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Short Communication

Effect of different levels of phosphorus and potassium combinations on the growth and yield of bambaranut (*Vigna subterranea* L.) in Yandev

R.A. Akombo [1*], U.S. Asema [2]

[1] *Department of Crop Production Technology, Akperan Orshi College of Agriculture, Yandev PMB 181 Yandev- Gboko, Benue State, Nigeria*

[2] *Department of Soil Science and Technology Akperan Orshi College of Agriculture, Yandev, Nigeria*

Abstract

There is insufficient information regarding the impact of phosphorus and potassium rates on the performance of bambaranut. Therefore, these experiments were carried out to determine the ideal combination of the two elements with a view in enhancing the productivity. The experiments were carried out at the Research Farm of Akperan Orshi College of Agriculture Yandev, Nigeria, during the 2010 and 2011 cropping seasons. Four combinations of phosphorus and potassium (0kg P_2O_5/ha+0kgK_2O/ha (control), 15kg P_2O_5/ha +30kg K_2O/ha, 20kg P_2O_5/ha + 40kgK_2O/ha and 25kg P_2O_5/ha + 50kg K_2O/ha) were used as treatments. These were replicated three times in a Randomized Complete Block Design using a spacing of 25cm x 30cm. Results indicated that fertilized plots performed better than non fertilized (control) plots. In the year 2010, significant difference was recorded on plant height at 6 and 10 weeks after planting (WAP) and number of leaves at 10WAP. Year 2011 recorded significant differences on plant height (10WAP), number of leaves (6 and 10 WAP), seed weight before and after shell removal. Increasing levels of fertilizer combination translated to increased performance of bambaranut. Hence, the combination 25kg P_2O_5/ha + 50kg K_2O/ha was recommended.

Keywords: Bambaranut, Phosphorus, Potassium, Fertilizer combination, Fertilizer levels

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[*] Corresponding author. *E-mail address:* akomborich@yahoo.com

1. Introduction

Bambaranut (*Vigna subterranean*) is a pulse crop of immense potential in enhancing food security especially in drought prone agricultural systems as an intercrop with cereals. It is also planted as sole crop (Linnamann, 1988). The production of bambaranut has, however, failed due to inadequate plant nutrients in the soil due to continuous cropping system (Sanginga et al., 2001). Legumes are able to meet much of their nitrogen requirement from atmospheric nitrogen through symbiotic relationship with bacteria (Herridge et al., 1993). The requirement of legumes for phosphorus and potassium is higher than cereals as these nutrients serve dual purpose in legumes including the growth of host plant and its associated biological nitrogen fixing bacteria. Therefore, additional supply of phosphorus and potassium is necessary in maintaining the crop growth and actualizing the yield potential. The deficiency of phosphorus in legumes depressed the activity of nitrogen fixing bacteria (Giller and Cadisch, 1995; Rahman et al., 2008) for which the availability of nitrogen in root zone is also reduced.

Potassium is the third most important essential nutrient after nitrogen and phosphorus. Its adequate supply during growth period improved the water relation of plants and photosynthesis (Garg et al., 2005). The results of previous studies did not carry sufficient information regarding the impact of phosphorus and potassium rates on the growth and yield of bambaranuts. Therefore, the present study was undertaken to determine the ideal combination of these elements that can enhance the growth and yield of bambaranut under agro-climatic conditions of Yandev.

2. Materials and methods

A field experiment was carried out at the Agronomic Research Area, Akperan Orshi College of Agriculture, Yandev (Lat. $7^{0}22^{1}$N and Long. $9^{0}3^{1}$E) Nigeria. The experiment which was laid out in a Randomized Complete Block Design (RCBD) consisted of four treatments and three replications. A plot was made up of four rows each with 3 m long spaced 30cm apart. The soil of the study area was sandy loam.

The cream local cultivar of bambaranuts commonly cultivated in the area was bought in Gboko market, cleaned and treated with fanasan D at the rate of 3kg of seed per sachet of chemical prior to sowing. The seeds were sown two per hole at the spacing of 25cm x 30cm, by dibbling to a depth of 3cm, giving a plant population of 133, 333 stands per hectare. The plantings were done on the 7th June, 2010 and 9th June 2011, while the seedlings were thinned to one plant/hill at 2 weeks after planting (WAP).

Four levels of single superphosphate fertilizer were combined with four levels of potassium sulphate fertilizer to form four combinations designated as C_1, C_2, C_3 and C_4. The combinations were:

- Combination one (C_1) = 0kg P_2O_5/ha + 0kg K_2O/ha (control)
- Combination two (C_2) = 15kg P_2O_5/ha + 30kg K_2O/ha
- Combination three (C_3) = 20kg P_2O_5/ha + 40kg K_2O/ha
- Combination four (C_4) = 25kg P_2O_5/ha + 50kg K_2O/ha

Weed control was done manually at 3 and 6 WAP by hoeing and hand pulling. Pods were harvested at 16WAP when the leaves started yellowing and drying using small hole. Rainfall and temperature data for the two seasons is presented in Table 1.

Data were recorded at appropriate growth stages on plant height and number of leaves at 6 and 10WAP for each of the traits. Seed yield was determined by measuring the weight of the seeds before and after pod removal. The data obtained were subjected to analysis of variance (ANOVA) to determine whether there

were any significant differences. Where the difference existed, Fisher Least Significant Difference (FLSD) was used to separate means.

3. Results

Means squares from analysis of variance are presented in Table 2. The table shows that there was significant difference among the different fertilizer combinations including the control in the 2010 cropping season. Significant fertilizer combination effects were recorded in plant height at 6 WAP, number of leaves at 10WAP, and in weight of seeds before and after shell removal. Table 2 further revealed that the 2010 cropping season recorded non significant fertilizer combination effects in number of leaves at 6WAP, weight of seeds before and after shell removal. In the 2011 cropping season, non significant fertilizer combination effects were recorded in plant height at 10WAP and number of leaves at 6WAP.

Means of some growth parameters and seed yield are presented in Table 3. The table revealed that application of fertilizer has significant effect on the height of bambaranut at both 6 and 10 WAP except in 2011. In 2010, C_3 produced bambaranuts with highest plant height at 6WAP while C_4 produced the highest number of leaves at 6WAP. At 10WAP, they had been gradual decrease in number of leaves from C_1 to C_4.

Table 3 further revealed that C_4 recorded highest weight of seeds in 2010 and 2011 while C_3 recorded highest seed weight after shell removal in 2010 but C_4 recorded the highest seed weight after shell removal in 2011.

4. Discussion

The ability/inability of fertilizer combination to show significant difference for some traits in one season but not significant in the other is an indication that factors other than fertilizer probably rainfall might have influenced their expression.

Plant height tends to increase with increase in different levels of fertilizer combinations. This is an indication that those combinations are essential for the expression of plant height. Ayub et al. (2012), Mauyo et al. (2008), Toungos et al. (2010) and Jakusko and Belel (2009) reported similar findings. The inability of C_4 to produce plants taller than control (C_1) indicated the optimum levels of the fertilizer combinations was probably exceeded.

The higher number of leaves produced by bambaranut when fertilizer was applied indicated the need of fertilizer by this plant for formation of leaves. This could be advantageous as more number of leaves implies more sites for photosynthesis. Muayo et al. (2008) reported a similar result with nitrogen on spider plant.

The significant different recorded for seed weight (with and without shell) indicated that some combinations were significantly different from others. The increase in seed weight with increased application of fertilizer showed that barnbaranut needed fertilizer for high seed yield. Similar results were reported by Jakusko and Belel (2009), Toungos et al. (2010) and Ayub et al. (2012).

Table 1. Mean annual rainfall and temperature data in Yandev for 2010 and 2011 seasons

Rain fall (mm)												
Year/Month	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2010	0	0	1.0	67.1	147.8	116.1	104.6	265.0	144.3	267.6	8.1	0
2011	0	0	0	144.7	166.4	127.9	117.7	344.5	225.6	300.0	0	0
Temperature (°c)												
Year/Month	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2010	28.7	33.3	32.4	32.7	31.6	29.3	28.1	27.7	28.2	28.8	30.5	28.3
2011	30.6	30.3	33.3	31.6	29.7	28.6	28.1	26.4	25.7	24.0	25.2	26.9

Source: Agro-meteological substation, Yandev.

T**able 2.** Source of variation, degrees of freedom and mean squares from analysis of variance for some traits quantified in bambaranuts (Yandev, 2010 and 2011)

		Mean Square											
Source of variation	**Degree of freedom**	**Plant height(cm) at 6 WAP**		**Plant height (cm) at 10 WAP**		**Number of leaves at 6 WAP**		**Number of leaves at 10 WAP**		**Seed weight (t/ha) before shell removal**		**Seed weight (t/ha) after shall removal**	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Fertilizer combination	3	13.73**	2.40*	13.12*	13.10	420.34	340.75**	14056.45*	225.44*	0.03	0.22*	0.081	0.125*
Block	2	3.61	0.17	1.63	0.14	436.68	3.08	3137.80	12.17	0.14	0.04	0.002	0.004
Error	6	1.30	0.49	2.67	4.68	154220.74	2.08	632.77	6.83	0.41	0.03	0.066	0.021

***, * = Significant at 1% and 5% level of probability respectively / WAP = Weeks after planting*

Table 3. Means of some growth parameters and seed yield quantified in bambaranut applied with various fertilizer combinations (Yandev, 2010 and 2011)

Fertilizer Combination	**Plant height (cm) at 6 WAP**		**Plant height (cm) at 10 WAP**		**Number of leaves at 6 WAP**		**Number of leaves at 10 WAP**		**Weight(t/ha) dried of seeds before shell removal**		**Weight t/ha of dried seeds after shell removal**	
	2010	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**
No Fertilizer application	20.30	13.60	24.50	20.10	71.33	45.33	120.00	142.33	0.97	1.62	0.82	1.55
15kg P_2O_5+30kgK_2O	24.03	15.00	27.87	23.27	95.70	46.33	220.20	142.00	0.98	1.73	0.95	1.67
20kgP_2O_5+40kgK_2O	25.20	14.33	27.73	21.47	97.70	34.33	266.40	132.00	1.01	1.70	1.00	1.63
25kg P_2O_5+5OkgK$_2O$	22.30	12.93	28.53	18.33	87.60	60.33	264.2	124.33	1.18	2.22	0.80	2.00
CV (%)	4.97	5.01	5.80	10.41	459.85	3.10	11.55	1.93	71.95	9.67	24.94	8.43
FLSD	2.28	1.40	3.26	-	-	2.88	50.26	5.22	-	0.35	-	0.29

CV = Coefficient of variation / FLSD = Fisher Least Significant Difference

5. Conclusion and recommendation

The combination of both phosphorus and potassium is essential for optimum growth and yield of bambaranut. The performance of bamaranut increased with increased application of the levels of phosphorus and potassium. Therefore, C_4 (25kg P_2O_5/ha + 50kg K_2O/ha) is recommended for optimum growth and seed yield in bambaranut.

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