC_5	13.20^{b}	21.00^{ab}	26.70^{a}	1.47^{a}	2.21^{a}	2.90^{ab}	7.60^{ab}	14.30^{a}	23.44^{a}	50.40^{a}	69.11^{a}	84.30^{a}	48.90^{a}	74.70^{a}	80.95^{ab}
T_6WC_6	16.30^{a}	22.44^{a}	27.30^{a}	1.50^{a}	2.45^{a}	3.30^{a}	8.00^{a}	14.60^{a}	21.33^{ab}	49.00^{a}	66.88^{a}	83.60^{a}	55.20^{a}	70.00^{ab}	80.35^{abc}
LSD	1.52	1.86	4.26	0.16	0.28	0.42	0.63	1.40	2.59	5.88	6.45	15.10	8.43	9.19	9.72

Means in the same column having the same letters are not significantly different at (P<0.05).

Table 3:Effects of different weed control methods mean number of Root nodules per plant. Mean number of days of 50% flowering and mean plant Biomass at 40 days after planting.

Treatments	Mean number of root nodule per plant	Mean no of days to 50% flowering	Mean plant biomass (gm^{-2})
T_1WC_1	12.88_b	53.60^a	40.55^c
T_2WC_2	18.88^a	44.60^b	75.00^b
T_3WC_3	19.33^a	45.30^{ab}	77.77^{ab}
T_4WC_4	20.77^a	41.60^{ab}	82.77^a
T_5WC_5	21.11^a	44.00^b	78.33^{ab}
T_6WC_6	18.55^a	40.60^{bc}	84.44^a
LSD	**2.90**	**4.98**	6.94

Means in the same column having the same letter(s) are not significantly different at ($p<0.05$).

Table 4: Effects of different weed control methods on the yield and yield components of cowpea

Treatments	N0 of pods per /plant	Number of pods per/plot	Pod weight / plot (g)	100 seeds weight(g)	Pod yield kg/ha	Seed yield kg/ha
T_1WC_1	10.00^c	249.35^c	411.22^6	60.50^d	657.95^c	25.55^d
T_2WC_2	18.77^a	468.22^a	829.00^a	72.20^c	1326.40^a	46.66^{ab}
T_3WC_3	17.55^b	423.11^b	820.056^a	72.50^c	1312.89^a	41.11^c
T_4WC_4	17.33^b	422.33^b	773.78^a	83.00^b	1238.04^{ab}	43.33^{bc}
T_5WC_5	18.88^a	475.22^a	818.33^a	94.10^a	1309.32^a	47.77^a
T_6WC_6	17.11^b	407.44^b	749.33^a	83.20^b	1198.92^b	42.22^c
LSD	1.20	33.24	150.35	7.14	240.56	0.03

Means in the same column having the same letter(s) are not significantly different at ($p<0.05$).

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