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Growth and yield performance of cowpea (*Vigna unguiculata* (L.) Walp.) as affected by insecticidal spraying regime and weed control methods

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ABSTRACT

Among the various constraints limiting cowpea production in Nigeria, weeds, pests and diseases appear to be the most deleterious, causing yield losses ranging between 50 to 86%. Field trials were conducted to evaluate the effects of insecticidal spraying regime and weed control methods on growth and yield of cowpea (Vigna unguiculata (L.) Walp) at the Teaching and Research Farm of the Federal University of Agriculture Abeokuta, (07^0 20′ N; 03^0 23′ E). The study area is situated in the Forest-savanna transition zone of South west Nigeria during the early and late rainy seasons of 2013. The experiments were arranged in a split plot design with three replicates. There were four main plot treatments of cyper-diphosphate insecticidal spraying regimes (0 spray, 2 sprays, 3 sprays and 4 sprays) at 1 liter/ha. tested along with seven weed control methods using commercial formulation of metholachlor + prometryn (Codal) at 1.0 kg a.i/ha, 1.0 kg a.i/ha followed by supplementary hoe weeding at six weeks after sowing (WAS), 2.0 kg a.i/ha, 2.0 kg a.i/ha followed by supplementary hoe weeding at 6 WAS, two hoe weedings at 3 and 6 WAS, three hoe weedings at 3, 6 and 9 WAS and weedy check all of which constituted the sub-plot treatments. Data collected which included weed cover score, weed density, cumulative weed dry matter production, crop vigour score, number of leaves per plant, canopy diameter, number of pods plant, pod length, number of damaged pods per plant and pod yield per hectare were subjected to analysis of variance using GENSTART discovery package to determine the level of significance. Insecticidal spraying regime did not have significant ($p > 0.05$) effect on any of the growth parameters. However, insecticidal spraying regime resulted in significant reduction of 41% and 78% in the level of pest damage in the early and late rainy seasons respectively, compared to the crop without insecticidal spray. All weed control methods caused significant ($p > 0.05$) reduction (75 - 78%) in weed growth compared to the weedy check with subsequent significant ($p > 0.05$) increase in cowpea grain yield. In the early rainy season, the maximum cowpea grain yield of 991 kg/ha was obtained with the application of Codal at 2.0 kg a.i/ha followed by supplementary hoe weeding at 6 WAS which compared with 896 kg/ha obtained from plots hoe weeded three times. However, in the late rainy season, cowpea grain yield of 1091.0 kg/ha was obtained with pre-emergence application of Codal at 2.0 kg a.i./ha followed by supplementary hoe weeding at 6 WAS which compared with the grain yield of 1011.0 kg/ha obtained with three hoe weedings with both of them significantly higher than those of the other weed control methods and weedy check.

Key words: Hoe weeding, insecticidal spraying regime, weed control methods

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp.) is one of the most important food legumes in semi-arid tropics covering Asia, Africa and Central America (Mortimore *et al*., 1997). In many parts of West and Central Africa, cowpea has become a crop of tremendous economic importance. Rural families derive their food protein, animal fodder (Tarawali *et al*.,1997; Asiwe, 2007; 2009) and cash (Asiwe, 2007) from the production of this crop. According to Islam *et al*. (2006), all parts of the plant used as food are nutritious providing protein and vitamins, immature pods and peas are used as vegetables while several snacks and main dishes are prepared from the grains.

Cowpea is a major source of plant protein for both urban and rural dwellers. Cowpea is of major importance to the livelihood of millions of relatively poor people in less developed countries of the tropics (FAO, 2002). It contains about 24% protein, 62% soluble carbohydrate and small amount of other nutrients. Cowpea, being a drought tolerant crop coupled with its ability to fix atmospheric nitrogen, enjoys special cultivation advantage in the tropics where moisture and low soil fertility are the major limiting factors to crop production (Hall *et al*., 2002).

World cowpea production was put at 2.27 million tonnes (FAO, 2002). Oseni *et al*. (2015) reported that Nigeria is the largest producer with an estimated production of 850,000 tonnes. In spite of the great economic importance of cowpea as a cheap source of protein and reliable source of income for many farmers, its production is limited by a number of factors which include high infestation of pests, diseases and weeds, the use of low yielding local varieties, low soil fertility, planting at sub-optimal plant density and lack of knowledge of improved cultural practices resulting in low yield of 150 – 400 kg/ha compared to 1500 – 3000 kg/ha under good research management (Ajeigbe *et al*., 2005). Of all the constraints limiting cowpea production, weeds, pests and diseases appear to be the most deleterious resulting in yield losses ranging from 20 – 100% (Akobundu, 1987). Pest and disease infestation in cowpea fields result in significant yield losses. Losses ranging from 50 – 86% have been attributed to weeds, pests and diseases infestation (Le *et al.,* 2004; Osipitan *et al*.,2013*;* Adigun *et al.,* 2014). Every stage in the life cycle of this crop is affected by at least one major pest and diseases that could cause serious damage to the crop.

Apart from the direct effect of weeds on yield and quality, common weed species such as P*ortulaca oleracea* L., *Solanum nigrum* L. and *Amaranthus spinosus* L. have been reported to serve as reservoir hosts for various pests and diseases (Alegbejo, 1987). Losses caused by weeds alone in cowpea production ranged from 25-60%, depending on the cultivar and environment (Osipitan *et al.,* 2013; Adigun *et al.,* 2014). In specific situations with pernicious weeds such as *Imperata cylindrica, Rottboellia cochinchinensis, Cynodon dactylon, Cyperus esculentus, Striga spp, Commelina erecta and Portulaca oleracea* complete crop loss may be recorded (Lagoke *et al.,* 1982). There is therefore an urgent need to develop appropriate technology to reduce the problem of pests, diseases and weeds in cowpea cultivation in order to boost its production. Hence, the objective of this study was to evaluate different weed control methods and insecticidal spraying regime for enhanced cowpea production.

MATERIALS AND METHODS

Field trials were conducted at the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta (07°20′ N; 03°23′ E) in the forest-savanna transition

zone of South west Nigeria. The first trial was established at the early rainy season in June while the second trial was established at the late wet season in September of year 2013. The experimental field was ploughed and harrowed at two weeks interval. There were four levels of insecticidal spraying regimes; 0 spray, 2 sprays, 3 sprays and 4 sprays using a mixture of cypermetryn (cyper-diphosphate) at 1 litre/ha + a fungicide mancozeb (Zinc + Manganese) at 1 kg/ha. These were the main plot treatments while the sub-plot treatments were made up of seven weed control methods [pre-emergence application of Codal (metolachlor + prometryn) at 1.0 kg a.i./ha; Codal at 1.0 a.i./ha followed by one supplementary hoe-weeding; Codal at 2.0 kg a.i./ha; Codal at 2.0 kg a.i./ha followed by supplementary hoe-weeding; hoe weeding two times at 3 and 6 weeks after sowing; hoe weeding three times at 3, 6 and 9 weeks after sowing and weedy check]. All the treatments in different combinations were laid out in a split-plot design with three replicates. Gross and net plot sizes were 4.5 x 3.0 m^2 and 3.0 x 3.0 m^2 respectively. Cowpea (Ife Brown variety) seeds, obtained from Institute of Agricultural Research and Training (IAR&T), Moor plantation, Ibadan, Nigeria, were planted at three seeds per hole at inter and intra-row spacing of 75 cm x 50 cm, respectively. The seedlings were later thinned to two plants per stand at two weeks after sowing. Metolachlor + Prometryn (Codal) was applied one day after sowing using a CP3 Knapsack sprayer at a spraying volume of about 200 - 240 litres per hectare using a deflector green nozzle at a pressure of 2.0 kg/cm^3. Data collected included weed cover score, weed density, weed dry matter production, crop vigour score, number of leaves, canopy diameter, number of pods per plant, number of damaged pods per plant, pod length and pod yield.

Data collected which included weed cover score, weed density, cumulative weed dry matter production, crop vigour score, number of leaves per plant, canopy diameter, number of pods plant, pod length, number of damaged pods per plant and pod yield per hectare were subjected to analysis of variance using GENSTART discovery package to determine the level of significance and means were separated using LSD where 'F' value was found significant. Weed cover score was by visual observation based on scale 1 -10 where 1 represented plots with the least weed infestation and 10 represented plots with full weed cover.

RESULTS AND DISCUSSION

Table 1 shows the soil physico-chemical properties of the experimental fields. In both early and late rainy seasons of 2013. The soils were generally sandy loam with low nitrogen content and pH near neutral and slightly acidic during the early and late rainy season respectively.

Effect of Insecticidal Spraying Regime and Weed Control Methods on Weeds in Cowpea

The fields on which the trials were sited were found to be infested with different categories of weeds including broad leaf weeds, grasses and sedges as shown in (Table 2). Table 3 shows the effect of insecticidal spraying regime and weed control methods on weed cover score weed density and weed dry matter production in cowpea.

Weed dry matter production of about 66 and 102 t/ha obtained from the weedy check in the early and late wet seasons, respectively (Table 3). It showed that the experimental sites were heavily infested with weeds. In spite of this heavy weed infestation, all the weed control methods led to significant reduction in weed growth compared with those of the hoe-weeded control and

significantly lower ($p > 0.05$) than the weedy check. Pre-emergence application of metolachlor + prometryn at 1.0 and 2.0 kg a.i./ha each followed by supplementary hoe-weeding were particularly effective and gave comparable weed control to that of three hoe-weedings. The advantage of this is that a farmer who applies this herbicide pre-emergence can save time and money particularly at the peak period of farming operations.

Table 1: Physicochemical properties of the soil of experimental sites at FUNAAB Alabatain the early and late rainy seasons of 2013 planting seasons.

Soil Property	Early	Late
pH	6.70	5.5
Sand (%)	93.00	85.0
Clay (%)	3.60	5.2
Silt (%)	3.40	9.8
Textural Class	Sandy loam	Sand loam
Exchangeable Bases	g/kg	g/kg
Ca	89.0	20.4
Mg	10.8	5.0
K	2.1	1.4
Na	6.1	3.5
%N	0.10	0.07
Av P (ppm)	20.1	20.4
Textural class	Sandy loam	Sandy loam

The soils of the experimental field was essentially sandy loam with low nitrogen content in both early and late wet season

Table 2: Meteorological data during the experimentat FUNAAB Alabata in the early and late rainy seasons of 2013.

	Total rainfall (mm)	**Relative humidity**	**Temperature (^{0}C)**		**Sunshine hour**	**Evaporation (mm)**
			Maximum	**Minimum**		
June	53.7	71.0	31.0	23.3	5.3	2.8
July	202.6	76.2	28.6	22.3	3.0	1.2
August	35.2	71.7	28.6	21.1	3.1	2.6
September	136.0	69.7	28.9	22.4	4.3	3.0
October	94.4	67.2	31.7	23.1	5.0	2.4
November	15.6	60.0	33.1	23.5	6.5	4.2
December	16.5	58.5	33.0	22.4	6.2	4.1

Source: Department of Agro Meteorology and Water Resources Management, University of Agriculture, Abeokuta, Ogun state.

It was observed that weed challenge was higher at the early rainy season of the experiment compared to the late season. This could be attributed to weed predominance occasioned by the higher total amount of rainfall in the former than in the

later (Table 2). During this period, the available conditions especially soil moisture and possibly better soil fertility favoured weed establishment. This observation was similar to that of Adigun and Lagoke (1994), who attributed more serious adverse effect of weeds on pepper to rapid weed growth occasioned by conducive climatic conditions such as temperature, rainfall and relative humidity.

Table 3. Common weed species found on the experimental sites during the study and their level of infestation at FUNAAB Alabata in early and late wet seasons of 2013

	Weed species	Early	Late
Broad leaved	*Cochorus olitorus (L.)*	**	**
	Euphobia heterophylla (Linn.)	* **	**
	Gomphrena celozoides (mart.)	**	***
	Hyptis sauveolens (Poit)	* **	***
	Mitracarpus villous (Sw.) DC	**	**
	Spigelia anthelmia (Linn.)	* *	**
	Talinum triangulare (Jacq.) Wild.	**	**
	Tridax procumbens (Linn.)	* **	**
Grasses	*Andopogon gayanus* (Kunth var.)	* **	-
	Commelina bengalensis (L.)	* *	*
	Cynodon dactylion (Linn.)	*	**
	Imperata cylindrica (Linn.)	**	-
	Panicum maximum (Jacq.)	* *	*
Sedges	*Cyperus rotundus* (Linn)	*	-
	Kylinga squaminata (Thonn)	* **	*
	Mariscus alternifolius (Vahl)	*	*

*** High infestation (60 – 90 %) * Low infestation (1 – 39 %)
** Moderate infestation (40- 60 %) - Not noticeable

In the early wet season, 3 hoe-weedings caused 75.05% reduction in total weed dry matter production and 90.38% in the late wet season. Adigun (2004) reported 64% - 98.07% reduction in weed biomass by keeping crops weed free throughout the period of crop growth. All weed control methods evaluated in this study resulted in significantly lower weed cover score, weed density and weed dry matter production compared with the weedy check. Plots hoe-weeded twice at 3 and 6 WAS and those treated with pre-emergence application of metolachlor + prometryn (Codal) at 1.0 and 2.0 kg a.i. /ha had comparable weed biomass in both seasons. These results agreed with the earlier reports on the efficacy of herbicides for weed control in legume crops (Adigun and Lagoke, 2004; Badmus *et al*., 2006).

Effect of Insecticidal Spraying Regime and Weed Control Methods on Growth Parameters of Cowpea

Insecticidal spray did not have significant effect on any of the growth parameters of cowpea throughout the period of observation both during the early and late cropping seasons of 2013 (Tables 4 and 5).

All weed control methods, including hoe weeding, produced similar crop vigour, number of leaves per plant and canopy

diameter all of which were significantly higher than those of the respective weedy check throughout the period of observation in both early and late wet seasons of 2013. Unchecked weed growth had tremendous detrimental effect on crop growth, particularly during the early stage of the crop growth. For example, unchecked weed growth reduced crop vigour score by 55-80% and 65-83%, number of leaves by 32-42% and 43-45% and canopy height by 1-1.8% and 17-35% in the early and late seasons, respectively (Table 4). This observation was also made by Lagoke *et al*. (1982); Akobundu (1987); Osipitan *et al.* (2013) and Adigun *et al.* (2014), that cowpea is sensitive to weed competition especially at the early stage of crop growth. Weed control methods with Codal at 2.0 kg a.i./ha followed by supplementary hoe weeding at 6 WAS performed best, producing the highest cowpea canopy diameter at the early wet season trial while 2 hoe-weedings produced maximum canopy cover in the late season. This observation in canopy cover may be linked to adequate rainfall and effective weed management throughout the period of observation. Plots hoe-weeded had comparable crop vigour with those treated with pre-emergence application of codal at both rates with supplementary hoe-weeding. This observation is in line with that of Shinggu (1999) who reported that weed control enhanced crop vigor score of cowpea. Weed control methods produced similar number of leaves per plant which were significantly different from those of weedy check at 6 and 9 WAS both in the early and late wet seasons. This trend was also observed with pre-emergence application of metolachlor + prometryn at 2.0 kg a.i./ha. The 2 and 3 hoe-weedings produced similar number of leaves per plant and canopy diameter compared to pre-emergence application of metolachlor + prometryn at both rates either with or without supplementary hoe-weeding during the early and late rainy seasons of 2013. which included *Maruca* spp and *Aphis crassivora*. This finding is in agreement with the reports of Kyamanywa (1996) and Karungi *et al*. (2000) that insecticidal application once at flowering increased grain yield of cowpea by 78% and twice at flowering and podding gave yield advantage of 126%. The results of this study also indicated that insecticide application remains an important strategy for suppressing cowpea insect pests on the field if properly managed to coincide with high infestation levels. With proper timing, all levels of herbicide application supplemented with hoe-weeding produced significantly higher number of pods per plant than the respective rates of Codal without supplementary hoe-weeding. In the late wet season, pre-emergence application of Codal and three hoe-weedings produced similar number of pods cowpea per plant which was significantly higher than all other

Effect of Insecticidal Spraying Regime and Weed Control Methods on Yield and Yield Attributes of Cowpea

Table 6 shows the effect of spraying regimes and weed control methods on yield and yield attributes of cowpea. Insecticidal spraying regime did not have significant effect on any of the yield parameters of cowpea except for number of damaged pods per plant. Application of insecticide generally reduced pests' infestation and damage to number of pods per plant of cowpea both in the early and late wet season trials by 78.6 and 55.7%, respectively. This consequently brought about increase in the grain yield of cowpea that received various levels of insecticidal spray. In this study, the increase in yield obtained with various levels of insecticidal spray was due to successful control of some of the most devastating cowpea pests found on the field,

methods of weed control. Pre-emergence application of Codal at 1.0 kg a.i./ha either used alone or supplemented with hoe-weeding did not significantly improve the number of cowpea pods per plant compared to two and three hoe-weedings. However, both were significantly higher than the weedy check (Table 6).

Weed control methods were found to have significant effect on the number of pod damaged per plot throughout the period of observation in the early wet season in 2013. Two hoe-weedings produced significantly higher number of damaged pods per plot in cowpea than the three hoe-weedings. Weedy check produced significantly higher number of damaged pods per plot in cowpea than all weed control methods throughout the period of observation. However, in the late wet season the trend was reversed as all the weed control methods did not have any significant effect on the number of damaged pods in cowpea throughout the period of observation.

Table 4: Effects of insecticidal spraying regime and weed control methods on weed cover score weed density and weed dry matter production in cowpea at FUNAAB Alabata in the early and late wet seasons of 2013

Treatment	Weed cover score				Weed density				Cumulative weed dry matter at harvest (t/ha)	
Insecticidal spraying regime	**Weeks after sowing**									
	6		**9**		**6**		**9**			
	Early	**Late**	**Early**	**Late**	**Early**	**Late**	**Early**	**Late**	**Early**	**Late**
0 Spray	3.71	3.24	4.29	3.52	68.2	28.80	60.6	37.0	58.0	25.1
2 sprays	3.24	3.05	4.48	3.62	70.8	22.70	61.4	38.0	59.9	23.3
3 sprays	3.71	3.52	4.90	3.81	63.4	26.30	58.9	40.2	55.2	20.6
4 sprays	3.86	3.43	5.33	3.95	68.4	28.70	76.0	46.5	55.5	28.3
LSD p≤0.05	ns	Ns	ns	ns	Ns	ns	ns	ns	ns	ns
Weed management										
Codal at 1 kg a.i/ha	4.42	3.42	8.25	6.33	62.3	23.50	82.2	19.2	57.8	26.8
Codal at 1 kg a.i/ha fb SHW at 6 WAS	4.00	3.17	2.42	2.17	40.0	18.70	29.7	13.7	59.8	23.0
Codal at 2 kg a.i/ha	3.58	2.58	6.58	3.33	51.3	16.30	32.3	16.3	60.5	13.9
Codal at 2 kg a.i/ha fb SHW at 6 WAS	2.75	2.67	1.67	2.17	36.3	12.70	23.0	11.3	36.5	17.7
Hoe weeding 2 X at 3 and 6 WAS	2.42	2.08	3.33	1.08	42.7	24.00	15.7	17.3	54.8	17.0
Hoe weeding 3 X at 3, 6 and 9 WAS	1.58	2.00	1.00	1.00	39.0	17.70	33.7	10.3	25.4	6.30
Weedy check	6.67	7.25	10.00	10.00	202.2	73.30	233.0	195.2	101.8	65.5
LSD p≤0.05	0.22	0.13	0.22	0.30	1.32	0.75	1.55	1.13	9.03	7.9
Spraying × weeding management	ns	Ns	0.46	ns	ns	ns	ns	ns	ns	ns

2- Sprays at 4 and 6 WAS, 3- Sprays 4, 6 and 8 WAS, 4-Sprays at 4,6, 8 and 10 WAS.
a. i. = active ingredient. LSD = Least significant difference.
f.b = followed by. SHW = Supplementary hoe weeding WAS = Weeks after sowing

Weed Cover Score was by visual observation based on scale 1 -10 where 1 represented completely weedy plot and 10 represented the most clean plot.

Weed control methods and hoe-weedings produced significantly higher pod weight than that of the weedy check. However, weed control methods had significant effect on pod weights of cowpea per hectare in both early and late wet seasons. The highest pod weight of cowpea was produced with pre-emergence application of Codal at 2.0 kg a.i /ha followed by supplementary hoe-weeding at 6 WAS in both early and late wet season. This was significantly higher than the pod weights of all the other weed control methods including those of the hoe-weedings. Pre-emergence application of *Codal* at both rates supplemented with hoe-weeding at 6 WAS produced significantly higher pod weight of cowpea than that of corresponding rates of codal without supplementary hoe-weeding.

Weed control methods produced significantly higher grain yield of cowpea than that of the weedy check. The highest grain yield of cowpea was produced with pre-emergence application of *Codal* at 2.0 kg a.i./ha followed by supplementary hoe-weeding at 6 WAS in both early and late wet seasons. Pre-emergence application of Codal at both rates supplemented with hoe-weeding at 6 WAS produced significantly higher grain yield of cowpea than that of corresponding rates of Codal without supplementary hoe-weeding. Three hoe-weedings produced significantly higher grain yield of cowpea than the two hoe weedings in both seasons of experimentation. In this study unchecked weed growth throughout the crop life cycle resulted in about 68.5 – 69.8% reduction in potential cowpea grain yield. The drastic reduction in the yield of cowpea grains in the weedy check in both seasons of these trials could be due to the deleterious effect of various weed species on yield components of cowpea. This view was supported by the findings of Takim and Uddin (2010) that yield reduction due to uncontrolled weed growth in cowpea was estimated to be 50-60% and 70-80% compared to two and three hand weeding respectively. Olorunmaiye and Ogunfolaji (2002) reported 58, 13, 22, and 27% yield losses when cowpea was infested by *Euphorbia heterophylla* for 3, 4, 5 and 6 weeks after sowing and till harvest, respectively. Tijani-Eniola (2001) also reported that weed could cause yield losses ranging from 50 to 80%. In this study, cowpea pod weight and grain yield obtained in the late wet season were generally higher than those of the early wet season. In spite of the high rainfall in the early wet season which could have increased soil moisture content and thereby increased cowpea yield. However, higher weed infestation in the early wet season trial caused lower productivity of cowpea compared to the yield in the late wet season. Higher solar radiation in the late wet season could also be responsible for the higher yield in the late wet season compared to the early wet season. This observation is similar to those of Adigun (2004) who reported higher groundnut pod yield during the late wet season and Badmus *et al*. (2006) who reported lower crop yields during the early wet season compared to the late wet season. Unchecked weed growth throughout crop life cycle resulted in 67.97% and 70.72% as well as 68.52 and 70.58% reduction in potential grain yield in early and late wet season, respectively (Table 5). Tripathi and Singh (2001) similarly reported yield reduction of 82.0 % due to unchecked weed growth in cowpea, while Le *et al*. (2004) observed that weed density, type of weed, their persistence and crop management practices determine the magnitude of yield loss in crop production.

Table 5.Effects of insecticidal spraying regime and weed control methods on crop vigour score, number of leaves/plantand leaf areaof cowpea at FUNAAB Alabata in the early and late wet seasons of 2013

Treatment	Crop vigour score				Number of leaves/plant				Canopy diameter (cm)			
	Weeks after sowing											
	6		9		6		9		6		9	
Insecticidal spraying regime	**Early**	**Late**	**Early**	**Late**	**Early**	**Late**	**Early**	**Late**	**Early**	**Late**	**Early**	**Late**
0 Spray	8.24	8.10	8.81	8.00	9	14.1	14.62	23.24	42.43	6.91	6.14	6.99
2 sprays	8.24	7.62	7.76	7.81	8.43	15.33	15.43	26.19	38.36	6.11	5.2	6.84
3 sprays	8.19	7.43	7.67	7.14	8.05	15.57	13.62	25.14	35.16	6.29	5.48	7.05
4 sprays	8.24	6.95	7.62	7.10	8.29	15.57	15.33	25.19	34.08	6.47	5.39	7.12
LSD p≤0.05	ns	ns	ns	ns	ns	ns	Ns	Ns	ns	Ns	ns	ns
Weed management												
Codal at 1 kg a.i/ha	7.50	7.75	6.42	7.25	8.67	17.25	14.83	25.58	36.69	6.62	5.20	7.18
Codal at 1 kg a.i/ha fb SHW at 6 WAS	7.50	7.75	9.08	8.67	8.58	16.17	15.33	22.33	39.02	6.49	5.50	7.21
Codal at 2 kg a.i/ha	8.25	7.08	7.33	8.00	8.67	16.00	16.08	27.50	39.77	6.69	5.64	7.34
Codal at 2 kg a.i/ha fb SHW at 6 WAS	9.83	7.25	10.00	8.08	9.33	15.58	16.25	26.83	36.01	6.38	5.44	7.43
Hoe weeding 2 X at 3 and 6 WAS	9.75	9.67	9.50	9.50	9.83	15.08	16.92	24.58	35.12	6.88	5.67	7.09
Hoe weeding 3 X at 3, 6 and 9 WAS	10.00	9.53	10.00	10.0 0	7.25	16.17	14.00	30.58	37.23	6.51	5.73	6.96
Weedy check	4.50	3.33	1.67	1.08	6.75	9.57	9.83	17.17	38.69	5.54	5.68	5.81
LSD p≤0.05	0.11	0.18	0.10	0.27	0.26*	0.29**	0.46*	0.45**	ns	0.64	ns	0.60
Spraying × weeding management	ns	ns	ns	ns	ns	ns	Ns	Ns	ns	Ns	ns	ns

2- Sprays at 4 and 6 WAS, 3- Sprays 4, 6 and 8 WAS, 4-Sprays at 4,6, 8 and 10 WAS.
a. i. = active ingredient. LSD = Least significant difference.
f.b = followed by. WAS = Weeks after sowing
Weed Cover Score was by visual observation based on scale 1 -10 where 1 represented completely weedy plot and 10 represented the most clean plot.

Table 6: Effect of insecticidal spraying regime and weed control methods onnumber of pod, pod length, Number of damaged pod yield and grain yield of cowpea at FUNAAB in the early and late wet seasons of 2013

	Number of pods/plant		Pod Length/Plant(cm)		Number of damaged pod/plot		Grain yield (kg/ha)	
Treatment	Early	Late	Early	Late	Early	Late	Early	Late
Insecticidal Spraying Regime								
0 Spray	17.95	17.05	11.82	12.19	3.00	4.91	576.0	713.0
2 Sprays	18.19	16.29	12.18	12.44	1.33	2.81	600.0	725.0
3 Sprays	16.19	16.48	12.14	13.42	2.00	1.57	672.0	850.0
4 Sprays	16.33	18.19	11.59	12.89	1.76	1.05	639.0	776.0
Lsd p≤0.05	ns	ns	ns	ns	0.25	0.49	ns	ns
Weed Management								
Codal at 1 kg a.i/ha	15.75	15.92	12.62	13.05	2.67	1.92	446.0	670.0
Codal at 1 kg a.i/ha fb SHW at 6 WAS	19.5	14.75	12.76	13.41	2.58	1.50	567.0	773.0
Codal at 2 kg a.i/ha	17.00	17.83	12.40	12.03	2.33	1.75	425.0	681.0
Codal at 2 kg a.i/ha fb SHW at 6 WAS	19.92	22.08	12.45	14.14	2.50	1.58	991.0	1091.0
Hoe weeding 2 X at 3 and 6 WAS	19.08	16.5	13.14	13.41	2.50	1.75	716.0	815.0
Hoe weeding 3 X at 3, 6 and 9 WAS	17.42	22.83	11.49	13.83	2.50	1.58	896.0	1011.0
Weedy check	11.5	9.03	8.67	9.28	3.00	4.08	312.0	321.0
LSD p≤0.05	3.79	2.65	4.91	1.20	0.22	ns	124.6	138.6
Spraying × weeding management	ns	ns	Ns	ns	0.46	ns	255.2	252.3

CONCLUSION

In Nigeria, pests, diseases and weeds have been identified as the major constraints limiting cowpea production. From the results of this study, it has been shown that the use of 2-4 sprays of cyper-diphosphate at the rate of 1 liter/ha caused significant reduction in number of damaged cowpea pods.

In addition, pre-emergence application of Codal at the rate of 1 kg a.i./ha followed by supplementary hoe weeding at 6 weeks after sowing caused significant reduction in weed growth with subsequent high cowpea yield comparable to that of the hoe-weeded control. It is therefore recommended that farmers use a combination of insecticidal spray like cyper-phosphate at the rate of 1 liter/ha, 2-4 times and pre-emergence herbicides such as Codal for insect and weed control, respectively.

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