TESTING VARIETAL RESPONSE TO VARIOUS FERTILIZER TREATMENTS: PHOSPHORUS, POTASSIUM AND MICRONUTRIENTS ON IMPROVED GROUNDNUT VARIETY (SAMNUT 24) IN AJINGI AND GAYA SAVANNA ZONE OF NIGERIA

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ABSTRACT

Groundnut is a leguminous crop that have several applications. This necessitate the search for the application of ways that could improve its production. Field experiments were conducted during the 2015/16 wet season at two locations. The research farm of N2Africa at Ajingi location (Latitude 11^0. 762238N and Longitude009^0.04805E) and Gaya location (11^0.97570N and longitude 008^0. 95753E), the experiment consisted six treatments namely; phosphorus (P), phosphorus +Potassium (PK), Phosphorus + Potassium + Micronutrients (PKM), Phosphorus + Potassium + Micronutrients + Organic Manure (PKMOM), Organic Manure (OM) and Control. The treatments were laid out in a Randomized Complete Block Design (RCBD) with six plots and five replications. P fertilizer (7.5kg) was allocated to plot 1, P (7.5kg) + K in form of MOP at the rate of 20kg K_20/ha were allocated to plot 2, p (7.5kg) + K in form of MOP at the rate of 20kg K_20/ha were allocated to plot 3, P (7.5kg) + K in form of MOP at the rate of 20kg K_20/ha + Organic Manure were allocated to plots four, plot 5 had organic manure and plot 6 control. Soil physico - chemical analysis of the research fields were determined and the metrological data. Data collected on growth and yield parameters (Fresh Weight of Pods, Fresh Weight of Stover, Number of Pods per Plant, Dry Weight of Pods per Plant and Haulms dry weight.) were subjected to analysis of variance (ANOVA) using SAS latest version 2010 and the result indicated that application of all treatment (different fertilizers) combinations significantly ($P \leq 0.05$) at par showed higher shelling (%) 74.5 % than control 45.1% across plots, locations and at combined analysis.

Keyword: Fertilizer treatments, phosphorus, potassium, micronutrients, organic manure, Groundnut

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) of the family leguminasea, is an annual legume which bears many names including peanut, earthnut, monkey-nut and goobers. It originated from Latin America and the Portuguese introduced it into African continent from Brazil in the 16th century (Adinya *et al.., 2010;* Hamidu *el al.,* 2007).

The crop is mainly grown for oilseed, food and animal feed (Pande *et al...* 2003; Upadhyaya *et al..,* 2006). It is the world 13th most important food crop, 4th most important source of edible oil and 3th most important vegetable protein (Taru *et al.,* 2010).

Groundnut is a crop which can be grown in the tropics and warm temperate region between 40^0N and 40^0S latitude (Roman, 2001). The crop has some specific environmental and management requirements which must to be met order to achieve a good crop yield. Some of the climatic requirements for groundnut crop production include rainfall of between 450mm – 1250 per annum which should be well distributed and on an altitude of no more than 1500m (Busolo *et al.,* 2002).

Groundnut production is faces with some constrains against it ease of production which lead to low pods and haulms yield, although there has been some yield improvement trend in Nigeria from 780kg ha to 950kg ha in the recent years (John .O 2010).

Feedback from trial conducted by N2Africa in 2014 confirmed that soil of the Nigerian Savannah are low in available P, therefore, application of P fertilizers has been recommended to boost soil P status and ultimately increase productivity since legumes generally have a good respond to P input in Nigerian Savannah soil. Therefore, the objective of the research is to test varietal response to various fertilizer treatments phosphorus, potassium and micronutrients on improved variety Samnut 24.

The research was aimed to investigate impact of biophysical condition on the yield of legumes and varietal response to inputs and evaluate the varietal response to different treatments phosphorus, potassium and micronutrients on improved groundnut variety (Samnut 24).

MATERIALS AND METHODS

Experimental Sites

Two field trials were conducted during the 2015/16 at wet season. One of the trials was conducted at Gaya location (Latitude 11^0. 762238N and longitude 008^0. 95753E; Alt. 432m above sea level) and the other one at Ajingi location (Latitude 11^0. 97570N and Longitude 009^0. 04805E; Alt. 417m above sea level). Both sites are located in the Sudan Savanna. The soil of the experimental site is well drained sandy loam. Moreover, the experiment consisted six treatments namely; phosphorus (P), phosphorus +Potassium (PK), Phosphorus + Potassium + Micronutrients (PKM), Phosphorus + Potassium + Micronutrients + Organic Manure (PKMOM), Organic Manure (OM) and Control. The treatments were laid out in a Randomized Complete Block Design (RCBD) with six plots and five replications.

Collection and Analysis of Soil Sample

Soil sample were taken at random from each of the two sites before planting at 0-25cm depth using soil auger. Composite soil sample were made for each site and were air-dried, sieve using 2mm mesh and analyzed for physical and chemical properties using standard procedures. The pH was determined by glass electrode pH Meter; particles size; Organic carbon by oxidation; Available phosphorus; Total Nitrogen content; Exchangeable Bases (Ca, Mg, K, and Na); Cation Exchange Capacity. (Bremner and Mulvaney, 1982)

Treatment and Experimental Design

The experiment consisted six treatments namely; phosphorus (P), phosphorus +Potassium (PK), Phosphorus + Potassium + Micronutrients (PKM), Phosphorus + Potassium + Micronutrients + Organic Manure (PKMOM), Organic Manure (OM) and Control. The treatments were laid out in a Randomized Complete Block Design (RCBD) with six plots and five replications. P fertilizer (7.5kg) was allocated to plot 1, P (7.5kg) + K in form of MOP at the rate of 20kg K_20/ha were allocated to plot 2, p (7.5kg) + K in form of MOP at the rate of 20kg K_20/ha were allocated to plot 3, P (7.5kg) + K in form of MOP at the rate of 20kg K_20/ha + Organic Manure were allocated to plots four, plot 5 had organic manure and plot 6 control. Two 2 plots received micronutrient 33 grams of agrolyzer and dissolve in 10litre of water which had been applied to 10x10m plot.

Land preparation

The land was cleared and ridged by using ox-plough and it was ridged against slope, the plot of 10x10m was established appropriately. Alley of 0.5m spacing between rows/ridge is 75cm

Sowing

Groundnut seed was sown at the rate Of 2 seeds per hole without thinning, spacing between plant stand 10cm and 75cm intra raw spacing.

Fertilizer application

In each plot, four plots of 10mx10m were fertilized by applying 0.3kg $P_2{}^0 5$ which is equal to 2kg SSP/plot of $100m^2$. Phosphorus fertilizer (SSP) were applied at planting by dibbled the fertilizer and covered. Potassium K was applied to three plots of 10mx10m at the rate of K_20 in form of MOP which is translated into 0.33kg K_20/plot of 100^2m. Recommended rate of organic manure 40kg/ha were applied to plot of100^2m, 33 grams of micronutrients agrolyzer were applied to two plots of 10mx10m.

Harvesting

Harvesting was done when the foliage slightly turned yellow and the pods attained physiological maturity. The plant was then cut below the level of the pods in the soil with hoe.

Data collection

Fresh weight of pods, this was determined by weighing those pods of plants in each of the

net plot after harvesting by using weighing balance and converted it to kg/ha.

Number of pods per plant, the number of pods/plants were counted from the sampling plants and averaged out and recorded.

Fresh weight of Stover, this was determine by weighing the Stover and residues after removing all pods from the Stover and recorded. Dry weight of pods, all pods were sun dried and the dry weight was determined by weighing the pods and recorded.

Dry weight of haulms, this was done after stripping the pods from the haulms the sun dried haulms was weighted by using spring weighing balance to determine the dry weight of haulms.

Data Analysis

The data was analyzed using SAS latest version (2010), the data collected was subjected to Analysis of Variance (ANOVA), as described by Snedecor and Cochran (1976) and treatment means were compared using Duncan Multiple Range Test (DMRT) Duncan, 1955.

RESULT

Soil physicochemical Properties:

Physiochemical Properties of the Soil at Experimental Sites:

The characteristics of the soil at experimental sites are presented in Table 1. The soil at Ajingi was sandy loam while that of Gaya was loamy sandy in texture. The pH value for Ajingi was 6.68 and that of Gaya was 5.83 which indicate there are different reactions. Soil had medium organic carbon 0.392gkg-^{1} for Ajingi and Gaya 0.757 gkg-^{1} respectively, the total Nitrogen content for Ajingi 0.22 gkg^{-1} and 0.42 gkg^{-1} for Gaya which was very low, the available phosphorus content of Ajingi was high 11.25 (mgKg^{-1}). The exchangeable cations (Ca, Mg) at Ajingi Ca was 3.86 and that of Gaya was 2.91, Mg at Ajingi was 2.30, Gaya was at 1.50K potassium was medium at both location range between 0.18 – 0.12, Na content of both locations was moderate. The CEC of the soil analysis from both locations were medium and ranged between 5.89 cmo1^{+}Kgha^{-1} for Ajingi and 4.21 cmo1^{+}Kgha^{-1} for Gaya soil.

Fresh Weight of pods (Kg/ha)

Testing varietal response to various fertilizer treatments on fresh weight of pods is presented in table 2. Application of all rates and combination of different of fertilizer produced statistically ($P \leq 0.01$) similar fresh weight of pods per plot, irrespective of location and the combined analysis. However, the various types of fertilizer applied produced significantly higher fresh weight of pods per plot than the control treatment in all locations and combined analysis. At Ajingi site, application of OM or P, PK-MN and control treatment alone produced statistically similar but the least number of fresh weight of pods compared to the application of PK-MN-OM, and PK which were statistically at par but statistically superior to the application of OM or P, PK-MN and control treatment alone which were statistically similar at Gaya site and combined analysis. There was statistically significant higher treatment effect to be recorded at both locations and combined analysis.

Table 1: Soil characteristics of the experimental sites at Ajingi and Gaya locations (0-25cm depth)

Soil Properties	**Ajingi**	**Gaya**
Particle size (%)		
Sandy	89.9	80
Clay	3	4
Silt	7.1	10
Texture Class	Sandy loam	Loam sandy
Chemical Properties		
pH in water (1:2:5)	6.68	5.83
Organic carbon (gkg^{-1})	0.392	0.757
Total Nitrogen (gkg^{-1})	0.22	0.42
Available P (mg/kg^{-1})	11.25	3.92
Exchangeable base (cmo/kg)		
Ca	3.86	2.91
Mg	2.30	1.50
K	0.18	0.12
Na	0.54	0.22
CEC	5.89	4.21

Table 2: Testing varietal response to various fertilizer treatments on fresh weight of pods (kg/ha) Of Groundnut (*Arachis hypogaea* L.) at Ajingi and Gaya

Treatment	Ajingi	Gaya	Combine
PK-MN-OM	2029.0a	2142.9a	2086.0a
OM	1917.8a	1959.9ab	1938.8a
PK	2308.3a	1797.1ab	2052.7a
P	1891.1a	1643.7ab	1767.4a
PK-MN	1748.8a	1896.4a	1822.6a
CONTROL	1236.0b	1199.2b	1217.6b
SE	187.4	113.7	216.6
Significance	**	**	**
Interaction			
T x E	NS	NS	NS

Keyword: Means within a column followed by same letter(s) are statistically similar ($P \leq 0.05$) using Duncan Multiple Range Test (DMRT); NS = Not Significance; PK-MN = Phosphorus + Potassium + Micronutrient; OM = Organic Manure; PK-MN-OM = Phosphorus + Potassium + Micronutrient + Organic Manure; PK = Phosphorus + Potassium; CONTROL = No input; P= Phosphorus only; T = Treatment; E = Experiment; **= significant at 1% Probability; WAS= Weeks After Sowing.

Fresh weight of Stover (Kg/ha)

Testing varietal response to various fertilizer treatments on fresh weight Stover is presented in table 3. Application of all rates and combination of different of fertilizer produced statistically ($P \leq 0.01$) similar fresh weight of Stover per plot, irrespective of locations and combined analysis. However, the various type of fertilizer applied produced significantly higher weight of Stover per plot than the control treatment in all locations and in the combined analysis.

Number of Pods per plant (Kg/ha)

Testing varietal response to various fertilizer treatments on number of pods per plant is presented in table 4. Application of all rates and combination of different of fertilizer produced statistically ($P \leq 0.05$) similar number of pods per plant, per plot, irrespective of locations and the combined analysis. However, the various types of fertilizer applied produced statistically similar number of pods per plant with the control treatment. In Ajingi site, while only application of PK-MN-OM was statistically superior to the control. At Gaya site, all applied fertilizer combination produced statistically more number of pods per plant then control except application of only P, which is statistically at par with control. Similarly, trend was recorded in the combined analysis

.**Table 3:** Testing varietal response to various fertilizer treatments on fresh weight of Stover (kg/ha) Of Groundnut (*Arachis hypogaea* L.) at Ajingi and Gaya

Treatment	Ajingi	Gaya	Combine
PK-MN-OM	6889.3a	5947.2a	6418.3a
OM	6654.4a	5961.8a	6308.1a
PK	6693.3a	5145.9a	5919.6a
P	6453.2a	5092.9a	5773.0a
PK-MN	5947.8a	5540.1a	5773.0a
CONTROL	3814.0b	3149.2b	3481.6b
SE	585.9	328.9	470.9
Significance	**	**	**
Interaction			
T x E	NS	NS	NS

Keyword: Means within a column followed by same letter(s) are statistically similar ($P \leq 0.05$) using Duncan Multiple Range Test (DMRT); NS = Not Significance; PK-MN = Phosphorus + Potassium + Micronutrient; OM = Organic Manure; PK-MN-OM = Phosphorus + Potassium + Micronutrient + Organic Manure; PK = Phosphorus + Potassium; CONTROL = No input; P= Phosphorus only; T = Treatment; E = Experiment; **= significant at 1% Probability; WAS= Weeks After Sowing

Table 4: Testing varietal response to various fertilizer treatments on Number of pods per plant (kg/ha) of Groundnut (*Arachis hypogaea* L.) at Ajingi and Gaya

Treatment	Ajingi	Gaya	Combine
PK-MN-OM	20.64a	18.44a	19.54a
OM	17.28ab	20.28a	18.78a
PK	13.56ab	18.72a	16.14a
P	14.12ab	15.40a	14.76ab
PK-MN	15.66ab	17.72a	16.69a
CONTROL	8.26b	10.80b	9.53b
SE	3.21	1.82	2.78
Significance	**	**	**
Interaction			
T x E	NS	NS	NS

Keyword: Means within a column followed by same letter(s) are statistically similar ($P \leq 0.05$) using Duncan Multiple Range Test (DMRT); NS = Not Significance; PK-MN = Phosphorus + Potassium + Micronutrient; OM = Organic Manure; PK-MN-OM = Phosphorus + Potassium + Micronutrient + Organic Manure; PK = Phosphorus + Potassium; CONTROL = No input; P= Phosphorus only; T = Treatment; E = Experiment; **= significant at 1% Probability; WAS= Weeks After Sowing.

Table 5: Testing varietal response to various fertilizer treatments on Dry weight of pods (kg/ha) of Groundnut (*Arachis hypogaea* L.) at Ajingi and Gaya

Treatment	Ajingi	Gaya	Combine
PK-MN-OM	1212.6a	1296.7a	1254.7a
OM	1127.4a	1119.0a	1123.2a
PK	1271.9a	965.0b	1118.5a
P	1102.4a	964.1b	1033.2a
PK-MN	1069.1a	1087.3b	1078.2a
CONTROL	728.8b	624.4b	676.6b
SE	78.92	99.1	468.4
Significance	**	**	**
Interaction			
T x E	NS	NS	NS

Keyword: Means within a column followed by same letter(s) are statistically similar ($P \leq 0.05$) using Duncan Multiple Range Test (DMRT); NS = Not Significance; PK-MN = Phosphorus + Potassium + Micronutrient; OM = Organic Manure; PK-MN-OM = Phosphorus + Potassium + Micronutrient + Organic Manure; PK = Phosphorus + Potassium; CONTROL = No input; P= Phosphorus only; T = Treatment; E = Experiment; **= significant at 1% Probability; WAS= Weeks After Sowing.

Dry Weight of Haulms (Kg/ha)

Testing varietal response to various fertilizer treatments on dry weight of haulms is presented in table 6. Application of all rates and combination of different of fertilizer produced statistically ($P \leq 0.01$) similar higher dry weight of haulms per plot than the control only. At Ajingi location, there was significant treatment effect of all various fertilizers applied, though control treatment produced the least number of haulms dry weight at that location. At Gaya location, similar trend was recorded, but statistically at par compared to Ajingi only with the application of PK-MN-OM at Gaya location.

Table 6: Testing varietal response to various fertilizer treatments on Dry weight of Haulms (kg/ha) Of Groundnut (*Arachis hypogaea* L.) at Ajingi and Gaya

Treatment	Ajingi	Gaya	Combine
PK-MN-OM	2872.0a	3833a	3352.4a
OM	2883.3a	1821ab	2352.2ab
PK	2840.8a	1652ab	2246.4ab
P	2850.7a	1708ab	2279.2ab
PK-MN	2800.7a	1674ab	2237.6ab
CONTROL	1651.2b	1093b	1371.9b
SE	249.9	815.5	610.8
Significance	**	**	**
Interaction			
T x E	NS	NS	NS

Keyword: Means within a column followed by same letter(s) are statistically similar ($P \leq 0.05$) using Duncan Multiple Range Test (DMRT); NS = Not Significance; PK-MN = Phosphorus + Potassium + Micronutrient; OM = Organic Manure; PK-MN-OM = Phosphorus + Potassium + Micronutrient + Organic Manure; PK = Phosphorus + Potassium; CONTROL = No input; P= Phosphorus only; T = Treatment; E = Experiment; **= significant at 1% Probability; WAS= Weeks After Sowing.

CONCLUSION

Finding of the study revealed that application of all rates and combination of different fertilizers significantly showed higher treatment effect across plots, location and combined analysis. Similarly, application of combination of PK-MN-OM and PK-MN significantly ($P \leq 0.01$) recorded higher number of established plant, fresh weight (kg) of pods per plots, fresh weight of Stover (kg) per plots, number of pods per plant, dry weight of pods per plots, haulms weight per plots, 100 seeds weight (g), shelling (%) 74.5 % than control 45.1% across plots, locations and at combined analysis than, treatment with PK, P, OM and the control. Therefore, the results showed that, application of combination of PK-MN-OM and PK-MN was statistically higher than application of combinations of PK, P, OM and the control treatment.

Recommendation

From the finding of this study: it is hereby recommended that: -

- Application of PK-MN-OM and PK-MN should be adopted
- Organic manure at the rate of 40kg/ha should be use and combine with phosphorus fertilizer at the rate 30kg/ha which produced high yield
- Groundnut variety Samnut 24 is recommended

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