Effects of NPK Fertilizer Rates on Seed Yield of Some Local Cultivars of Bambara Groundnut *(Vigna Subterranean*(L.) Verdc.)

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***Abstract*---**Field experiment was carried out to investigate the effects of NPK fertilizer rates on the growth, yield and yield components of Bambara groundnuts (*Vigna subterranean* L.) at the Teaching and Research Farm of the Department of Crop Production and Horticulture, Modibbo Adama University of Technology, Yola-Nigeria. The experimental treatments consisted of three NPK fertilizer rates and three local cultivars of Bambara groundnut. The experiments were laid out in a split-plot design with NPK fertilizer rates as the main plot treatments and cultivars as the sub-plot treatment replicated three times. Data collection were subjected to analysis of variance, the means were separated using the Least Significant Difference (LSD). Results from the study show significant ($P \leq 0.05$) effects of NPK rates on number of leaves, per plant numbers of branches per plant, Plant height days to 95% maturity, number of pods per plant, number of seeds per plant, 100 seed weight and seed yield (kg/ha). Based on the findings of these study, it is suggested that Ex-kula perform better in terms of seed yield and therefore should be adopted in the study area.

***Keywords*---**Bambara groundnut, cultivar, NPK fertilizer, yield, Nigeria

I. Introduction

BAMBARA groundnut (*Vigna subterranean* (L.) Verdc) belongs to the family fabaceaee and sub – family papilionoidae. The crop is an annual legume with subterranean habitat and characterized by long petiole, trifoliate leaves which are produce from small creeping stems, Yellowship flowers, well develop taproot with hard and wrinkled fruits about 1.5 – 2.5cm in diameter containing 1-2 seeds in each pod, which are mostly round or oval in shape. The seeds are smooth and hard which could be red, black or white, or sometime with black spots.

Bambara groundnut is cultivated throughout the tropics because of its adaptation to areas of low rainfall and low soil fertility as well as tolerant to pests and disease compared with other leguminous crops (Doku and Karikari, 1971; Duke 1978).

In Nigeria, the crop is grown by small scale farmers on small plots of land and in frequently intercropped with cereals (pearl millet, sorghum or maize) root and tuber crops (yam, sweet potatoes or cassava), cotton, traditional vegetables and other legumes (Rachie, and Silvester 1977; Heller et al; 1997).

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Research to improve the yield of Bambara groundnut compared with other legumes such as soybean (*Glycine max* (L) merr) and groundnut (*Arachis hypogae* L.).
Although Stanton (1968) suggested that high levels of fertilizers could be profitable, the use of mineral fertilizers for the production of Bambara groundnut has rarely been practiced.

This study therefore was carried out to investigate the effect of NPK rates on growth and yield of some local cultivars of Bambara groundnut (*Vigna subterranean* (L) verdc.) as well as to the determine the optimum level of NPK for higher yield and to come up with recommendation of NPK rates for the crop in the study area.

II. Materials And Methods

Field experiments were carried out at the Teaching and Research Farm of the Modibbo Adama University of Technology, Yola (latitude 9^0 10'N and longitude 11^0 14'E and 15,8m above sea level), during the 2009 and 2010 cropping seasons, to study the effect of NPK rates on growth and yield of some local cultivars of Bambara groundnut. Three local cultivars of Bambara groundnut Ex-shelleng, Ex-kiri and Ex-kula were obtained from Shelleng Local Government Area of Adamawa State.

The experimental seeds were characterized as follows:

i. Ex- shelleng – white colour, round shaped, smooth shining seed coat with white edge.
ii. Ex – kiri – brown colour, oval shaped, smooth seed coat with white eye.
iii. Ex – kula variegated colour, round shaped, smooth seed coat with white eye.

The experiment consisted of three (3) NPK compound fertilizer (15:15:15) at the rate of 45,60 and 90kg/ha^{-1} as the main plot treatment and the three (3) local cultivars of Bambara groundnut (ex – shelleng, ex – kiri and ex-kula) were assigned to the sub-plot in a three by three (3x3) factorial experiment. The treatments were replicated three (3) times in a split plot design making a total of 27 sub-plots. Plot size was 3m x 2m ($6m^2$) and one metre (1m) pathway between replications and subplots respectively. The soil physiochemical properties were analyzed (table 1) and rainfall data collected. The experiment plots were kept weed free by manual weeding and no incidence of pest or diseases during the study period.

Data were collected on establishment count, number of leave per plant, number of branches per plant, days to 50%

flowering, days to 50% maturity, number of pods per plant, number of seeds per plant, 10 seed weight (gm) and grain yield per plot and per hectare (ha). Data collected were subjected to analysis of variance (Anova) and the mean separated using the least significant (LSD). (Gomez and Gomez, 1984).

III. Results And Discussion

Table II: shows the effect of fertilizer levels and cultivar on number of pods per plant and number of seeds per plant of Bambara groundnut in 2009 and 2010 growing season and the combined season. In 2009, application of various NPK rates resulted in significant difference on number of pods per plant. Application of 60kgNPK/ha gave the highest number of pods per plant followed by 90kgNPK/ha and 45kgNPK/ha. Similarly trend was observed in 2010 cropping season where application of 60kgNPK/ha produced high number of pods per plant while 45kgNPK/ha and 90kg NPK/ha produced similar number of pods plant. The combined analysis was significantly ($P \leq 0.05$) effects on number of pods per plant. Application of 60kgNPK/ha produced high number of pods per plant followed by 90kgNPK/ha and 45kgNPK/ha. There was no significant difference among the cultivars under study with respect to number of pods per plant in both seasons. However there were significant differences in the combined analysis.

Application of various NPK rates resulted in significant differences on number of seeds per plant in 2009 cropping season. Application of 60kgNPK/ha produced higher number of seeds of 28.50 seeds per plant. While 45kgNPK/ha and 90kgNPK/ha produced various NPK rates resulted in significant differences on number of seeds per plant . Application of 60kgNPK/ha produced higher number of seeds per plant followed by 90kgNPK/ha and 45kgNPK/ha. Significant difference was recorded on the combined analysis.

There was no significant difference among the cultivars under study on number of seeds per plant in 2009 cropping season. However, there were significantly difference among the cultivars under study on number of seeds per plant in 2010 cropping season. Ex-Kula produced high number of seeds of 32:42 seeds per plant, followed by Ex –Shelleng with mean value of 29:09 seeds per plant and Ex-kiri with mean value of 24.88 seeds per plant.

Significant differences ($P \leq 0.05$) was recorded in combined analysis on number of seeds per plant. Ex-Shelleng and Ex-Kula produced similar number of seeds with mean value of 27:42 and 29:27 seeds per plant. While Ex-Kiri produced lower number of seed per plant with mean value of 24:88 seeds per plant.

The mean effects of fertilizer levels and cultivar on weight of pods and weights of seeds per plant of bambara groundnuts in 2009 and 2010 growing seasons and combined season (Table III). There were significant difference ($P \leq 0.05$) of fertilizer level on weight of pods per plant in 2009 cropping season. The higher values were recorded when 60kgNPK/ha and 90kgNPK/ha of NPK fertilizer was applied on pods per plant and with mean values of 119.32g and 117.12g respectively. The lowest value was recorded when 45kgNPK/ha was applied with mean values of 72.56g. In 2010 season, application of various NPK rates resulted in to significant differences on weight of pods per plant. However, there was significant difference ($P \leq 0.05$) on the combined analysis. Application of 60kgNPK/ha produced the highest weight of pod per plant followed by 90kgNPK/ha and lastly 45kgNPK/ha with mean values of 118.22g, 106.21 and 87.46g respectively.

There were no significant differences among the cultivars under study with respect to weight of pods per plant in both seasons and the combined analysis.

Application of various NPK rates resulted in significant differences on weight of seeds in 2009 cropping season. Application of 60kgNPK/ha and 90kgNPK/ha produced weight of seeds per plant, while 45kgNPK/ha produced different weight of seeds per plant with mean values of 85.42g, 82.56g and 51.02g respectively. There were no significant differences on the various application of NPK rates on weight of seeds per plant in 2010 and combined analysis. Application of 60kgNPK/ha and 90kgNPK/ha produced similar weight of seed per plant. In the combined analysis, application of 60kgNPK/ha produced the highest weight of seeds per plant, followed by 90kgNPK/ha and lastly 45kgNPK/ha with mean values of 91.59g, 83.63g and 60.57g respectively. There were significant differences ($P \leq 0.05$) among the cultivars on weight of seeds per plant in 2009 and 2010 cropping season. However, there were significant differences in the combined analysis on weight of seeds per plant. Ex-Kula produced the highest weight of seeds per plant while Ex-Shelleng and Ex-Kiri produced similar weight of seeds per plant with mean values of 90.65g, 82.55g and 79.72g respectively.

Table IV shows the mean effects of fertilizer levels and cultivar on grain yield kg/ha and 100 seed weights of bambara groundnuts in 2009 and 2010 growing seasons and combined season (Table 21). Application of various NPK rates resulted in significant ($P \leq 0.05$) effect on 100-seed weight of bambara groundnut in both seasons and the combined analysis.

There were significant differences among the cultivars under study with respect to 100 seed weight in both seasons. Ex-kula produced the highest seed weight followed by Ex-Shelleng while Ex-Kiri produced the lowest seed weight.

Application of the various NPK rates resulted in significant effect on the grain yield per hectare of Bambara groundnut in both seasons and the combined analysis. Application of 60kgNPK/ha produced statistically similar grain yield with 90kgNPK/ha. Similarly there were no statistical difference between 45kgNPK/ha and 90kgNPK/ha on grain yield in 2009. In 2010 season, application of 60kgNPK/ha produced higher grain yield while application of 45kgNPK/ha and 90kgNPK/ha produced similar grain yield. In the combined analysis, application of 60kgNPK/ha produced statistically similar grain yield with 90kgNPK/ha. Similarly, there was no statistical difference between 45kgNPK/ha and 90kgNPK/ha.

There was no significant differences among the cultivars under study with respect to grain yield in 2009 cropping season. However, in 2010 and the combined analysis, Ex-Shelleng and Ex-Kula produced statistically similar grain yield per hectare while the least grain yield was produced by Ex-Kiri in all two cases, though, in the combined analysis, the cultivar is statistically similar to Ex-Shelleng.

Application of different NPK rates influence the yield of the crop. NPK promote vegetative growth of the plant and increase yield of the plant. NPK plays a vital role by increasing the yield of the crop. The statement agrees with the report of Dadson and Brooks (1989) which state the high nitrogen application is required for high yield of the crop. Petkov (1976) reported that NPK application stimulate viable seed with high germination capacity and high yield component.

Significant difference was recorded on the interaction between NPK rates and cultivars on grain yield. Ex-kula produced high yield when 60kgNPK/ha was applied. This is as a result of higher application of NPK fertilizer, resulting in higher yield. This is an agreement with Toungos *et al.* (2009) who reported application of NPK fertilizer results in higher source capacity which may translate into higher dry matter production which may later be allocated to the pods for higher yields.

Application of various NPK rates influenced 100-seed weight. The application of 60kgNPK/ha and 90kgNPK/ha gave the same 100-weight while 45kgNPK/ha gave the lower 100-seed weight. Significant effect was recorded on 100-seed weight among the cultivars. Ex-Kula gave the higher 100-seed weight than Ex-Shelleng and Ex-Kiri. This may be due to the fact that the number of grain per plant and seed size in Ex-kula was significantly higher which resulted in higher 100-seed weight that finally increased yield per hectare. Kadams and Sajo (1988) on 100-seed weight observed that, as the production number per plant increases, the seed size decreases. This is really expected because competition between pods for assimilates during grain filling.

Higher significant interactions on 100-seed weight per plant were recorded in the combined analysis between fertilizer levels and cultivars. Significant difference was recorded on grain yield in both seasons. A significant interaction on grain yield was recorded in the combined analysis between fertilizer levels and cultivars. The difference might be due to genetic make-up of the cultivars, with Ex-kula having a better yield than Ex-shelleng and Ex-Kiri. This agrees with Kadams and Sajo (1998) who reported that pods per plant has significant phenotypic and genotypic relation with seed yield per plant, 100-seed weight and yield per hectare.

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TABLE I
SOIL PHYSICO-CHEMICAL CHARACTERISTICS OF THE EXPERIMENTAL SITES

Soil Characteristics	2009	2010
sand %	57.3	56.7
Silt %	29.4	29.1
Clay %	13.3	14.2
PH (H_2O)	6.5	6.4
Organic C (g/kg)	5.3	6.7
Total N (g/kg)	0.4	0.4
Available P(mg/100g)	0.9	0.9
Exch K (cmol+/kg)	0.30	0.26
Exch. Mg (cmol+/kg)	1.00	1.11
Exch Ca (cmol+/kg)	2.15	2.07
Soil textural classification:	sandy loam	sandy loam

TABLE II
MEAN EFFECT OF FERTILIZER LEVELS AND CULTIVAR ON NUMBER OF POD AND NUMBER OF SEEDS PER PLANT OF BAMBARA GROUNDNUTS IN 2009 AND 2010 CROPPING SEASONS

Treatment fertilizer (main-treatment) Kg/ha	Number of Pod per plant 2009	2010	Combined	Number of seeds per plant 2009	2010	Combined
45	20.19	25.83	23.07	23.09	23.38	23.24
60	26.80	29.89	26.85	28.50	30.30	29.40
90	23.83	27.31	27.07	23.19	26.66	24.93
LSD	2.99	2.61	1.88	3.69	2.56	2.13
Cultivar (sub-treatment)						
Ex-Shelleng	23.56	28.07	25.78	25.78	29.09	27.42
Ex-Kiri	22.34	26.99	24.66	24.88	24.88	24.88
Ek-kula	24.64	28.97	26.81	26.12	32.42	29.27
LSD	2.99	2.61	1.88	3.69	2.56	2.13
Interaction (fertilizer x cultivar)	*	*	*	*	*	*

* = Significant

TABLE III
MEAN EFFECT OF FERTILIZER LEVELS AND CULTIVAR ON WEIGHTS OF POD AND WEIGHTS OF SEEDS PER PLANT OF BAMBARA GROUNDNUTS IN 2009 AND 2010 CROPPING SEASONS

Treatment fertilizer (main-treatment) Kg/ha	Weight of pods per plant (grams) 2009	2010	Combined	Weight of seed per plant (grams) 2009	2010	Combined
45	72.56	102.36	87.46	51.02	70.11	60.57
60	119.32	117.12	118.22	85.42	97.76	91.59
90	111.08	101.31	106.21	82.56	81.80	83.63
LSB	18.03	17.02	11.74	18.03	17.01	08.05
Cultivar (sub-treatment)						
Ex-Shelleng	98.06	106.91	102.99	79.86	85.24	82.55
Ex-Kiri	95.88	106.07	100.98	76.09	83.34	79.72
Ek-kula	106.71	107.52	106.63a	82.77	98.52	90.65
LSD	18.03	17.02	11.74	18.03	17.01	08.05
Interaction (fertilizer x cultivar)	*	*	*	Ns	*	*

Ns = Not significant * = significant

TABLE IV
MEAN EFFECT OF FERTILIZER LEVELS AND CULTIVAR ON GRAINS YIELD KG/HA AND 100 SEED WEIGHTS OF BAMBARA GROUNDNUTS IN 2009 AND 2010 CROPPING SEASONS

Treatment fertilizer (main-treatment) Kg/ha	Grain yield kg/ha 2009	2010	Combined	100 seed weight (grams) 2009	2010	Combined
45	230.32	371.21	300.76	82.86	88.24	85.55
60	402.62	456.87	429.75	85.27	96.37	90.82
90	390.90	418.77	404.84	84.95	93.14	89.05
LSB	216.37	102.52	113.4	1.86	4.39	2.26
Cultivar (sub-treatment)						
Ex-Shelleng	413.64	487.86	450.75	92.80	101.42	97.11
Ex-Kiri	303.08	377.15	340.12	67.51	70.33	68.92
Ek-kula	474.70	531.90	503.30	95.99	106.01	99.40
LSD	216.37	102.52	113.4	1.86	4.39	2.26
Interaction (fertilizer x cultivar)	**	**	**	*	*	*

* = significant ** = highly significant