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EFFECT OF PHOSPHORUS (P) RATES AND WEEDING FREQUENCY ON THE GROWTH AND GRAIN YIELD OF EXTRA EARLY COWPEA (*VIGNA UNGUICULATA* L. WALP) IN THE FOREST-SAVANNA AGRO-ECOLOGICAL ZONE OF SOUTHWEST NIGERIA

Olusegun R. Adeyemi[1*], Kikelomo O. Ogunsola[1], Patience M. Olorunmaiye[1], Jamiu O. Azeez[2], David O. Hosu[1] and Joseph A. Adigun[1]

[1]Department of Plant Physiology and Crop Production, Federal University of Agriculture, Abeokuta, Nigeria
[2]Department of Soil Science, Federal University of Agriculture, Abeokuta, Nigeria

Abstract: Field experiments were conducted at the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta (7^{o} 20’N, 3^{0} 23’E) during the 2014 early and late cropping seasons to evaluate the effect of weeding frequency and phosphorus fertilizer application on the growth and grain yield of the early maturing cowpea variety (*Vigna unguiculata* L. Walp). The experiment was laid out in a split-plot arrangement fitted into a Randomized Complete Block Design with three replications. The main plot consisted of three phosphorus fertilizer rates (0, 15 and 30 P_2O_5kg ha^{-1}) while the subplot comprised five weeding frequencies (no weeding, weed-free, hoe weeding at 3 weeks after sowing (WAS), hoe weeding at 3 and 6 WAS and weeding at 3, 6 and 9 WAS). The results showed that plots treated with phosphorus fertilizer at 15 kg ha^{-1} produced the highest number of leaves and the tallest plant in the late season while the highest grain yield was recorded in the early trials. Weeding at 3, 6 and 9 WAS during the early season trial gave the highest grain yield compared with other weeding treatments. Unchecked weed infestation reduced yield by 53.10 % and 49.9 % in the early and late seasons respectively compared to the maximum obtained from weed-free plots. This study concluded that application of 15 kg P_2O_5 ha^{-1} and weed removal at 3, 6 and 9 WAS were effective for effective weed control and optimum grain yield in cowpea production.

Key words: cowpea, phosphorus fertilizer, weed biomass, weed infestation, weed species composition.

*Crossponding author: e mail: adeyemior@funaab.edu.ng

Introduction

Cowpea (*Vigna unguiculata* L. Walp) is one of the most important grain legumes in less developed countries of the tropics, particularly Asia and Africa (Mortimore et al., 1997; Van Ek et al., 1997). Cowpea has been reported to be grown on an estimated area of 12.3 million ha in Africa in 2014 with the bulk of production occurring on 10.6 million ha in West Africa, most especially Niger, Nigeria, Burkina Faso, Mali and Senegal (FAOSTAT, 2016). The world's estimated annual cowpea production is put at 5.4 million tonnes with Africa producing 5.2 million (Agro Nigeria, 2015). In 2010, Nigeria produced 2.2 million metric tonnes of cowpea production making it the largest producer and consumer of the crop with estimated yield put at 687 kg ha^{-1} (FMARD, 2011) compared to the mean of 450 kilograms per hectare obtained globally.

Tarawali et al. (2002) have noted that cowpea has a significant role in contributing to food security, income generation and sustainable environment for millions of small-scale farmers who cultivate it in West Africa. The seed is the largest contributor to the overall protein intake of several rural and urban families (Agbogidi, 2010; Kyei-Boahen et al., 2017).

Cowpea fixes atmospheric nitrogen through symbiosis with nodule bacteria (Shiringani and Shimeles, 2011). The seed also contains bioactive antioxidants such as vitamin C, carotenoids and phenolic compounds which represent a crucial group of bioactive elements in foods that prevent the development of diseases such as atherosclerosis and cancer (Omae et al., 2011).

In spite of the great potential for cowpea in Southwest Nigeria, the yield of cowpea obtained by farmers is generally low due to high level of diseases, pest infestation (Adigun et al., 2014), lack of knowledge of good agricultural practices, use of low-yielding varieties coupled with low soil fertility and weed management problems (Adigun et al., 2014; Osipitan, 2017). Yield loss resulting from weed infestation in cowpea is often aggravated by the low level of soil nutrient particularly phosphorus. Weeds could cause yield losses ranging from 40% to 80% in cowpea (Tijani-Eniola, 2001; Li et al., 2004; Osipitan, 2017). Phosphorus plays a vital role in the growth and development of cowpea. Phosphorus deficiency in cowpea has also been reported to affect nodule formation, accumulation of N, seed formation as well as grain filling (Tang et al., 2001).

The timing of weed operation and availability of nutrient facilities in cowpea appear to be very vital in the determining the outcome of the competitive interaction between crop and weed as well as assisting the farmer to reduce the number of weeding on his/her farm, reduce the cost of production and maximize his/her profit. Das (2011) reported that the more abundant the soil nutrient, the less important the weed competition. However, in tropical soils, soils are low in nutrient and competition becomes critical. Moreover, applying fertilizer to improve crop yield will tend to provide maximum benefit unless weeds are properly managed.

Hand weeding is the most common agricultural practice among small-scale cowpea producers. The persistent use of manual weeding by cowpea farmers could be as a result of the high cost of herbicides which may not even be within their reach. Moreover, most farmers have not adequately timed their weed control with the use of fertilizer in cowpea. It should be noted that proper timing of weeding and fertilizer application can modify the weed flora and provide a platform for effective weed control.

Quite a number of research work done on the weed control in cowpea has not really addressed the interaction of P application and weeding frequency in cowpea. Hence, this research work is developed to investigate the growth and yield performance of the early maturing cowpea variety (IT97k-568-18) as influenced by the application of P fertilizer and weeding regime.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta (Latitude 7^0 15^IN, Longitude 3^0 25^IE) in Southwest Nigeria during the early (April–July) and late (September–November) cropping seasons of 2014. The plot was cropped with maize in the previous season. The soil was sandy loam in texture with (84.4 g kg-1, 89.4g kg-1) sand, (4.8 kg-1, 5.8g kg-1) clay and (6.8 kg-1, 4.8g kg-1) silt particles in the early and late seasons respectively. The soil pH was moderate ranging between 6.65 and 5.65. However, the soil was very low in organic carbon (1.00% and 0.82%) and thus low in organic matter content and total nitrogen (0.08% and 0.10). Exchangeable potassium (0.23 cmol kg-1 and 0.17cmol kg-1) and available phosphorus (Bray -1 P) of the soil were low (6.02ppm and 8.75ppm). Exchangeable magnesium was low (0.90 cmol kg^{-1} and 0.71cmolkg^{-1}), however exchangeable calcium was high (8.31 cmol kg^{-1} and 5.12 c mol kg^{-1}).The climate of the study area is of the sub-humid type with the total amount of rainfall of 466.9 and 246 mm in the early and late seasons of 2014 respectively. The mean temperature was 26.75^{o}C and 26.97^{o}C in the early and late seasons respectively.

The early maturing cowpea variety (IT97k-568-18) used was sourced from the International Institute of Tropical Agriculture Ibadan, Oyo State, Nigeria. The experiment was a split-plot fitted into a Randomized Complete Block Design (RCBD) with three replicates, given a total number of 45 experimental units. The treatment consisted of the main plot of phosphorus rates at three levels: 0, 15 and 30kg P_2O_5 ha^{-1} and the subplot of five weeding frequencies (weedy check, weed-free, weeding once at 3 weeks after sowing (WAS), weeding twice at 3 and 6 WAS and weeding thrice at 3, 6 and 9 WAS). Weedy- check in this study implies leaving the plot weed-infested throughout the crop life cycle (that is no weeding was applied) while weed-free was achieved by weeding the plot every week.

The experimental site in each crop cycle was ploughed and harrowed at the two-week interval and the land was marked out into various plots each measuring 5 m x 4 m. Three seeds of the cowpea variety (Var. IT97K-568-18) treated with CIBAPLUS were dibbled into the soil at a depth of 3–5 cm on the 18th of April 2014 for the early-season cowpea while the late-season crop was sown on the 5th of September 2014. The seeds were sown at a spacing of 50 cm x 20 cm (Dugje et al., 2009) and were thinned to 2 plants per stand two weeks after sowing (WAS). The seeds were sown at inter-row spacing of 50 cm and intra-row spacing of 20 cm between and within ridges respectively, representing 200,000 plants ha^{-1}. Hoe weeding was carried out according to the treatment structure using a West African hand hoe (a local farm tool that is used for weeding, ridging and heaping). Application of Cypermethrin plus Dimethoate was done every ten days beginning from 14 days after planting to control insects using a CP3 knapsack sprayer with a green deflector nozzle at a pressure of 2.1kg/cm^2. Also, Mancozeb 80WP (fungicide) was applied at 4 WAS to prevent fungal diseases. Both the insecticide and the fungicide were applied at the rate of 0.6 L/ha. Harvesting of the early-season cowpea started on the 21st of June 2014 while harvesting of the late-season cowpea started on the 8th of November 2014.

Data were collected on plant height (cm), number of leaves/plant, leaf area (cm^2), number of days to 50% flowering, days to 50% podding, dry pod weight (kg/ha), number of seeds per pod, 100-grain weight of cowpea, grain yield of cowpea (kg ha^{-1}) and weed dry matter production. The data collected were subjected to analysis of variance (ANOVA) and significant means were separated using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Weed-crop competition can be influenced by the time of weed removal and soil fertility maintenance. Generally, weeds have higher nutrient and water use efficiency, therefore a realistic weed management procedure and enhancement of the soil nutrient status will go a long way in enhancing the completive ability of the crop against weeds. The most noticeable significance of weed competition in crops is a reduction in the economic yield of the affected crop (Alagbejo, 1987; Dadari, 2003). The results of this study showed that application of fertilizer levels and weeding frequencies on cowpea influenced growth, yield and yield components, pod weight and the number of seed per pod as well as weed biomass and flora composition.

Effect of phosphorus fertilizer application and weeding frequencies on the growth and development of cowpea

Effects of phosphorus fertilizer rates and weeding frequencies on plant height and number of leaves of cowpea during the 2014 early and late cropping seasons are presented in Table 1. It was observed that application of phosphorus fertilizer had no significant effect on plant height at 3, 6 and 9 WAS during the early cropping season and at 3 WAS during the late cropping season (Table 1). However, plant height significantly differed from one another during the late season at 6 and 9 WAS, where the application of 15 and 30 kg P_2O_5 ha^{-1} respectively gave similar and higher values compared with plots without phosphorus application. The effect of weeding frequencies was not significant on cowpea plant height in both cropping seasons. With respect to the cowpea number of leaves, a significant effect of phosphorus fertilizer application was observed only at 6 WAS during the late cropping season. Cowpea plants on plots treated with 15 and 30 kg P_2O_5 ha^{-1} produced higher number of leaves than those plants on unfertilized plots. The effect of weeding frequencies was significant on the number of leaves at 6 and 9 WAS in the early cropping season and 9 WAS in the late cropping season. In both cases, all the weeding frequencies produced a significantly similar number of leaves compared with weedy check plots where reduced values were obtained. Interactions of phosphorus fertilizer rates and weeding frequencies were not significant on cowpea plant height and number of leaves at the various weeks of observation (Table 1). As presented in Table 2, cowpea responded to fertilizer application with respect to the leaf area at 6 WAS, but no significant effect was observed at 3 and 9 WAS. At 6 WAS cowpea plants on plots applied with 15 and 30 kg P_2O_5 ha^{-1} had similar leaf area but significantly higher values than the control (0 kg P_2O_5 ha^{-1}. Weeding frequencies did not show any significant effect on the leaf area except at 6 and 9 WAS in the late season. Maximum and comparable leaf areas were recorded on the weed-free plots and the plots weeded at 3, 6 and 9 WAS at 6 and 9 WAS in the late season (Table 2). The increase in plant height and leaf production observed as a result of fertilizer application during the late season trial at 6 and 9 WAS could be attributed to the fact that the crop was able to utilize the residual nutrient in the soil. Furthermore, the higher number of leaves and leaf area could have allowed the greater reception of light which encouraged the photosynthetic process of the plants required for pod filling and improved yield. Similar findings have been reported by Muleba and Ezumah (1985) and Singh et al. (2011).

Table 1. Effects of weeding frequency and phosphorus fertilizer rates on plant height and number of leaves during the early and late wet seasons of 2014.

Treatments	Plant height (cm)					
	3 WAS		6 WAS		9 WAS	
	Early	Late	Early	Late	Early	Late
Fertilizer (F) (kg/ha)						
0	12.47	14.20	65.80	40.80b	96.10	81.40b
15	11.51	15.23	64.61	47.33a	95.00	96.47a
30	10.99	14.79	64.05	50.32a	95.00	95.38a
S.E (±)	0.59*	0.83	3.98	2.30**	4.01	5.28*
P < 0.05	0.022	0.182	0.955	0.006	0.913	0.028
Weeding frequency (W)						
Weedy check	11.87	15.3	64.82	44.19	95.2	100.77
Weed-free	11.56	15.56	65.04	49.92	95.2	90.69
Weeding at 3 WAS	11.70	14.01	66.84	48.49	97.3	85.42
Weeding at 3 and 6 WAS	11.76	13.67	61.96	43.17	92.3	87.24
Weeding at 3, 6 and 9 WAS	11.38	15.17	65.44	44.98	96.6	91.30
S.E (±)	0.76	1.07	5.14	2.97	5.17	6.82
P < 0.05	0.922	0.360	0.824	0.386	0.797	0.139
Fertilizer × Weeding frequency						
S.E (±)	1.32	1.85	8.91	5.15	8.96	11.80
P > 0.05	0.973	0.650	0.581	0.561	0.670	0.596

Table 1. Continued.

Treatments	Number of leaves (no./plant)					
	3 WAS		6 WAS		9 WAS	
	Early	Late	Early	Late	Early	Late
Fertilizer (F) (kg/ha)						
0	9.25	5.87	28.97	22.57b	50.69	33.47
15	9.03	5.87	28.39	28.45a	49.75	39.61
30	8.85	6.03	32.36	26.72a	57.87	40.52
S.E (±)	0.40	0.18	1.76	1.73*	3.61*	3.04*
P < 0.05	0.690	0.670	0.035	0.030	0.039	0.039
Weeding frequency (W)						
Weedy check	9.07	6.16	19.22b	23.56	31.38b	29.98b
Weed-free	9.31	6.07	33.98a	26.51	60.64a	42.53a
Weeding at 3 WAS	9.07	5.82	33.36a	26.16	59.64a	39.16a
Weeding at 3 and 6 WAS	8.89	5.64	31.44a	26.84	56.00a	38.11a
Weeding at 3, 6 and 9 WAS	8.89	5.96	31.53a	26.51	56.18a	39.56a
S.E (±)	0.58	0.24	2.27**	2.24	4.67**	3.92*
P < 0.05	0.979	0.233	0.001	0.492	0.001	0.034
Fertilizer × Weeding frequency						
S.E (±)	0.10	5.87	3.93	3.87	8.08	6.80
P > 0.05	0.526	0.724	0.488	0.530	0.621	0.128

WAS = Weeks after sowing, S.E = Standard error, p> 0.05= Not significant, *= Significant at p < 0.05, **= Highly significant at p< 0.01. Means followed by the different letter(s) within the same column and treatments are significantly different at 5% level of probability (DMRT).

Table 2. Effects of phosphorus fertilizer rates and weeding frequency on leaf area during the early and late wet seasons of 2014.

Treatments	Leaf area (cm^2)					
	3 WAS		6 WAS		9 WAS	
	Early	Late	Early	Late	Early	Late
Fertilizer (F) (Kg/ha)						
0	20.70	9.20	38.30b	41.80b	58.28	30.20
15	18.30	10.20	45.70a	45.50a	56.49	34.40
30	22.50	12.30	49.60a	47.20a	61.42	33.20
S.E (±)	2.31ns	2.23ns	2.58**	1.69*	2.38	2.06
P < 0.05	0.163	0.265	0.001	0.050	0.163	0.068
Weeding frequency (W)						
Weedy check	20.60	11.4	39.10	41.50b	59.19	24.8c
Weed-free	22.00	11.90	43.30	47.30a	59.14	35.3ab
Weeding at 3 WAS	19.50	11.60	46.60	45.70ab	57.85	30.9b
Weeding at 3 and 6 WAS	19.10	8.00	48.10	42.20b	57.36	36.7a
Weeding at 3, 6 and 9 WAS	21.40	10.10	45.60	47.50a	60.10	35.3ab
S.E (±)	2.98	2.88	3.90	2.19*	3.07	2.27**
P < 0.05	0.781	0.479	0.057	0.05	0.781	0.001
Fertilizer × Weeding frequency						
S.E (±)	5.17	4.98	6.76	4.44	5.32	4.60
P > 0.05	0.330	0.196	0.176	0.902	0.330	0.100

Fertilizer rates significantly affected the number of days to 50% flowering during the early and late cropping seasons. A delayed number of days to 50% flowering was observed in both seasons when phosphorus fertilizer was increased from 15 kg P_2O_5 ha^{-1} to 30 kg P_2O_5 ha^{-1} compared to no fertilizer treated plots (Table 3). However, weeding frequencies did not have a significant effect on days to 50% flowering and days to 50% podding in the early and late cropping seasons (Table 3).

Effects of phosphorus fertilizer application and weeding frequencies on cowpea yield and yield components

Cowpea pod and grain yield were significantly affected by fertilizer rates in the early season but not in the late season (Table 4). Application of 15 kg P_2O_5 ha^{-1} gave pod and grain yields in the early season which were very similar to the maximum values obtained from plots treated with 30 kg P_2O_5 ha^{-1} (Table 4). However, there were no significant effects of phosphorus fertilizer on the number of seeds per pod and 100-grain weight in both early and late season trials. Weeding frequencies significantly affected cowpea pod yield in early and late seasons (Table 4). Weeding at 3, 6 and 9 WAS gave significantly higher pod yield but similar to the weed-free in the early season. In the late season, though weeding thrice ranked highest with respect to pod yield, it was not significantly different from the weed-free, weeding once and weeding twice (Table 4). In the same vein, weeding at 3, 6 and 9 WAS gave the maximum and comparable grain yield and comparable values with weed-free plots. There was no significant interaction between fertilizer rate and weeding frequency on pod yield, number of seeds/pods, 100-grain weight and grain yield.

Table 3. Effects of phosphorus fertilizer rates and weeding frequency on the number of days to 50% flowering and numbers of days to 50% podding during the early and late wet seasons of 2014.

Treatments	Number of days to 50% flowering		Number of days to 50 % podding	
	Early	Late	Early	Late
Fertilizer (F) (kg/ha)				
0	43b	43b	52.67	52.67
15	45ab	43b	52.80	52.73
30	46a	44a	52.07	53.00
S.E (±)	0.20*	0.10*	0.37	0.10
P < 0.05	0.048	0.031	0.135	0.031
Weeding frequency (W)				
Weedy check	44	44	52.11	52.78
Weed-free	45	44	53.00	52.78
Weeding at 3 WAS	45	44	52.56	52.78
Weeding at 3 and 6 WAS	44	44	52.44	52.78
Weeding at 3, 6 and 9 WAS	45	44	52.44	52.89
S.E (±)	0.36	0.82	0.48	0.21
P < 0.05	0.482	0.815	0.801	0.816
Fertilizer × Weeding frequency				
S.E (±)	0.63	1.42	0.83	0.37
P > 0.05	0.924	0.923	0.780	0.923

The highest grain yield and yield characters such as pod yield recorded by the application of 30 kg P ha^{-1}could be attributed to the fact that cowpea responded to the application of phosphorus fertilizer. Similar research findings have been obtained by Okeleye and Okelana (1997) and Majeed et al. (2001). Reduction in cowpea yield in the early season compared to that of the late season could be attributed to the rainfall pattern during the period, which was higher than the one in the late season. This is in agreement with the report of Coulibaly and Lowenberg-DeBoer (2002), who documented that cowpea performed well in agro-ecological zones where rainfall distribution ranges between 500 mm and 1,200 mm/year. Therefore, the higher values recorded for yield and yield components of cowpea in the late season than early season could be attributed to the fact that rainfall during the growing period (September to November) was adequate and optimum in the late season. However, in the early season, excessive rainfall aggravated the preponderance of pest and diseases. This study, hence, showed that timely weed removal is important in cowpea production. Adigun et al. (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. It is also worth noting that weed-free plot recorded lower grain yield than the plants on the plots weeded at 3, 6 and 9 WAP in the early season. Flower abortion and destruction of the crop roots at the time of weeding could have accounted for this lower yield in the weed-free plot. In the late season, on the contrary, weeding regimes irrespective of the time of weed removal gave similar effects on the grain yield.

Table 4. Effects of phosphorus fertilizer rates and weeding frequency on pod yield, number of seeds/pods, 100 grain weight and grain yield in the early and late wet seasons of 2014.

Treatments	Pod yield (kg/ha)		Number of seeds/pod		100-grain weight (g)		Grain yield (kg/ha)	
	Early	Late	Early	Late	Early	Late	Early	Late
Fertilizer (F) kg/ha								
0	608.4b	884.22	12.03	14.35	13.60	16.80	405.60b	646.30
15	811.3a	918.59	11.93	13.25	13.93	17.60	622.00a	659.33
30	755.3a	1089.19	12.33	13.77	14.13	17.80	585.60a	797.26
S.E (±)	68.65*	116.77	0.28	0.63	0.37	0.53	59.50*	96.41
$P \leq 0.05$	0.020	0.414	0.255	0.570	0.234	0.601	0.029	0.114
Weeding frequency (W)								
Weedy check	531.50c	543.80b	12.20	13.23	14.22	17.00	361.10d	416.00b
Weed-free	820.40ab	1131.40a	12.28	14.06	14.00	18.56	610.50b	830.50a
Weeding at 3 WAS	709.30bc	1043.20a	11.59	13.37	14.22	16.56	528.60bc	715.30a
Weeding at 3 and 6 WAS	621.00c	1013.60a	12.16	13.42	13.56	17.11	417.50cd	736.50a
Weeding at 3, 6 and 9 WAS	943.10a	1088.00a	12.27	14.87	13.56	17.78	770.90a	806.40a
S.E (±)	88.63*	150.75*	0.36	0.82	0.47	0.68	76.80**	124.47**
$P \leq 0.05$	0.002	0.002	0.237	0.274	0.373	0.294	0.012	0.001
Fertilizer ×Weeding frequency								
S.E (±)	153.51	261.10	0.63	1.42	0.82	1.18	132.90	215.59
$P > 0.05$	0.603	0.365	0.392	0.331	0.893	0.410	0.700	0.480

Uncontrolled weed infestation throughout the crop life cycle in this study resulted in about 50% to 53% reduction in potential grain yield of cowpea. The significantly high percentage yield reduction could be attributed to the fact that the cowpea crop is sensitive to weed competition, especially in Nigerian savanna agroecological zones as indicated by Magani (1990). Moreover, the field was highly infested with broadleaf weeds such as *Tridax procumbens, Phyllanthus amarus* and these weeds are known to compete adversely with the cowpea crop. This finding was in conformity with the report of Li et al. (2004), who stated that yield losses ranging between 50% and 86% could occur due to unchecked weed growth throughout the life cycle in cowpea. It is, thus, become imperative that early weeding should be done to guarantee a higher yield in cowpea. Adigun et al. (2014) have observed 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 Southwest Nigeria.

Effects of phosphorus fertilizer rates and weeding frequency on weed dry matter production

In the early and late seasons, the fertilizer rates did not have a significant effect on weed biomass throughout the weeks of observation except at 6 WAS during the late-season trial (Table 5).

Table 5. Effects of phosphorus fertilizer rates and weeding frequency on weed dry weight during early and late wet seasons of 2014.

Treatments	Weed dry weight (kg/ha)			
	6 WAS		9 WAS	
	Early	Late	Early	Late
Fertilizer (kg/ha)				
0	641.95	284.60ab	1284.83	390.77
15	297.58	429.10a	595.17	276.03
30	471.74	154.30b	943.65	388.43
S.E (±)	179.60	103.31*	359.18	172.33
P ≤ 0.05	0.222	0.043	0.222	0.630
Weeding frequency (W)				
Weedy check	1492.20a	912.70a	2984.50a	1064.10a
Weed-free	57.40b	79.20b	116.20b	157.40b
Weeding at 3 WAS	335.20b	66.30b	670.30b	198.40b
Weeding at 3 and 6 WAS	287.60b	222.00b	575.20b	242.70b
Weeding at 3, 6 and 9 WAS	179.70b	169.60b	359.90b	96.20b
S.E (±)	231.87**	133.37**	463.71**	222.48**
P ≤ 0.05	0.001	0.001	0.001	0.003
Fertilizer × Weeding frequency				
SE (±)	401.61	231.01	803.17	385.35
P > 0.05	0.796	0.076	0.795	0.614

In the late-season trial, fertilizer application significantly affected weed dry matter with the application of 15 kg P_2O_5 ha^{-1} giving the highest weed dry matter which was similar to the value obtained with no fertilizer application. Application of 30 kg P_2O_5 ha^{-1} gave the least dry matter production. Weed dry matter was significantly reduced by 77.6, 80.7 and 87.9% when weeding was carried out once at 3 WAS, twice at 3 and 6 WAS and thrice at 3, 6 and 9 WAS respectively. In the late season, on the other hand, weed dry matter was reduced by 81.4, 77.2 and 90.9 % in the plot weeded at 3 WAS, 3 and 6 WAS and 3, 6 and 9 WAS respectively

(Table 5). Higher weed biomass was recorded during the late season trial at 6 WAS when the plots were treated with 15 kg P_2O_5 ha^{-1} High weed relative density of *Cyperus esculentus* (12.29%), *Dactylotenum aegyptium* (13.65%), *Digitaria horizontalis* (21.84%) and *Kyling abulbosa* (8.19 %) observed on these plots at the early stage of crop growth at the second peak of rain in the ecology could have accounted for the increased weed biomass. These weed species were known to have higher competitive ability than field crops in the rainforest and savanna ecology (Adeyemi et al., 2008).

Conclusion

Application of phosphorus fertilizer at 15 kg P_2O_5 ha^{-1} and weed removal at 3 and 6 weeks after planting in the late season are appropriate and adequate for cowpea production in the forest-savannah transitional zone of Southwest Nigeria. Hoe weeding at 3, 6, and 9 WAS significantly ($p < 0.05$) reduced weed biomass by 85% compared to control plots while application of 15 kg P_2O_5 ha^{-1} increased grain yield by 34.8 and 30.7 % in early and late seasons, respectively. The use of phosphorus fertilizer and timely weed removal are, thus, a *sine qua non* in promoting weed control effectiveness in cowpea and improving grain yield.

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UTICAJ KOLIČINA FOSFORA (P) I UČESTALOSTI PLEVLJENJA NA RAST I PRINOS ZRNA VRLO RANE VIGNE (*VIGNA UNGUICULATA* L. WALP) U ŠUMSKO-SAVANSKOJ AGRO-EKOLOŠKOJ ZONI JUGOZAPADNE NIGERIJE

Olusegun R. Adeyemi[1*], Kikelomo O. Ogunsola[1], Patience M. Olorunmaiye[1], Jamiu O. Azeez[2], David O. Hosu[1] i Joseph A. Adigun[1]

[1]Odsek za biljnu fiziologiju i ratarstvo, Federalni poljoprivredni, Univerzitet Abeokuta, Nigerija
[2]Odsek za nauke o zemljištu, Federalni poljoprivredni, Univerzitet Abeokuta, Nigerija

R e z i m e

Poljski ogledi su sprovedeni na Nastavno-istraživačkom imanju Federalnog poljoprivrednog univerziteta u Abeokuti (7^o 20’N, 3^0 23’E) tokom 2014. rane i kasne sezone gajenja (dve sezone), kako bi se procenio uticaj učestalosti plevljenja i primene fosfornog đubriva na rast i prinos zrna rane sorte vigne (*Vigna unguiculata* L. Walp). Ogled je postavljen po rasporedu podeljenih parcela uklopljenom u potpuno slučajni blok dizajn sa tri ponavljanja. Glavna parcela se sastojala od tri količine fosfornog đubriva (0, 15 i 30 P_2O_5kg ha^{-1}) dok je potparcela obuhvatala pet učestalosti plevljenja (bez plevljenja, održavanje parcele čistom plevljenjem motikom 3 nedelje posle setve, plevljenje motikom 3 i 6 nedelja posle setve i plevljenje 3, 6 i 9 nedelja posle setve). Rezultati su pokazali da su biljke gajene na parceli tretirane fosfornim đubrivom od 15 kg ha^{-1} proizvele najveći broj listova i najveću visinu biljke u kasnoj sezoni, dok je najviši prinos zrna zabeležen kod gajenja vigne u ranoj sezoni. Plevljenje 3, 6 i 9 nedelja posle setve tokom ispitivanja u ranoj sezoni dalo je najviši prinos zrna u poređenju sa ostalim tretmanima plevljenja. Na parcelama na kojima nije primenjivana mera kontrole korova smanjen je prinos za 53,10% i 49,9% u ranoj odnosno kasnoj sezoni u poređenju sa maksimalnim prinosom dobijenim sa parcela bez korova. Ovim istraživanjem se zaključuje da su primena đubriva od 15 kg P_2O_5 ha^{-1} i mehaničko suzbijanje korova 3, 6 i 9 nedelja posle setve najefikasnije mere kontrole korova i dobijanja optimalnih prinosa zrna u proizvodnji vigne.

Ključne reči: vigna, fosforno đubrivo, biomasa korova, zakorovljenost, sastav korovskih vrsta.

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*Autor za kontakt: e mail: adeyemior@funaab.edu.ng