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Short Communication

Growth and yield responses of *Sphenostylis stenocarpa* (Hochst ex A. Rich) Harms to phosphate enrichment of soil

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The effects of varying levels (0, 110, 220, 330, 440, and 550 kg P/ha) of phosphate application on some growth and yield parameters of African yam bean were studied. Plant dry weight under 550 kg P/ha treated soils with values ranging from 13.79 to 16.32 g per plant significantly (<0.05) differed from those of the control treatment, (12.79 g). Grain yield was enhanced following increased phosphate fertilization, with highest yield (1509.02 kg/ha) recorded in 330 kg/ha compared to those under 550 kg/ha treatments (1420.72 kg/ha).

Key word: Fertilizer, phosphate, *Sphenostylis stenocarpa,* yield.

INTRODUCTION

With the ever increasing population pressure in many third world countries, and the fast depletion of natural resources, attention has shifted to the exploitation of alternative plant resource material for food in order to meet the needs of human society.

The African yam bean (*Sphenostylis stenocarpa*) is a lesser-known legume widely cultivated in the southern part of Nigeria. The plant branches profusely from the axils of the leaves. The leaves are alternately arranged along the stem. The pods are long, glabrous, and up to 50 cm long. Seeds vary in colour from grey to various shades of brown and black. Highest yields are obtained in mixed planting with yams, maize, okra and other vegetables (Okigbo, 1973).

Crop fertilization represents the greatest use of phosphorus in agriculture today. Phosphorus is a component of many cell constituents, and plays a major role in several key physiological processes in plants. Adequate phosphorus is needed for the promotion of early root formation and growth. It also improves crop quality and is necessary for seed formation (Rodriguez et al., 1998). The aim of the present study therefore is to investigate the effects of phosphate application on yield of African yam bean.

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MATERIALS AND METHODS

The present investigation was carried out on the experimental garden of the main campus of the University of Benin, Benin City (6°36'', long. 6°19'') Nigeria, within the rain forest ecological zone of Midwestern Nigeria with annual rainfall of 1825 mm.

The experiment was carried out during the rainy season (May-Sept., 2004). The plot was cleared and tilled manually with hand hoe. The physicochemical properties of the soil in the experimental site are presented in Table 1. Seeds were sown at the field using a spacing of 60 x 30 cm. Seedlings were thinned to two seedlings per stand (55,000 stands per hectare).

The source of phosphorus for the present study was super phosphate with absolute amounts of P being 46% P_2O_5 per weight of super phosphate. Superphosphate was applied three weeks after planting (3WAP) in a band and in five different levels: 2, 4, 6, 8, and 10 g per stand (110, 220, 330, 440, and 550 kg P/ha respectively). The plot was weeded when necessary, and plants were staked on bamboo poles after five weeks. The entire study lasted fourteen weeks.

RESULTS AND DISCUSSION

The topsoil was slightly acidic (pH 5.63). Physicochemical composition of the soil is presented in Table 1. Phosphate application to soil significantly (p > 0.05) enhanced plant height and leaf area development of the plant (Table 2). Higher levels of phosphate (550 kg P/ha) significantly (p < 05) increased plant dry weight to 16.32 g as against 12.79 g in the control treatment. Colomb et al.

Table 1. Physicochemical properties of soil of the experimental site.

Soil properties	Value
pH (1:1)	5.63
Carbon (%)	3.87
Total N (ppm)	20.62
NO_3(ppm)	15.10
P (ppm)	36.54
K (meq/100 g)	3.54
Ca (meq/100 g)	2.33
Mg (meq/100 g)	2.57
CEC (meq/100 g)	8.42
Sand (%)	64.46
Silt (%)	24.38
Clay (%)	11.16

Table 2. Effects of phosphate application to some growth parameters of *Sphenostylis stenocarpa.*

Treatment (kg P/ha)	Plant Height (cm)	Leaf area (cm^2)	Plant dry wt (g)	Total leaf Chlorophyll (mg/g)	Root Length (cm)	No. of root nodules per plant	10 nodules weight (g)
0	103.57	51.49	12.79	3.47	57.5	21.38	0.09
110	114.43	53.74	14.71	3.24	60.9	21.75	0.08
220	115.74	55.07	15.79	3.33	47.8	20.25	0.08
330	114.92	54.83	15.42	3.36	51.6	22.13	0.07
440	116.17	57.36	15.83	3.36	50.2	22.25	0.08
550	117.03	59.73	16.32	3.38	54.9	23.01	0.09
LSD (0.05)	12.2	3.59	2.69	0.38	3.67	1.79	0.01
LSD (0.01)	19.61	4.87	3.8	0.51	5.08	2.54	0.03

Table 3. Effects of phosphate application to some yield parameters of *Sphenostylis stenocarpa*.

Treatment (kg P/ha)	No. of flowers /plant	days to 50% of lowering (DAP)	Days to 50% maturity (DAP)	No. of pods/plant	Pod length (cm)	No. of seeds/pods	100 seed wt (g)	Grain yield (kg/ha)
0	145	71.13	86.69	18.31	16.58	13.26	8.28	1104.83
110	174	71.5	89.94	18.81	14.87	13.19	9.97	1355.13
220	176	71.38	87.75	18.63	14.85	13.21	9.93	1347.97
330	177	71.36	89.13	18.44	16.61	14.13	10.53	1509.02
440	166	70.88	89.31	18.56	15.84	13.88	10.12	1433.87
550	164	70.88	90.69	18.51	15.09	13.97	9.95	1420.72
LSD (0.05)	40.6	2.04	3.83	2.94	1.76	1.54	1.08	148.21
LSD (0.01)	56.2	3.26	5.67	3.87	2.34	2.1	1.44	209.02

(1995) reported that P deficiency significantly decreased plant biomass accumulation of sunflower.

Total leaf chlorophyll content (3.47 mg/g) in the control treatment did not significantly differ from all the treatments. The present findings that P concentrations increased vegetative growth differ from earlier reports by Singinga et al. (1989) that higher levels of P (60 mg/kg) caused vegetative growth reduction in *Allocasuarina* and *Casuarina* species.

Phosphate treatment enhanced the yield parameters of African yam bean compared to the control treatment (Table 3). Grain yield, calculated as a factor of pod per plant, seed per pod, and seed weight, was greatly enhanced upon increased phosphatization. Though grain yield per hectare increased with increasing soil P level, highest yield (1509.02 kg/ha) was obtained at 330 kg P/ha treatment against 1104.83 kg/ha in the control and 1420.72 kg/ha in 550 kg P/ha treatment. Ayodele (1993) reported over 70% increase in fruit number of okra when soil was replenished with 40 kg P/ha plant nutrient. Gallet et al. (2003) also reported that omission of P in soil tend to decrease yield of most crops.

According to Bergman, (1985) phosphorus is essential for plant growth and yield just as crop fertilization represents the greatest use of phosphorus in agriculture today. Phosphorus is also essential for a number of physiological functions that are involved with energy transformations. Although the economic benefits of phosphorus fertilization on crop production are well documented (Gaydou and Arrivets, 1983; Bergman, 1985; Kemp and Blair, 1984; Colomb et al., 1995), excessive soil phosphorus is a potential threat to water quality.

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