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The Southern Guinea Savanna in Nigeria: How Phosphorus Dosages Affect Cowpea Yields

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ABSTRACT

To determine the impact of different phosphorus rates on the productivity of cowpea types in Nigeria's Southern Guinea Savanna, an experiment was set up in a screen house on the Teaching and Research farm of the Federal University of Technology, Minna Niger State. There were four different amounts of phosphorus (0, 15, 30, and 45 Kg P2O5 ha-1) and four different species used as treatments.

from the cowpea family (Sampea-14, --15, --16, and --17). The experiment used a Completely Randomized Design with three replicates and a 4x4 factorial layout. The pre-crop soil investigation revealed that the soil had the texture of Sandy loam and a somewhat acidic response. Low levels of organic carbon, total nitrogen, and available phosphorus were detected. There was a lack of cation exchange capability. Several growth and yield characteristics responded significantly to the phosphorus application, including plant height, nodule number, nodule fresh and dry weight, pod number, seed number, and seed weight at 50 percent maturity. According to the data, Sampea-17 had the greatest yield, followed by Sampea-16.

grain output with 45 kg P205 applied per hectare.

INTRODUCTION

The cowpea (Vigna unguiculata) is a member of the fabaceae family and is a major leguminous grain crop. Originally, cowpea was grown throughout Central Africa. It may be found in almost any tropical region, as Ecocrop (2009) notes. Tarawali et al. (1997) found that in more than two-thirds of the developing world, cowpea is produced as a compound or relay crop alongside main grain. About 70% of the projected global total area in 1996 was located in West Africa (Singh et al., 1996). Africa accounted for approximately 8 million hectares. Cowpea is generally used as a fodder crop, green manure, and cover crop in various regions, including Australia and Asia. To wit: (Tarawali et al., 1997). Cowpea thrives in the dry savannah of the Tropics spanning 12.5 million hectares with yearly output of roughly 3 million tons (FAO, 2005). Nigeria is one of the world's leading producers of cowpea with an average output of 2.29 million tons followed by Niger with 1.10 million tons (FAO, 2012).

Millions of people in the semi-arid area of West and Central Africa rely on cowpea for their survival. It's a solid source of cash revenue and a protein-rich grain that goes well with cereal and starchy tuber crops. The immature pods and tender young leaves are used as a vegetable. Cereal crops like millet benefited from cowpea because of the nitrogen it added to the soil. nitrogen from the air into the soil in the form of nitrates (Sheahan, 2012). An estimate of the amount of N fixed annually by cowpea is given as between 73 and 240 kg ha^{-1} by Nutman (1971).

Cowpea is primarily cultivated in the Semi Arid region of low land Tropics and Sub Tropics where soils are poor and rainfall is limited (Singh *et al*., 1997). Cowpea does not require too much nitrogen fertilizer because of its ability to fix its own nitrogen from the atmosphere. However, there is a need to apply a small quantity of about 20 kg ha^{-1} as a starter dose for good yield. Excessive supply of nitrogen over the amount required will make the plant to grow luxuriantly with poor grain yield. Phosphorus is among the most needed element for crop production in many Tropical soils. They require phosphorus in growth, maturity and especially in nitrogen fixation which is energy driven process. It also plays an important role in flower initiation, seed and fruit development (Ndakemi and Dakora, 2007). Legumes are phosphorus demanding plants. It is very important to cowpea production and yield as it stimulate growth, initiate nodule formation as well as influence the efficiency of the *Rhizobium* legume symbiosis (Haruna and Aliyu, 2011). Phosphorus is also required in large quantities in young cells such as shoot and root tips where metabolism is high and cell division is rapid. Most of the farmers in Nigeria believed that cowpea does not require fertilizer. Poor performance of cowpea in the Southern Guinea Savanna zone of Nigeria may also be attributed to cultivation of unimproved varieties by farmers (Wakili, 2013). This results in less productivity and lower yields. Therefore, the study was conducted to determine the growth performance, yield and yield components of cowpea varieties to the different levels of phosphorus so as to determine suitable recommendation in the study area.

Materials and Methods

The study was carried out in the screen house of the School of Agriculture and Agricultural Technology, Federal University of Technology Gidan–Kwano Campus, Minna (Latitude 9^0 31^1 N and Longitude 6^0 29^1 E), from June to September, 2018. The climate is sub humid with an average annual rainfall of 1284 mm from April to October and a distinct dry season occurring from November to March. The mean maximum temperature remain high at about 33.5^0C (Ojanuga, 2006; Lawal *et al*., 2012). The soils of Minna are predominantly Alfisols developed from basement complex rocks ranging from shallow to very deep soils overlaying deeply weathered gneisses and magnetite with some, underlain by iron pan to varying depths (FDALR 1990).

Soil collection and preparation

The top soil (0- 20 cm depth) was collected randomly within the study site. The soil wascollected using a spade marked to the required height (0-20 cm). The soil collected was clearedof all debris, gently crushed, thoroughly mixed and filled into each perforated plastic pot of 4liters size, with each pot containing (6 kg) of soil. Each pot has a length of 18.5 cm and a diameter of 19.8 cm. After the mixing, part of the soil sample was collected and passed through 2mm sieve for pre-cropped soil analysis. four early maturing varieties of cowpea namely; Sampea-14, Sampea-15, Sampea-16 and Sampea-17. The source of the inorganic phosphorus was single super phosphate (SSP). Theseeds were obtained from the Institute for Agricultural Research (IAR) Samaru Zaria. Fourblocks of pots, each group occupied by the phosphorus levels was arranged. Each group of the four phosphorus levels forms one replication which was replicated three times. Each variety was splitted into four which was occupied by the phosphorus levels designated as (P0, P15, P30 and P45). Therefore, the experimental design was 4×4 factorial arranged in a Completely Randomized Design with 3 replications. A total of 48 pots were used with each replication containing 16 pots.

Planting and fertilizer application

Four seeds were sown in each pot at a sowing depth of 4 – 5 cm, which were later thinned to two seedlings at two weeks after sowing. Phosphorus rates of 0, 15, 30 and 45 kg ha^{-1} in form of single super phosphate were applied to all the pots in a ring form at 5cm depth and 5cm away from the seeds at sowing. Nitrogen was applied to all the pots at the rate of 20 kg N ha^{-1} in form of urea as basal application at two weeks after sowing.

Data Collection

Plant height was measured from the base of the plant to the highest tip of the stem at two weeks interval for six weeks using meter rule. The average plant height was calculated for each treatment per pot. Nodulation was done at 50% flowering. The plants were watered, uprooted carefully, washed gently in clean water and the nodules were separated from the roots and counted per plant in each treatment. The nodules counted were then put in labeled envelops and dried at 60^0C for 48 hours in an oven. The fresh and dry nodule weights were taken using a sensitive weighing balance per treatment. The number of pods per plant was obtained by plucking all the pods when they had turned brown in each treatment and counted. Number of seeds per plant was obtained by threshing the harvested dried pods; seeds were separated from the threshed pods and counted per treatment. Seed weight was obtained by weighing 50 randomly selected seeds of pods from each treatment using a sensitive weighing balance.

Data analysis

The data collected were subjected to analysis of variance (ANOVA) using SAS version 9.1 (2012). Treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Table 1: Physical and Chemical Properties of the Soil.

SOIL PROPERTIES	VALUES
Particle size distribution (gkg^{-1})	
Sand	701
Silt	169
Clay	130
Textural Class	Sandy loam
pH (H_20) (1:2.5)	6.60
Org. C (gkg^{-1})	4.01
Total N(gkg^{-1})	0.97
Available P ($mgkg^{-1}$)	4.00
Exchangeable bases ($cmolkg^{-1}$)	
Ca	2.34
Mg	1.33
K	0.35
Na	0.63
Exch. Acidity (H+Al) ($cmolkg^{-1}$)	0.03
ECEC ($cmolkg^{-1}$)	4.68

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Physical and Chemical Properties of the Soil at the experimental site

The results for the initial physical and chemical properties indicated that the soil was sandy loam in texture with sand, silt and clay contents of 701, 169 and 130 g kg-1 respectively and slightly acidic in reaction (pH 6.6) (Table 4.1). The organic carbon, total nitrogen and available phosphorus were low. Calcium was medium, magnesium, sodium and potassium were high. The effective cation exchange capacity was low.

Table 2: Effect of Phosphorous and Cowpea Variety on Plant Height.

	Plant Height (cm)		
Treatments	2WAS	4WAS	6WAS
Phosphorous level (P) (Kg P_2O_5 ha^{-1})			
0	17.70[a]	29.03[b]	38.77[b]
15	20.56[a]	38.30[a]	50.08[ab]
30	20.95[a]	38.30[a]	55.54[a]
45	19.55[a]	39.16[a]	62.20[a]
S E ±	1.29	2.29	4.87
Varieties (V)			
Sampea- 14	21.27[a]	40.08[a]	64.44[a]
Sampea-15	20.41[a]	39.51[a]	50.96[ab]
Sampea -16	20.69[a]	35.83[a]	47.78[bc]
Sampea-17	16.41[b]	29.37[b]	37.41[c]
S E ±	1.23	2.29	4.61
Interaction			
P * V	NS	NS	NS

Effect of Phosphorus and Variety on Plant Height of Cowpea

Plant height was higher at P rates of 15 and 30 kg P_20_5 ha^{-1} at two weeks after sowing than P rates of 45 and 0 kg P_20_5 ha^{-1}. However, at four (4) weeks after sowing, significant increase was observed in plant height at P rates of 30 and 45 kg P_20_5 ha^{-1} than 15 and 0 kg P_20_5 ha^{-1}. At six (6) weeks after sowing, application of 30 and 45 kg P_20_5 ha^{-1} produced significantly tallest plants while 15 and 0 kg P_2O_5 ha^{-1} produced the shortest plants. This increase in plant height could be due to the fact that phosphorus is required in large quantities in shoot and root tips where metabolism is high and cell division is rapid (Ndakemi and Dakora, 2007). This explains the fact that all the cowpea varieties effectively utilized the phosphorus fertilizer in growth and development process. This is in line with the findings of Ndor *et al*. (2012) and Nkaa *et al*.(2014) who reported that growth attributes such as plant height, leaf area index and numbers of branches per plant were significantly increased with phosphorus application. This is however, not in conformity to observation made by Sharma *et al*. (2002), which states that P has no significant effect on plant height.

The difference in plant height on the varieties at 2, 4 and 6 WAS could be attributed to genetic effect of individual varieties (Magani and Kuchinda, 2009). There was no significant effect of interaction of phosphorus levels and variety on plant height of cowpea. The findings agrees with those of (Magani and Kuchinda, 2009), who reported that no significant interaction between phosphorus and variety on cowpea plant height.

Table 3: Effect of Phosphorous and Cowpea Variety on Nodulation

Treatments	**NON** (Plant^{-1})		
Phosphorous level (P) (Kg P_2O_5 ha^{-1})			
0	27.00^{c}	1.19^{b}	0.24^{b}
15	44.00^{bc}	2.05^{ab}	0.41^{ab}
30	82.00^{ab}	2.56^{a}	0.53^{a}
45	109.00^{a}	2.88^{a}	0.55^{a}
S E ±	14.20	0.35	0.08
Varieties (V)			
Sampea- 14	25.00^{c}	1.13^{b}	0.23^{b}
Sampea-15	47.00^{bc}	2.82^{a}	0.51^{a}
Sampea -16	109.00^{a}	2.14^{a}	0.38^{ab}
Sampea-17	80.00^{ab}	2.60^{a}	0.61^{a}
S E ±	14.09	0.35	0.07
Interaction			
P * V	NS	NS	NS

NON= Number of Nodules, FNW= Fresh Nodule Weight, DNW= Dry Nodule Weight, NS = Not significant; Means with the same letters in a column are not significantly different from one another at 5% level of probability.

References

Agboola, A. A. & Obigbesan, G. O. (2001). Effect of different sources and levels of P Performance and P uptake of Ife- Brown variety of cowpea. *Ghana Journal of AgriculturalScience*, 10 (1), 71-75

Ayodele, O. J. & Oso, A. A. (2014). Cowpea Responses to Phosphorus Fertilizer Application atAdo-Ekiti, South-West Nigeria.

FDALR. (Federal Department of Agricultural Land Resources). (1990). Reconnaissance soil survey Report of Nigeria, Volumes 1-4.Jos: FDALR.

Haruna, I. M. & Aliyu, L. (2011). Yield and economic returns of sesame *(Sesame indicum .L.*) as influenced by poultry manure nitrogen and phosphorus at Samaru, Nigeria. *Elixir Agriculture.* 39, 4884-4887

Haruna, I. M. & Usman, A. (2013). Agronomic efficiency of cowpea varieties (*Vigna unguiculata* L. Walp) under varying phosphorus rates in Lafia, Nasarawa State, Nigeria. *Asian Journal of Crop Science,* 5, 209-215.

Lawal, B. A., Adeboye, M. K. A., Tsado, P. A., Elebiyo, M. G. & Nwajoku, C. R. (2012). Properties, classification and agricultural potential of lateritic soils of Minna in sub humidagroecological zone, Nigeria. *International Journal of Development and Sustainability*, 1(3), 903-911.

Magani, I. E. & Kuchinda, C. (2009). Effect of phosphorus fertilizer on growth, yield and crude protein content of cowpea (*Vigna unguiculata*[L.] Walp) in Nigeria. *Journal of Applied Biological Science*, 23, 1387 -1393.

Mokunye, A. U. & Bationo, A. (2002). Meeting the Phosphorus Needs of Soils and Crops of West Africa: The Role of Indigenous Phosphate Rocks. In: Integrated Plant Nutrient Management in Sub- Saharan Africa: From Concept to Practice, Valauwe, B., J. Diels, N.

Ndakemi, P. A. & Dakora, F. D. (2007). Yield components of nodulated cowpea (*Vigna unguiculata* (L.) Walp) and maize *Zea mays)* plants grown with exogenous phosphorus in different cropping systems. *Australian Journal of Experimental Agriculture.* 47, 587-590.

Ndor, E., Dauda, N. S., Abimuku, E. O., Azagaku, D. E. & Anzaku, H. (2012). Effect of phosphorus fertilizer on growth, nodulation count and yield of cowpea (Vigna unguiculata (L) Walp) in Southern Guinea Savanna Agroecological Zone, Nigeria. *Asian Journal* of *Agriculture Sciences***,** 4(4), 254-257

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