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Growth and Yield Performance of Cowpea (*Vigna Unguiculata* (L.) Walp) as Influenced by Row-Spacing and Period of Weed Interference in South-West Nigeria

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Abstract

Weed problem appears to be the most deleterious factor causing between 25 and 60% reduction in potential yield of cowpea. Field trials were therefore conducted to study the effect of inter-row spacing and period of weed interference on growth and yield of cowpea (*Vigna unguiculata* (L) Walp) at the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta (07° 15′; 03° 25′ E) in South Western Nigeria during the early and late wet seasons of 2009. The experiment consisted of eight main plots of weed interference which included initial weed removal for 3, 6, 9, and 12 weeks after sowing (WAS) and subsequently weed –infested until harvest as well as initial weed infestation for corresponding periods and thereafter kept weed free until harvest. There were also sub-plot treatments of three inter-row spacing of 60, 75, and 90 cm. All treatments in different combinations were laid out in a split-plot design with three replications. In both trials, the use of inter-row spacing of 60 cm resulted in significant reduction in weed growth as evident in lower weed dry matter production and subsequent higher cowpea pod and grain yields than those of 75 and 90 cm inter-row spacing. Initial weed infestation of up to 3 WAS did not have any adverse effect on crop growth and cowpea grain yields provided the weeds were subsequently removed. On the other hand, cowpea grain yield loss was not significantly averted by keeping the crop weed free for only 3 WAS without subsequent weed removal. In this study, initial weed-infestation for 6 WAS and beyond significantly depressed various crop growth parameter and cowpea grain yield compared with the crop kept weed free throughout its life cycle. In order to obtain optimum yields similar to that of the weed free cowpea field, it was required to keep the crop weed free for 6 WAS and beyond. However, frequent weeding beyond 9 weeks after sowing did not improve cowpea yield significantly and as a matter of fact it may even result in reduction of cowpea grain yield due to mechanical damage of hoe weeding. The practical implication of this finding is that early weeding starting from 3 WAS is very crucial for cowpea production while the critical period of weed removal for optimum yield in cowpea is between 3 and 9 WAS in the forest-savannah transitional zone of south Western Nigeria.

Keywords: inter-row spacing, weed interference growth and yield of cowpea

1. Introduction

Cowpea (*Vigna unguiculata* (L) Walp) is a crop of tremendous economic value being a major source of protein in West and Central Africa where more than 60% of the world's cowpea is being produced. Rural families derive food and animal fodder (Tarawali et al., 1997; Asiwe, 2007) as well as cash from the production of this crop (Quin, 1997). In many parts of West Africa, cowpea is a popular staple food utilized to fortify cassava, plantain, cereal-based meals and yoghurt (Henshaw et al., 2005). The chemical composition of cowpea is similar to that of most edible legumes. It contains about 24% protein, 62% soluble carbohydrate and small amount of other nutrients.

Apart from it's role in controlling soil erosion and fixing atmospheric nitrogen into the soil, thereby reducing nitrogen requirement for its growth (Langdale et al., 1997); cowpea is also a food security crop in the semi-arid zone of West and Central Africa which ensures subsistence food supply even in the dry years. It is adapted to stressful environment where other crops either fail or do not perform well.

World estimated annual cowpea production was put at 4.5 million metric tonnes from an estimated land area of 14 million hectares with Nigeria being the largest producer with an annual production of 2.4 million metric tonnes from an estimated land area of 5 million hectares. Traditionally, the production centres of this crop are in guinea and sudan savannah ecologies but in recent years cultivation of this crop has spread to the forest and derived savannah ecologies for which a number of varieties have been developed (Anonymous, 1992).

Although there is a great potential for cowpea production in South Western Nigeria, the yields obtained by farmers are generally low due to high level of diseases and pest infestations (Asiwe*,* 2007), lack of knowledge of good cultural practices, use of local varieties which are generally low yielding coupled with low soil fertility and weed management problem.

Of all the constraints limiting the production of cowpea in Nigeria, weed problem appears to be the most deleterious resulting in various degrees of yield losses ranging from 50-86%*;* (Akobundu, 1979; Le et al., *2004*). Apart from direct effect on yield and quality reduction, commong weed species such as *Portulaca oleraceae*; *Solanum nigram* (L) and *Amaranthus spinosus* (L) have been reported to serve as reservoir hosts for various pests and diseases (Alegbejo, 1987).

A number of studies have shown that increased crop density would decrease the magnitude of effect of weed competition with crops (Street et al., 1981; Teasday & Frank, 1983; Adigun, 1992; Adigun 2002). Studies with soyabean by Cooper (1995) indicated that the semi dwarf soybean cultivars produced greater yield at a very narrow spacing of 17 cm with little advantage over standard cultivars at 75 cm row spacing and low plant densities. The semi dwarf lines produced relatively higher yields at the narrowest row spacing. Similarly in groundnut, yields increased with better competition against weeds obtained by growing the crops in narrow rows (Buchaman et al., 1976). Burnside and Juricek (1967) also observed that soyabean population of 98000; 196,000 and 390,000 plant/ha gave weed dry matter production of 2,259, 1,425 and 1,175 kg/ha, respectively; an effect attributed to earlier and more vigorous shading and better competitive advantage in more dense crop population, using snap beans, planted at constant density of 15 to 46 cm suppressed weed growth more than that of 91cm row. Biswan et al. (2002) reported that population density had significant effect on cowpea pod and seed yields while Aliyu (2007) observed that densely intercropped cowpea with millet could reduce Striga emergence thereby increasing grain yield. Adigun and Lagoke (1994) reported a 50-94% reduction in groundnut pod yield due to unchecked weed growth throughout the crop life cycle.

The impact of weeds on yields of crops varies with the characteristics of crop, the weed species, weed density, the environment, the stage of crop growth and duration of crop exposure to weeds (Dowson et al., 1973). Although many competitive studies (Friesen, 1979; Adigun et al., 1992; Adigun et al., 1994; Adigun & Lagoke 2003; Usman et al., 2002) have been conducted in the temperate and tropical regions between field and indigenous population of weeds, there is at present paucity of information on the effect of row spacing and period of weed interference on growth and yield of cowpea.

The objective of the present study is to evaluate the effect of inter-row spacing and period of weed interference on growth and yield of cowpea in South Western Nigeria. Such study will enable the practicing farmer to decide on the appropriate row spacing to be adopted in order to reduce the menace of weeds and the critical period of weed removal for optimum yield and profitability.

2. Materials and Methods

2.1 Description of Experimental Site

Field experiments were conducted to evaluate the effects of inter-row spacing and period of weed interference on growth and yield of cowpea at the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta (7°15′N, 3°25′E), in South Western Nigeria during the early (April-July) and late (August – October) cropping season of 2009. The location is characterised by a bimodal rainfall pattern with peaks usually in July and September and short dry spell in August with annual mean of about 1300 mm and a mean temperature of about 27°C. The soils of the experimental sites were freely drained loamy sand with a pH of between 6.8 and 7.11, organic carbon of 0.62-0.88%, total nitrogen of 0.07-0.17% and available P of 20.10-20.40%.

2.2 Treatment and Experimental Design

In both seasons the experiment consisted of eight main plots of weed interference periods which included initial weed removal for 3, 6, 9 and 12 weeks after sowing and subsequently kept weed-infested until harvest as well as initial weed infestation for corresponding periods and thereafter kept weed free until harvest. There were also sub-plot treatments of inter-row spacings of 60, 75 & 90 cm; all intra-spaced at 30 cm. All treatments in different combinations were laid out in a Split-plot design with three replications.

2.3 Land Preparation and Crop Management

The land was ploughed and disc- harrowed at two weeks interval. Inorganic fertilizers were broadcast at the rate of 45 kg/ha each of P_2O_5 and K_2O before harrowing. Gross and net plot sizes were (3 x 4.5) m^2 and (1.5 x 3.0) m^2 , respectively. Seeds of cowpea (var. Ife Bimpe) were sown at the rate of two to four seeds per hole and later thinned to two per stand. Weed removal was carried out using the West African hand-hoe. Insecticides and fungicides were applied at the onset of flowering and subsequently fortnightly until pod maturity to protect the plants against insect and disease damage.

2.3 Parameters Measured and Data Analysis

Weed dry matter production at harvest, crop vigour score number of leaves per plant, canopy diameter, number of pods per plant, pod yield, 1000 seed grain weight were some of the parameters used to evaluate the performance of the treatments. Crop vigour score was taken by visual observation based on scale 0-10, where 0 represented plots with crops completely killed and 10 represented plots with the most vigorous growing and healthy crop. At each time of weed removal, weed density and fresh weight were taken from quadrat of 1m x1m randomly placed in the central rows of the plots. Weed density was taken by physically counting the number of weeds which were then cleaned and oven dried to constant weight to get the weed dried matter production.

All parameters were taken and subjected to analysis of variance. The treatment means were compared using least significant different (LSD) where F values showed significance.

3. Results and Discussion

3.1 Effect of Inter-Row Spacing on Weed Dry Matter Production, Growth and Yield of Cowpea

The common weeds at the sites of the trials which included all categories of weeds and their levels of infestation are presented in Table 1. The common broad leaved weed species were: *Euphorbia heterophyllia* Linn; *Talinum triangulare* (Jacq) *Wild*; *Amaranthus spinosus* (L.); *Acanthospermum hispidium DC*; *Boerhavia coccinea (*Mill); *Boerhavia diffusa* (L).

Some grass weed species present also include Digitaria ciliaris (Ret) kock; Rottboellia cochinensis (Lour) Clayton; Panicum maximum (Jacq); Cynodon dactylon (L.) Gaertn and Imperata cylindrical (L.). While the sedges included Cyperus spp.

Table 1. Common weed species found on the experimental sites during the course of study and their level of infestation in early and late wet seasons of 2009

	Level of infestation	
Weed Species	**Early season**	**Late season**
Broad Leaved		
Euphorbia heterophylla Linn	***	***
Euphorbia hirta (L)	*	*
Talinum triangulare (Jacq) *Walid*	***	***
Chromolaena odorata (L)	*	*
Tridax procumbens Linn	**	**
Senna hirsute (Linn)Irwin	*	*
Amaranthus spinousus (l.)	**	**
Amaranthus viridis (l.)	*	*
Acanthospermum hispidium DC	**	**
Boerhavia coccinea Mill	***	***
Boerhavia diffusa l.	**	**
Hyptis lancoeolata Poir	*	*
Tithonia diversifolia (Hemsl.) A. Gray		
Grasses		
Digitaria ciliaris (Ret) Kock	*	*
Imperata cylinrica (L.)	*	*
Commelina bengalensis (L.)	*	*
Rottbeollia cohinchinesis (Lour) Clayton	*	*
Planicum maximum Jacq	*	*
Cynodon dactylon (L.) Geartn	**	**
Branchiaria lata Hubb (Schum)	**	**
Sedges		
Cyperus rotundus (L.)	*	-
Cyperus esculentus (L.)	**	**

*** High infestation (60 – 90%).

** Moderate infestation (40 – 50%).

* Low infestation (1 – 39%).

Inter-row spacing had significant effect on canopy height at 9 weeks after sowing (WAS) in the early wet season of 2009 in which, inter-row spacing of 60cm produced significantly taller canopy height than those of 75 and 90cm inter-row spacing. Similarly, canopy diameter was significantly affected by inter-row spacing at 9 WAS in the early wet season where inter-row spacing of 60cm produced significantly higher canopy diameter than those of 75 and 90cm inter-row spacing (Tables 2). Number of leaves per plant and leaf area also showed similar trend although there was no significant difference among the inter-row spacing in this case (Table 3).

Table 2. Effect of period of weed interference and inter-row spacing on canopy height and canopy diameter early and late seasons

Treatments	Canopy height (cm)		Canopy diameter (cm)	
	Early season 9WAS	Late season 9WAS	Early season 9WAS	Late season 9WAS
Period of Weed Interference				
Initial weed removal for 3WAS	53.28d	53.94c	34.52b	36.69cd
Initial weed removal for 6WAS	56.53bcd	54.57c	31.77b	39.94bc
Initial weed removal for 9WAS	53.9cd	57.2bc	38.23a	43.68a
Initial weed removal for 12WAS	-	-	-	-
Initial weed infestation for 3WAS	55.50cd	55.48bc	36.20b	41.61ab
Initial weed infestation for 6WAS	58.11abc	58.79b	30.93c	35.53de
Initial weed infestation for 9WAS	60.78ab	62.43a	31.47c	32.91e
Initial weed infestation for 12WAS	61.27a	62.58	-	-
SE(±)	0.92	1.29	0.06	1.16
Spacing (cm)				
60	58.32a	59.19	35.03a	37.97
75	56.29a	57.15	34.94a	38.78
90	55.20b	56.07	32.46	37.25
SE(±)	0.89	1.16	0.03	0.93
Interactions				
Weed x spacing	*	*	NS	NS

WAS – weeks after sowing; *Significant, NS – Not significant;

- Treatment not completely applied at the time of observation;

Values with the same alphabets within the same column are not significantly different.

Table 3. Effect of period of weed interference and inter-row spacing on number of cowpea planting at early and late seasons

Treatments	Number of leaves/plant		Leaf area/plant (cm^2)	
	Early season 9WAS	Late season 9WAS	Early season 9WAS	Late season 9WAS
Period of Weed Interference				
Initial weed removal for 3WAS	103.56a	82.67c	86.64bc	91.18b
Initial weed removal for 6WAS	111.00a	1139.00a	117.38	110.30a
Initial weed removal for 9WAS	104.00a	106.33ab	92.06bc	118.77ab
Initial weed removal for 12WAS	-	-	99.93b	108.38a
Initial weed infestation for 3WAS	109.33a	106.00ab	102.71a	108.14a
Initial weed infestation for 6WAS	50.67b	100.00b	90.83bc	91.71b
Initial weed infestation for 9WAS	57.00c	58.67d	80.43c	86.60b
Initial weed infestation for 12WAS	-	-	81.76c	88.87b
SE(±)	1.71	3.48	7.25	3.61
Spacing (cm)				
60	92.37	93.83	94.88	100.71
75	90.92	92.29	95.02	100.46
90	88.54	89.38	92.00	100.30
SE(±)	0.82	0.82	3.71	4.08
	NS	NS	NS	NS
Interactions				
Weed x spacing	NS	NS	NS	NS

WAS – weeks after sowing; *Significant, NS – Not significant;

- Treatment not completely applied at the time of observation;

Values with the same alphabets within the same column are not significantly different.

In this study, both the pod and grain yields significantly increased with decrease in row width. In both seasons, inter-row spacing of 60 cm resulted in 32 to 90% and 30 to 93 increase in cowpea pot and grain yields, respectively compared to 75 and 90 cm spacing.

There were two obvious advantages in the close spacing. First there was early and better canopy formation coupled with higher plant populations for enhanced weed suppression and crop productivity. For example, plant spaced at 60cm had a population of 111, 111 plants/ha compared to 88,888 and 74,074 in the case of 75 and 90cm inter-row spacing respectively. This observation is similar to that of Paica and Albuguergiu (1970); Ismail and Hall (2001), Busman et al. (2002) and Aliyu (2007). In an experiment conducted by Ismail and Hall (2001) on semi-dwarf and standard height cowpea responses to inter-row spacing (15, 76, and 102 cm), it was observed that both the semi dwarf and standard height cowpea produced their greatest yields at the narrowest inter-row spacing of 51 cm.

The increase in pod number and length in the wider-spacing may be the result of availability of better growth resources to the individual plants. Also, narrow spacing might cause mutual shading which may cause floral abscission and pod dropping in the lower canopy strata, however, the narrowest spacing gave the highest pod and grain yields probably due to higher plant population density.

There was significant reduction in weed dry matter production in narrow inter row spacing (Table 7). This could be attributed to faster and better canopy cover of the crop under narrow spacing resulting in better suppression of weeds. Reduction in weed bio-mass due to narrow rows has been reported by Burnside (1979); Burdock et.al. (1986); Adigun et al. (1994); Adigun and Aderibigbe (2011).

Table 4. Effect of period of weed interference and inter-row spacing on crop vigour at early and late seasons

Treatments	Crop Vigour Score			
	Early season		Late season	
	6WAS	9WAS	6WAS	9WAS
Period of Weed Interference				
Initial weed removal for 3WAS	7.44a	7.81a	7.44a	7.97a
Initial weed removal for 6WAS	7.40a	7.76a	7.80a	8.17a
Initial weed removal for 9WAS	-	7.81a	-	8.27a
Initial weed removal for 12WAS	-	-	-	-
Initial weed infestation for 3WAS	7.53a	7.93a	7.83a	8.24a
Initial weed infestation for 6WAS	6.86a	7.49a	6.98b	7.68b
Initial weed infestation for 9WAS	-	7.43a	-	6.38b
Initial weed infestation for 12WAS	-	-	-	-
SE(±)	0.20	0.02	0.21	0.41
	*	*	*	*
Spacing (cm)				
60	7.00	7.73	7.19	7.84
75	6.84	7.49	7.04	7.59
90	6.83	7.49	7.03	7.53
SE(±)	0.05	0.01	0.05	0.03
	NS	NS	NS	NS
Interactions				
Weed x spacing	NS	*	NS	*

WAS – weeks after sowing; *Significant ($p \leq 0.05$); NS – Not significant;

Values with the same alphabets within the same column are not significantly different.

Table 5. Effect of period of weed interference and inter-row spacing on shoot and root dry weight

Treatments	Shoot dry weight (g/plant)		Root dry weight (g/plant)	
	9WAS		9WAS	
	Early	Late	Early	Late
Period of Weed Interference				
Initial weed removal for 3WAS	20.49cde	21.44b	2.48b	3.14b
Initial weed removal for 6WAS	23.61abc	28.77a	3.32a	4.35a
Initial weed removal for 9WAS	23.67abc	29.54a	3.34a	4.35a
Initial weed removal for 12WAS	25.75a	28.86a		
Initial weed infestation for 3WAS	23.84ab	29.50a	3.31a	4.34a
Initial weed infestation for 6WAS	21.36bcd	23.60b	2.37b	3.24b
Initial weed infestation for 9WAS	18.25de	18.67b	2.27b	2.53b
Initial weed infestation for 12WAS	18.06e	18.78b	2.32b	2.55b
SE(±)	2.01	6.65	0.012	0.38
Spacing (cm)				
60	23.26a	25.71	3.12a	3.88a
75	21.64	24.50	2.82ab	3.60ab
90	20.74b	23.71	2.61b	3.38b
SE(±)	0.63	0.68	0.01	0.04
	*	NS	*	*
Interactions				
Weed x spacing	NS	*	*	*

WAS – weeks after sowing; *Significant, NS – Not significant;

- Treatment not completely applied at the time of observation;

Values with the same alphabets within the same column are not significantly different.

3.2 Effect of Period of Weed Interference on Growth and Yield of Cowpea and Weed Dry Matter Production

Weed infestation for only 3 weeks after sowing did not have significant effect on the growth and yield of cowpea growth and yield in both seasons of experimentation. On the other hand, weed removal for only 3 weeks after sowing did not obviate yields loss. This is because weeds during the first 3 WAS were not yet well established and were not aggressive enough in their competitive ability to cause any adverse effect on crop growth and productivity. At this stage weeds with rudimentary root system and few leaves were mostly present and could not cause serious depression on g rowth and yield of the crop. In addition, at the initial stages of crop/growth, both crop and weeds have adequate amount of environmental resources such as light, nutrients and water relative to their individual requirements, hence the crop was not adversely affected. Several workers (Vashney, 1993; Lagoke et al., 1988; Adigun et al., 1991; Adigun et al., 1994; Musa et al., 1996; Naem et al., 2000) have reported that weed infestation for the first 3 WAS did not cause any significant depression in crop growth and yield. In this study, the crop growth parameters mostly affected by initial weed infestation beyond the first three weeks of crop emergence include crop vigour score, canopy diameter, number of leaves, leaf area and shoot and root dry weight (Tables 2 to 6) while the yield and components affected were number of pods per plant and pod and grain yields (Tables 2 to 6). It was observed that plots with initial weed removal for the first 6 WAS and beyond had better growth and yield than those obtained from plot initially weed infested for the same period. This shows that early weed removal is more important than the late weed removal. Adigun (1991) observed that the period between 3 and 6 WAS is particularly critical for weed removal in the wet season due to vigorous weed growth and competition with the crops.

In both seasons, the highest cowpea grain yields of (496 and 595 kg/ha) were obtained from plots with initial weed removal for 9 WAS though these were not significantly different from those obtained with initial weed removal for 6 WAS (475 and 575 kg/ha) and 12 WAS (459 and 578 kg/ha) as well as initial weed infestation for 3 WAS (435 and 584 kg/ha). This shows that initial weed removal for 6 WAS and beyond were not significantly different in terms of cowpea yield produced (Table 6).

Consequently, initial weed removal at 9 WAS and beyond could not appreciably increase cowpea yields. As a matter of fact further weeding beyond 9 WAS could be detrimental to the crop due to damaging effect of the hoe-weeding on crop roots, leaves and branches as well as reproductive parts such as flowers and pods.

On the other hand the highest cowpea yield losses of about 64 to 68% were obtained when crop was infested with weeds up to 9 WAS. Moreover, if the crop was allowed to be infested with weeds beyond 6 WAS, subsequent weeding did not improve the crop yield significantly compared to the crop kept weed-infested throughout its life cycle. Weed infestation throughout the crop life cycle resulted in about 64 to 68% reduction in potential grain yield of cowpea (Table 6). Akobundu (1979) and Le et al. (2004) reported yield losses ranging between 50-86% due to unchecked weed growth throughout the life cycle in cowpea.

Table 6. Effect of period of weed interference and inter-row spacing on seed weight, pod yield and grain yield in early and late season

Treatments	1000-seed Weight (g)		Pod Yield (kg/ha)		Grain Yield (kg/ha)	
	Early	Late	Early	Late	Early	Late
Period of Weed Interference						
Initial weed removal for 3WAS	131.98ab	145.66a	334.73bc	439bc	295.78cd	265.44b
Initial weed removal for 6WAS	133.45a	148.09	665.09a	743.78	474.88a	575.67a
Initial weed removal for 9WAS	132.74a	149.04a	695.46a	795.33a	495.58a	595.22a
Initial weed removal for 12WAS	131.78a	146.98a	640.87a	770.67a	458.45a	578.11a
Initial weed infestation for 3WAS	131.75a	148.95a	589.93a	769.44	434.48ab	584.33a
Initial weed infestation for 6WAS	132.52a	146.75a	454.41bc	500.94b	365.34bc	288.44b
Initial weed infestation for 9WAS	120.79c	130.13b	285.13c	253.78c	161.07d	214.22b
Initial weed infestation for 12WAS	122.99bc	131.51b	237.98c	347.56bc	202.77d	229.11b
SE(±)	1.89	4.30	72.66	125.69	51.68	113.21
	*	*	*	*	*	*
Spacing (cm)						
60	13.42	14.35	672.11a	791.25a	483.40a	527.49a
75	13.48	14.49	546.57ab	620.47ab	386.19a	418.39ab
90	13.50	14.59	342.30b	422.38b	251.05b	336.33b
SE(±)	0.07	0.07	45.88	47.47	24.04	24.03
	NS	NS	*	*	*	*
Interactions						
Weed x spacing	NS	NS	NS	NS	NS	NS

WAS – weeks after sowing.

Values with the same alphabets within the same column are not significantly different.

*Significant ($p \leq 0.05$).

NS – Not significant.

- Treatment not completely applied at the time of observation.

Table 7. Effect of period of weed interference and inter-row spacing on weed dry weight and density in early and late seasons

Treatments	Weed dry weight (t/ha)		Weed density (no/m^2)	
	Early	Late	Early	Late
Period of Weed Interference				
Initial weed removal for 3WAS	5.23b	6.89b	49.33de	77.33b
Initial weed removal for 6WAS	4.64c	4.10c	59.00bcde	76.33b
Initial weed removal for 9WAS	4.50c	4.00c	55.23cde	73.30bc
Initial weed removal for 12WAS	4.63c	3.87c	62.33bcd	54.00d
Initial weed infestation for 3WAS	4.60c	3.77c	47.43e	62.32cd
Initial weed infestation for 6WAS	5.37b	6.90b	84.00a	80.67b
Initial weed infestation for 9WAS	11.29a	14.71a	64.33a	126.33a
Initial weed infestation for 12WAS	11.37a	14.90a	70.33a	124.67a
SE($\pm$)	0.35	1.25a	3.65	7.01
	**	**	*	*
Spacing (cm)				
60	4.94b	7.04	49.25c	74.00c
75	6.49ab	7.31	61.88b	81.88b
90	7.93a	7.49	73.38a	97.25a
SE($\pm$)	0.15	0.06	2.0	2.46
90	**	NS	**	*
SE($\pm$)				
Interactions				
Weed x spacing	*	*	*	*

WAS – weeks after sowing.

Values with the same alphabets within the same column are not significantly different.

*Significant ($p \leq 0.05$).

NS – Not significant.

4. Conclusion

In conclusion, the results obtained from this study showed that the use of inter-row spacing of 60cm resulted in significantly lower weed dry matter production and higher cowpea pod and grain yields than those of 75 and 90cm spacing. Initial weed infestation of up to 3 WAS did not have any adverse effect on crop growth and yield provided weeds are subsequently removed. Similarly, cowpea yield loss was not significantly averted by keeping the crop weed free for only 3WAS without subsequent weed removal. In order to obtain optimum yield similar to the weed free cowpea field, it was required to keep the crop weed free for 6 to 9 WAS. Also, frequent weeding beyond 9WAS could result in reduction in cowpea yield due to mechanical damage of hoe weeding. The practical implication of this finding is that early weeding starting from 3WAS is very crucial in cowpea production and for optimum pod and grain yield the crop requires weed removal between 3 and 9 WAS.

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