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Responses of Cowpea to Phosphorous Application Rates and Row Spacing in the Sudan Savanna Zone of Nigeria

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ABSTRACT

Field trials were conducted to evaluate the effects of rates of **Phosphorus** fertilizer and intra-row spacings on growth and yield of Cowpea (*Vigna unguiculata* (L.) Walp) in the Sudan Savana zone of Nigeria, during 2018 cropping season at Mohammet Lawan college of Agriculture, Maiduguri (11^{0}50' N, 13^0 10' E, altitude 354 above sea level, altitude 354 above sea level. The experiment consisted of five (5) **Phosphorus** rates (0, 20, 40, 50 and 60 kg Pha^{-1}) and five (5) intra-row spacings (15, 20, 25 30 and 35cm). The treatments were arranged in a split plot design and replicated three times at each site. **Phosphorus** rates were assigned to the main plot and intra-row spacings in the sub-plot. The objective was to determine the optimum rate of phosphorus fertilizer that will increase yield performance of cowpea in Sudan savanna zone of Nigeria and determine the most suitable intra-row spacing that will increase yield of cowpea in Sudan Savanna of Nigeria. Data were collected on plant height, number of leaves per plant, days to 50% flowering, number of grain per pod, 100 grain weight, grain yield per hectare and fodder yield per plant respectively.

Application of P fertilizer significantly influenced most of the growth and yield characters as well as the yield. Grain yield per hectare were optimum at 50kg Pha^{-1} Contrary to above finding, number of grain per pod and 1000-grain were all not influenced by the application of P fertilizer and intra-row spacing.

Keywords : Phosphorous. Row Spacing

I. INTRODUCTION

Cowpea (*Vignaunguiculata* (L.) Walp) belongs to the family Leguminosae which is second only to Poaceae in terms of nutrition to man (Balder *et al*., 1988). It is an herbaceous annual crop commonly referred to as bean, black-eye pea, kafir pea, southern pea, china pea, marble pea, lubia, niebe, coupe or frijole (Olowe, 1978;

Blackhurst and Miller, 1980). It also includes vegetable types of such as yard long bean and asparagus.

Cowpea is an important grain legume in the dry savanna of the tropics covering 12.5 million hectares with annual productions of 3.3 million tons (FAO, 2005). Nigeria is the world's largest producer with 2.1 million tons followed by Niger with 650,000 tons and Mali with 110,000 tons (IITA 2003). Cowpea originated in Africa and it became an integral part of traditional cropping system throughout Africa, particularly in the semi-arid region of west Africa savanna. Cowpea is a dicotyledonous belonging to the family Fabaceae. Cowpea is a global legume of Africa origin. Davies *et al*. (2005) and Jeferson (2005) attested that cowpea is an ancient crop whose cultivation began in Africa between 5000 and 6000 years ago. Cowpea moved to Asia much earlier than America, but it has been entrenched in the cropping systems of both continents, even if it is less important than in Africa (Ng and Marechal, 1985). Today, the crop is widely grown across continents of the world. Some 8 million hectares of cowpea are grown in west and central Africa, especially in Burkina Faso, Mali, Niger, Nigeria and Senegal. Out of an area of about 12 million hectares under cowpea production in sub-Saharan Africa, Nigeria accounts for 4.3 million ha (36%) producing over 2.4 million tons (60% of the world total) annually (www.fao.org). The first written reference of the word 'cowpea' appeared in 1798 in the United States. The name was most likely acquired due to their use as a fodder crop for cows. Cowpea is adapted to warm weather and requires less rainfall than most crops; therefore, it is primarily cultivated in the semi-arid regions of low land tropics and subtropics, where soils are poor and rainfall is limited. The crop can be harvested in three stages while the pods are young and green, mature and green and dry. The grain yield potential and availability of good quality fodder in cowpea is limited by several factors. In Nigeria, millions of rural and urban consumers derive food, animal feed, and an inexpensive source of protein from cowpea. Cowpea grain contains about 25% protein and 64% carbohydrate (Bressani, 1985) and therefore has a tremendous potential to contribute to the alleviation of malnutrition among resource poor populace. The young leaves and immature pods are eaten as vegetables. There is a big market for the sale of cowpea grain and fodder in West Africa. In Nigeria, farmers who cut and store cowpea fodder for sale at the peak of annual income by 25% (Dugje *et al*., 2009). Cowpea also plays an important role in providing soil nitrogen to cereal crops (such as maize, millet, and sorghum) when grown in rotation, especially in areas where poor soil fertility is a problem. It does not require a high rate of nitrogen fertilization; its roots have nodules in which soil bacteria called Rhizobia inhabit and help to fix nitrogen from the air into the soil in the form of nitrates (Sheahan, 2012). Cowpea is generally grown as the under storey crop in a system based on cereals or tuber crops. Cowpea is useful because it establishes rapidly, and this result in less soil erosion, a reduction in soil temperature, and lower weed pressure (Zuofa *et al*., 1992). Cowpea is drought hardy, and it is able to maintain some growth or at least survive under dry soils condition and this trait is in part explained by the deep rooting habit of some varieties. Magani and Kuchinda (2009), reported that for economic growth and yield, cowpea required 37.5kg/ha of phosphorus in northern guinea savanna agro-ecological zone of Nigeria. Phosphorus plays an important role in the maturity of the crop, root development, photosynthesis, nitrogen fixation and other vital physiological processes. Maximum yield of a particular crop in a given environment can be obtained at spacing where competition among the plants is minimal. Ahmed and Abdelrhim (2010) observe that this can be achieved with optimum spacing which not only utilize soil moisture and nutrients mare effectively but also avoid excessive competition among the plants. However, beyond certain limit yield cannot be increased with decreasing/increasing row spacing. Hence, optimum spacing induces the plant to achieve its potential yield.

II. Materials and Methods

Field trial were conducted during 2018 rainy season at Mohammet lawan college of Agriculture of Borno State, in the Sudan Savanna Zone of Nigeria. The treatments consist of factorial combinations of five levels of phosphorus rates (0, 20, 30, 40, and 50 kg/ha) and five intra-row spacings (15, 20, 25, 30 and 35cm) laid in Split plot design and replicated three times. The cowpea variety IT99K-573-2-1 were obtained from (BOSADP) Borno state, Nigeria, and used for the experiment. It is improved to medium maturing and semi-determinate variety which mature within 75-80 days which consist of medium seed size, with rough and white seed colour.

Data collection:

Data for growth and yield and yield component were collected as per procedure mention as follows: plant height, number of leaves per plant, days to 50% flowering, number of grain per pod, 100-grain weight and grain yield per hectare

Data analysis:

Data collected was subjected to Analysis of variance (ANOVA) and differences between means will be identified using Duncan Multiple Range Test (DMRT)at 5% level respectively as reported by Gomez and Gomez (1984).

III. Results and Discussions

Table 1 shows the effects of Phosphorus (P) fertilizer rates and spacing on growth parameters of Cowpea, the findings reveals that significant increase in plant height was observed at all the sampling period at all the P rates applied except when 20 and 0kg P/ha at 4WAS and 0kgP/ha at all the sampling period which recorded the shortest plant height respectively. This result agrees with the findings of Magani and Kuchinda (2009) in assessing effect of Phosphorous fertilizer on growth and yield of cowpea in Nigeria, who reported that plant height increased with increasing level of P compared with control (check). Similarly, increasing row spacing significantly increase plant height at all the sampling period except at narrow spacing of 10cm at 4 and 8WAS, and at 12WAS wider row spacing of 35cm gave the tallest plant height compared with the other treatments. The tallest plant height obtained may be attributed to the less competition among individual plant for large space available at 35 cm intra row spacing that ultimately eliminate intra plant competition for resource required for growth and development.

Similarly, the effect of Phosphorous rates and intra-row spacings on number of leaves per plant of cowpea crop. Application of P fertilizer significantly influenced number of leaves at all the P rates applied at all the sampling periods except when no P was applied which gave the least number of leaves. This agrees with the findings of Rajput (1994) reported significant effect of phosphorus on number of leaves per plant particularly at 50kg/ha.

The use of different levels of intra- row spacing had significant effect on number of leaves at all the sampling period, each increase in intra-row spacing from 25 – 35 cm had resulted in a corresponding increase in number of leaves per plant at all the sampling periods but the difference in number of leaves between plant spaced 15 and 20 cm was not significant.

Table 1: Effect of rates of Phosphorous fertilizer and row spacings on growth parameters of cowpea during 2018 cropping season at Maiduguri

Treatments	**Plant height (cm) (Weeks after Sowing)**			**Number of leaves per plant (Weeks after sowing)**		
P rates (kg/ha)	4	8	12	4	8	12
0	24.09^{c}	30.00^{b}	36.82^{b}	26.26^{b}	33.37^{b}	50.60^{b}
20	30.65^{bc}	44.05^{a}	41.12 ^{ab}	33.68^{ab}	40.64^{ab}	60.93^{ab}
30	31.77^{ab}	44.17^{a}	50.44^{a}	37.53^{a}	42.88^{ab}	59.53^{ab}
40	33.05^{ab}	44.74^{a}	45.09^{ab}	36.21^{a}	36.28^{ab}	54.25^{ab}
50	37.63^{a}	42.62^{a}	43.63^{ab}	40.34^{a}	44.25^{a}	64.94^{a}
SE ±	6.85	12.04	10.10	7.48	10.52	12.85
Spacing (cm)						
15	31.49^{c}	32.53^{b}	43.68^{b}	30.51^{b}	34.00^{c}	53.48^{b}
20	31.68^{a}	38.42^{a}	39.00^{b}	33.76^{ab}	34.85^{bc}	52.12^{b}
25	32.14^{a}	38.21^{a}	41.25^{b}	34.89^{ab}	42.37^{ab}	57.02^{ab}
30	32.50^{a}	47.00^{a}	38.29^{b}	37.29^{a}	42.17 ^{ab}	61.77^{ab}
35	29.37^{a}	44.42^{a}	54.28^{a}	37.58^{a}	44.02^{a}	65.86^{a}
SE ±	4.62	10.75	9.72	4.74	8.04	11.64

Means followed by the same letters within a column are not significantly different according to Duncan Multiple Range Test (DMRT) at 5% level of probability

The effect of P fertilizer and intra-row spacing on yield and yield component of cowpea is presented in Table 2. The response of days to 50% flowering, number of grains per pod and 100- grain weight of cowpea to rates of Phosphorous fertilizer and intra-row spacing was not significantly influenced by the application of P fertilizer and Intra-row spacing. However, grain yield per hectare reveals that application of 20 -50kg P/ha had significantly increases yield as compared to control (0kgP/ha). At all the intra-row spacing tested produced statistically follows similar trend in grain yield. Application of phosphorus has been reported by several authors to improve yield of cowpea by enhancing number of pods per plant, number of seeds per pod and mean seed weight (Singh *et al,* 2011, Owolade *et al*, 2006; Rajput, 1994).

Table 2: Effect of rates of Phosphorous fertilizer and row spacing's on yield and yield component of cowpea during 2018 cropping season at Maiduguri

Treatments	Days to 50% flowering	Number of grain per pod	100-grain weight(g)	Grain yield per hectare (kg/ha)	Fodder yield (kg/ha)
P rates (kg/ha)					
0	46.33^{ab}	7.46^{a}	17.58^{a}	508.62^{b}	197.15^{b}
20	45.93^{ab}	8.46^{a}	18.61^{a}	728.55^{ab}	329.19^{ab}
30	45.00^{b}	7.48^{a}	18.82^{a}	759.69^{ab}	312.48^{ab}
40	47.33^{a}	7.66^{a}	18.98^{a}	829.93^{a}	293.02^{ab}
50	45.66^{ab}	7.19^{a}	18.71^{a}	870.66^{a}	338.14^{a}
SE ±	2.28	1.48	1.34	311.94	134.53
Spacing (cm)					
15	45.66^{ab}	7.49^{a}	18.27^{a}	703.69^{a}	267.93^{a}
20	46.53^{ab}	7.68^{a}	18.67^{a}	708.55^{a}	290.27^{a}
25	46.13^{ab}	8.16^{a}	18.66^{a}	715.09^{a}	282.05^{a}
30	46.93^{a}	7.36^{a}	18.38^{a}	770.85^{a}	304.43^{a}
35	45.00^{ab}	7.57^{a}	18.52^{a}	799.26^{a}	326.41^{a}
SE ±	1.83	1.24	0.95	205.39	84.40

Means followed by the same letters within a column are not significantly different according to Duncan Multiple Range Test (DMRT) at 5% level of probability

IV. CONCLUSION AND RECOMMENDATIONS

Based on the results obtained in this study, it can be concluded that application of 50 kg P ha-1 at wider intra-row spacing of 35 cm gave the optimum grain yield per hectare of cowpea, in Sudan savanna zone of Nigeria is found to be more promising.

From the study, it could be recommended that farmers should be advised to apply 50 kg P ha-1 and use wider intra-row spacing of 35 cm for optimum Cowpea grain yield per hectare and Fodder yield for those keeping Animal. Further research work should be pursued to ascertain the results obtained in the present study.

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