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EFFECT OF PHOSPHORUS LEVELS ON GROWTH, YIELD AND DEVELOPMENT OF COWPEA (*Vigna unguiculata* (L.) Walp) VARIETIES.

[*]Y. M. Mawo, [*]I. B. Mohammed and [**]M.S. Garko,
*Department of Agronomy, Bayero University, Kano, PMB 3011, Kano, Nigeria.
[**] Ministry for Local Govt. Kano State, Dept. of Agric & Nat. Res. Gezawa, L. G. Kano, Nigeria.

ABSTRACT
A pot experiment was conducted in Faculty of Agriculture Bayero University, Kano to determine the response of some cowpea varieties to phosphorus. The treatments consisted of cowpea varieties (IT90K-277-2, IT93K-452-1, IT93K-131-2, IT98K-491-4, IT98K-506-1 and IT99K-573-1-1) and three levels of phosphorus (0, 30 and 60g) which were factorially combined. The treatments were laid using Complete Randomized Design and replicated three times. The result obtained from the analyzed data indicated that cowpea varieties differed significantly in growth characters studied such as plant height, leave number, first flower, 50% flower and days to maturity. Also considering the yield and yield components the varieties differed in respect of average pod weight, number of seed, 100-seed weight and yield per hectare respectively. Likewise, the application of phosphorus equally influences the growth and yield components of cowpea at different levels. The results showed that variety IT99K-573-1-1 gave the highest grain yield of cowpea while application of 30kg/ha P_20_5 produced the highest grain yield of cowpea.

Keywords: Cowpea Varieties, Yield and Maturity

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is a grain crop which belongs to the Family *fabaceae*, Genus *vigna* and Tribe *phaseoleae* (Marechal *et al.,* 1978). However, all cultivated cowpeas are grouped under *V. unguiculata* subspecies *unguiculata*, which is subdivided into four cultivars groups, namely *unguiculat*a, *biflora, sesquipodalis and textilis* Marechal (1985) and Singh *et al*, (2003). Cowpea (*Vigna unguiculata* (L.) Walp) originated in central Africa where its wild types are found at the present time (Boukar *et al*., 2010). The precise location of the center of origin of the species is rather difficult to determine. Previous speculations on the origin and domestication of cowpea had been based on botanical and cytological evidence, information on its geographical distribution and cultural practices, and historical records (Marechal, 1985). About 94% of the cowpeas produced in the countries are produced in the areas where Institute for Agricultural Research (I.A.R) and International Institute for Tropical Agriculture (IITA) have research responsibility with Borno, Kano and Sokoto states being the leading producers Dugje *et al.* (2009). Among the nutrients required for good growth and yield of cowpea, phosphorus has been shown to be the most important. Familiar names like Dan Borno (brown) and Sokoto beans (white) are obvious reflections of the production areas. The crop is inter-cropped with cereals mainly sorghum and millet. Although very little is grown as a sole crop because of pest problem, customs or economy of labour. Cowpea production has spread in the last 200 years from East Africa to other parts of the worlds through the Sabenean lane along with other crops like sorghum, finger millet and bulrush millet. Cowpea is primarily cultivated in the semi-arid region of lowland tropics and subtropics where soils are poor and rainfall is limited (Singh *et al*., 1997). The study was carried out to evaluate the effect of phosphorus on growth, yield and yield components of cowpea varieties and to determine the optimum level of phosphorus to be applied so as to determine suitable recommendation in the study area.

Material and Methods

The experiment was conducted at the screen house, Department of Agronomy, Faculty of Agriculture Bayero University Kano (Latitude 11^0 58'N and Longitude 8^0 26'E).The experiment was conducted from September to November 2012. The varieties were obtained from the International Institute for Tropical Agriculture (IITA), Kano station, six (6) varieties were collected which include the early maturing varieties (IT98K-506-1 and IT93K-452-1), Medium maturing varieties (IT98K-131-2, IT98K-491-4, IT99K-573-1-1 and IT90K-277-2).The sources of the inorganic phosphorus (SSP) was obtained from the Department of Agronomy, Bayero University, Kano. The treatments consisted of three levels of inorganic phosphorus (0g, 30g and 60g) and six (6) cowpea varieties which were laid out in a Complete Randomized Design (CRD) with three replications. A plastic pot of 7 litres size was filled with 7kg of top soil. Two to three seeds were sown per pot at a depth of 3 - 5cm and were later thinned to two plants after two weeks of sowing (WAS). Single super phosphate (SSP) was applied as per the rates above using a sensitive weighing scale and applied accordingly. The fertilizer was applied to each pot three weeks after sowing (3WAS). The pots were kept almost weed-free by hand pulling throughout the period of the study.

Soil analysis and nutrient content of inorganic fertilizer

Analysis of the soil physicochemical properties of the experimental site (Table 1). Shows that the soil is sandy loam, with a pH of 6.4, the organic carbon was low with only 1.15%, available phosphorus was also high with 33.52ppm, and total nitrogen was also high with 0.035%. The exchangeable bases are potassium, calcium, magnesium and sodium and their values are 0.127, 1.20, 0.173 and 0.046meq/100, respectively.

RESULTS AND DISCUSSION

The results indicated that the growth and yield of cowpea varieties varied significantly across all the sampling stages (Table 3). Variety IT99K-573-1-1 out yielded the other varieties and exhibited superior canopy height across all the sampling stages, which was similar to the findings of Singh *et al*. (2003) who showed that variations in growth and yield of cowpea varieties is largely due to differences in inherent genetic composition of the varieties under consideration. Similarly, Haruna and Usman, (2013) observed a significant variation in growth and yield characters of some improved varieties of cowpea at the same location and attributed it to genetic make up of the varieties examined. Where, the effect of phosphorus levels on canopy height was not significant (Table 3). These may be due to differences in inherent genetic composition of the varieties under consideration and the inherent capacity of the soil of having higher percentage of phosphorus. Similar findings were reported by Ndor *et al.* (2012) observed a significant variation in growth and yield characters of some improved varieties of cowpea at the same location and attributed it to genetic make up of the varieties examined and the available phosphorus in the soil. Olaleye *et al*. (2011), observed contrary response on the differential phosphorus responses of 35 cowpea lines which he associated with the low fertility of the soil.

The effect of the varieties on number of leaves per plant is presented in Table 3. Variety significantly influenced number of leaves per plant at 6 WAS only when IT90K-277-2 significantly produced higher number of leaves than all other varieties examined (Table3). This is in agreement with finding of Singh *et al*. (2011) that some varieties have the ability to out yield the other varieties and exhibit superior growth and yield character. The effect of phosphorus levels on number of leaves was not significant at all sampling stages (Table 3), the non significance effect observed may be due to the inherent capacity of the soil as described by Olaleye *et al*. (2011). That soils that contains higher proportion of phosphorus are likely to result non significant results when phosphorus trails are made on it.

Days to first flowering and days to 50% flowering of the varieties was influenced by phosphorus levels of cowpea varieties and was significantly different with IT98K-131-2 been superior over all other varieties (Table 4). Similar findings were reported by Singh *et al*. (2011), adding that the variability of the varieties was as a result of their genetic make up of the plant. The effect of phosphorus levels on days to first flowering and days to 50% flowering were not significantly different. This did not agreed with finding of Haruna and Usman, (2013) that phosphorus is an important nutrient in flower setting and grain formation. In a related study Ndor *et al*. (2012), pointed out that flower setting in cowpea is a function of levels of soil and applied phosphorus and genetic make up of the variety which resulted in variation of first flower setting and days to

50% flower formation. Days to first pods maturity as influenced by phosphorus levels of cowpea varieties was significantly different with IT98K-131-2 and IT99K-573-1-1been superiors over all other varieties (Table 4). Similar findings were reported by Singh *et al*. (2011), adding that the variability of the varieties was as a result of their genetic make up. The effect of phosphorus levels on days to first maturity was not significantly different as all the levels reported non significant results and could be due to the inherent capacity of the soil having higher percentage of phosphorus Similar report were made by Krasilnikoff *et al.* (2003) and Olaleye *et al*. (2011), that soil that contain higher proportion of a nutrient are likely to yield non significant result on trials that involve that nutrient.

The number of seeds cowpea varieties as influenced by phosphorus levels is significant with IT98K-131-2, IT98K-506-1 and IT90K-277-2 varieties being superior over all other varieties (Table 5). The report is in conformity with finding of Dugje *et al*. (2009) and Singh *et al*. (2011), that different cowpea varieties have different genetic make up as such they have different number of seeds. The effect of phosphorus level was significantly different with 60g/ha producing more number of seeds per pot. These collaborate with the finding of Olaleye *et al*. (2011) that application of adequate levels phosphorus in the soil resulted in the highest number of seeds per hectare.

The hundred grain weight of the cowpea varieties as influenced by phosphorus level indicated that there is a significant difference as IT99K-573-1-1variety had higher hundred seed weight compared to all other varieties (Table 5). Similar report was made by Krasilnikoff *et al*. (2003) and Singh *et al*. (2003) that varieties differ in their genetic make up and this could have reflected their yield. The effect of phosphorus level was significantly different with application of 30gP/pot had the highest hundred seed weight compared to the other levels as the higher level of phosphorus in that soil of the experiment. The report is similar with the findings of Guin *et al*. (1997), Haruna and Usman, (2013), Pointed out that application 54-60kg/ha gave adequate hundred seed weight of cowpea compared with that of the 0gP/pot.

Pod weight of cowpea varieties as influenced by phosphorus levels indicated that pod weights of the varieties were significantly different with IT99K-573-1-1 out yielded all other varieties (Table 5). This report is in conformity with the finding of Haruna and Usman, (2013) and Singh *et al*. (2011) who reported that spreading and semi-spreading cowpea varieties differ in their potential growth and development which can positively affect the yield of the crop. The effects of phosphorus levels were significantly different with the application of 60gP/pot produced statistically the highest pod weight. This report is in conformity with findings of Guin, *et al*, (1997) and Olaleye *et al*. (2011), indicating that application of phosphorus 60g/pot increased grain weight of cowpea varieties.

The grain weight per hectare and grain yield per hectare of cowpea varieties as influenced by phosphorus levels is presented (Table 5) with all of the varieties out yielding IT93K-452-1 variety, The clear response to phosphorus application observed in terms of growth and protein content of the five varieties confirms that phosphorus is an important nutrient element affecting the yield of cowpea (Anonymous, 1977). The increased grain yield due to phosphorus addition may be attributed to increased leaf area, plant height and increased branching. The maximum yield response observed at 30 kg Pha^{-1} was similar to that reported by Yusuf (1987) who observed an optimum level of phosphorus for cowpea yield to be 40kg Pha^{-1}. There are, however, differential responses among the cowpea varieties studied. Okeleye & Okelana (1997) also observed significantly increased grain yield and total dry matter for cowpea varieties in response to P application. The observed increase in cowpea grain yield with P application agrees with the results of Luse *et al*. (1975) but contradicts the results of Agboola & Obigbesan (1977) pointed out that Phosphorus application did not significantly increase cowpea yield although it enhanced nodulation and Phosphorus content of leaf and stem. In another development the higher concentration of phosphorus levels in the soil before setting the experiment could be the reason for non murch variation in yield as such the crop might have taken more than applied from the soil. This supported the finding of Singh *et al*, (2003), Olaleye, *et al*, (2011), and Singh *et al*, (2011), That soils that contains more phosphorus is likely to yield non significant results on trails that involve that nutrient. However, the non-significant response of most of the growth and some few yield characters could be due to the high inherent level of available phosphorus in the soil as evidenced by the high phosphorus value in Table 1.

Conclusively, from this study it can be concluded that all the varieties except IT93K-452-1 could both be sown under the study area to obtain reasonable yield of the grain. Irrespective of the varieties, application of 60 kg P_2O_5 ha^{-1} could be recommended for higher yield of cowpea relative to 0 kg P_2O_5 ha^{-1} that yielded lower tone. However, 60 kg P_2O_5 ha^{-1} may not be the optimum as further application of P may or may not increase the yield of cowpea. Therefore it is subject to further investigations.

Table 1: Physical and chemical properties of the soil at the experimental site

Physical composition		%
Sand		76
Silt		14.6
Clay		9.3
Textural class		Sandy loam
Chemical composition		
pH		6.4
Organic carbon	1.15	
Available phosphorus		33.52
Total Nitrogen	0.035	
Exchangeable bases (meq/100g of soil)		
Ca		1.20
Mg		0.173
K		0.127
Na		0.046
CEC		3.03

The percentage content of the inorganic fertilizer is 18%$P_2 0_5$, 30%Cao, 1%moisture and 90% solubility.

Table 2: Inorganic fertilizer percentage nutrient

Nutrient	**%**
$P_2 0_5$	18%
Cao	30.0
Moisture	1.0
Solubility	90

Table 3: Effect of phosphorus levels on canopy height and number of leaves of cowpea varieties at BUK, 2012.

Treatment	Plant height (WAS)			Number of leaves (WAS)		
	4	6	8	4	6	8
Variety (v)						
IT90K-277-2	15.94c	21.12d	22.60d	19.00	28.33	33.44a
IT93K-452-1	15.93c	20.23d	22.61d	15.44	21.56	27.11d
IT98K-131-2	17.75b	23.10b	25.28b	18.00	28.11	32.44b
IT98K491-4	16.27c	21.50c	24.28c	4.33	3.22	30.33c
IT98K-506-1	16.48c	21.25c	22.97c	17.22	25.33	29.22d
IT99K-573-1-1	19.93a	25.84a	27.47a	14.33	25.78	30.11c
S.E(±)	0.786	1.053	0.968	1.287	1.607	1.539
Phosphorus level (P) g/pot						
0.00	17.74	21.97	23.83	15.22	23.44	27.17
30.00	16.68	22.51	25.06	16.33	25.39	31.00
60.00	16.74	22.04	23.71	17.61	27.33	33.17
SE (±)	0.555	0.745	0.684	0.910	1.136	1.088
Interaction V XP	NS	NS	NS	NS	NS	NS

Mean followed by same letter(s) within a column are not significantly different at 5% level of significance sing Duncan multiple range tests (DMRT).WAS = weeks after sowing, NS=Not significant.

Table 4: Effect of phosphors levels on days to first flower, 50% flower days to first pod maturity and number of pods of cowpea varieties at BK, 2012.

Treatment	Days to first flower	50% Flower	Days to first Maturity	Number of pods
Variety (v)				
IT90K-277-2	39.00d	44.00d	62.67d	9.44
IT93K-452-1	35.56d	40.33d	58.00d	9.56
IT98K-131-2	43.56a	48.44a	70.33a	9.89
IT98K491-4	40.22c	44.11c	67.22b	9.56
IT98K-506-1	40.78c	45.56c	63.56c	8.89
IT99K-573-1-1	41.89b	46.56b	67.67a	8.89
SE (±)	1.255	1.405	0.707	0.300
Phosphorus level (P) g/pot				
0.00	41.78	46.56	64.94	8.00
30.00	39.44	43.83	65.06	9.67
60.00	39.28	44.11	64.72	10.44
SE (±)	0.887	0.993	0.5	0.212
Interaction V XP	NS	NS	NS	NS

Mean followed by same letter (s) within a column are not significantly different at 5% level of significance sing Duncan multiple range tests (DMRT), NS = Not significant.

Table 5: Effect of phosphorus levels on pod weight, number of seeds and hundred seed weight per pot grain yield per pot, grain yield per hactare of cowpea at BUK, 2012.

Treatment	Pod weight Per pot	Number of seed	100-seed weight	Grain yield per pot	Grain yield per hectare
Variety (v)					
IT90K-277-2	2.833b	11.44a	16.86b	0.017a	4816a
IT93K-452-1	1.956d	10.56b	15.16c	0.015bc	4430c
IT98K-131-2	1.867d	11.78a	15.36c	0.017a	4895a
IT98K491-4	2.573c	11.33b	17.13b	0.017a	4895a
IT98K-506-1	2.356d	11.44a	16.59c	0.016ab	4740a
IT99K-573-1-1	3.078a	9.22c	17.67a	0.018a	5048a
SE (±)	0.057	0.440	0.586	0.001	1678
Phosphorus level (P) g/pot					
0.00	2.220c	9.39c	15.54c	0.016b	4440c
30.00	2.456b	11.28b	17.74a	0.018a	4600b
60.00	2.656a	12.22a	16.10b	0.016b	5068a
SE (±)	0.040	0.311	0.415	0.001	118.6
Interaction V XP	NS	NS	NS	NS	NS

Mean followed by same letter(s) within a column are not significantly different at 5% level of significance sing Duncan multiple range tests (DMRT). NS = Not significant.

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