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RESPONSE OF DIFFERENT TYPE OF FERTILIZERS ON GROWTH OF TWO GROUNDNUT (*Arachis hypogaea* L.) VARIETIES IN KATSINA A SUDAN SAVANNAH

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ABSTRACT
The **e**xperimental trial was conducted to evaluate the response of different types of fertilizers on the growth of two groundnut varieties in Katsina a Sudan savannah. The experiment was conducted during the 2020 and 2021 rainy seasons at Samaru farm Mani LGA, Katsina State, Nigeria. Treatments consisted of two varieties of groundnut (SAMNUT 25 and SAMNUT 26) and four different types of fertilizer (zero fertilizer, organic manure, NPK 30:30:30 and poultry manure) replicated three times. The treatments were factorized and laid out in a randomized complete block design (RCBD). The result shows that groundnut growth components such as: the number of leaves per plant, leaf area index and days to 50% flowering per plot was significantly influenced by different types of fertilizer and SAMNUT 25 ($P \leq 0.05$) outperformed SAMNUT 26. Different types of fertilizer Applications also recorded a significant ($P \leq 0.05$) effect on growth parameters. However, the Application of poultry manure significantly ($P \leq 0.05$) outperformed better on the number of leaves and leaf area index at 3, 6 and 9 WAS but during the 2020 growing season at 6 WAS organic manure recorded the highest (105) number of leaves. The study revealed that the application of poultry manure on SAMNUT 25 proves to promote better growth of groundnut in the study area.

Keywords: Groundnut Varieties, growth component, NPK fertilizer, organic manure, poultry manure

INTRODUCTION

Groundnut is one of the most edible vegetable oil crops in many countries, where it is a good source of protein (25%-34%), cooking oil (46%-52%) and vitamins the plant is also a native to Central America and has never been found uncultivated (Vabi, *et al.*, 2019). Groundnut is usually grown as a smallholder crop in the semi-arid tropics under rain-fed conditions. Groundnut is grown in 26.4 million hectares across the globe, with a total production of 37.1 million metric tons and average production of 1690 kg/ha (FAO, 2006). Groundnut kernels are consumed directly as raw, roasted or boiled kernels while the oil extracted from the kernel is used as culinary oil (Ojelade, et al., 2018). Its seeds contain 48-50% oil, 24-26% protein, and 10-20% carbohydrate (Obi *et al*., 2008). Groundnut is also important in the confectionery industry where products such as snack nuts, sauce, flour, peanut butter and cookies are made from high-quality nuts of the crop. In the northern Guinea and Sudan savanna zones of Nigeria, apart from being consumed whole, edible groundnuts are processed into or included as an ingredient in a wide range of other products, which include groundnut paste that is fried to obtain groundnut cake (*kuli kuli),* salted groundnut (*gyada mai gishiri),* a gruel or porridge made with millet and groundnut (*kunun gyada),* groundnut candy *(kantun gyada)* and groundnut soup (*miyar gyada)* (Usman, 2015). Its Nitrogen-fixing ability and vigorous growth in adverse environments, especially in N-deficient soils, are particularly advantageous in subsistence agriculture (Rahman, 2003). Cultivated groundnut has two subspecies, *hypogaea* and *fastigiata*, which in turn have two botanical varieties (ver *hypogaea* and var *aequatoriana*). Each of these botanical varieties has different plant, pod and seed characteristics. However, most of the commercially cultivated varieties are belong to the *hypogaea (*common name/makers type: Vigninia or runner), *fastigiata* (Valencia), and *vulgaris* (Spanish) botanical variety groups the average yield of grain crops in the zone stood at 1.7 t ha^{-1} compared to advance countries groundnut production can reach up to 3.5tons ha^{-1} (Tran, 2003). Nigeria is the third-largest producer of groundnut in 2019 with an annual production of 4.4 million tonnes after China 17.1 million tonnes and India 6.7 million tonnes (FAO, 2021). It is estimated that 3.9 million hectares were planted in 2019 with groundnut in Nigeria (FAO, 2021).

Groundnut requires moderate rainfall during the growing season, an abundance of sunshine and relatively high temperatures. Sudan Savanna in Nigeria also has the required soil, sunshine and temperature for groundnut production, there is the need to grow groundnut during the dry seasons to supplement rainy season production (Mukhtar, 2009). Groundnut improves soil fertility through nitrogen fixation, thereby increasing the productivity of other crops when used in rotation or a cereal cropping system. The poor productivity of groundnut cultivation in African countries may be attributed to a combination of factors such as unreliable rains, mostly non irrigated nature of cultivation, traditional small-scale farming with little mechanization, outbreaks of pests and diseases, use of low-yielding varieties, increased and/or continued cultivation on marginal land, poor adoption of agronomic practices and limited extension services. Groundnut-producing areas encompass the Sahel, Sudan and derived savanna, Northern Guinea and most parts of the Southern Guinea vegetation zone. The major groundnut producing states are Kano, Katsina, Kaduna, Jigawa, Sokoto, Zamfara and Kebbi in the Northwest; Adamawa, Bauchi, Yobe and Borno in the Northeast; and

Benue, Plateau, Taraba, Nasarawa, FCT Abuja, Kogi, Niger and Kwara in the Central Zone. ICRISAT, (2013) reported that groundnut yield in Africa has generally been poor due to a combination of factors, including unreliable rains, little technology available to small-scale farmers; poor seed varieties, and increased cultivation on marginal land. Groundnut production is seriously affected by the use of varieties (low yielding), pest and disease, climatic factors, poor agronomic practice, sub-optimal and inappropriate manure doses. Furthermore the use of inorganic fertilizer have not been helpful under intensive agriculture because it is often associated with reduced crop yield, soil acidity and nutrients imbalance (Ojeniyi, 2000).

Application of organic fertilizers is considered to be a traditional practice of maintaining soil fertility because apart from the macro and micronutrients which they supply, they also improve soil physical and chemical properties while Inorganic fertilizers application could be seen as the fastest way of meeting the nutrients requirement of groundnut production but it comes to our knowledge that Continuous use of inorganic fertilizers increases the acidity of the soil thus limiting the activities of beneficial microorganisms and percentage assimilability of available nutrients into the soil. However, groundnut has been reported to respond better to residual fertility than to direct fertilization. This means if a well-fertilized crop precedes a groundnut crop, direct fertilization may not increase the yield or quality of the groundnuts (Ajeigbe, *et al*., 2014). Ojeniyi (2000) reported that organic manure use in Nigeria is rather scanty. The need to use renewable forms of energy and reduce the costs of fertilizing crops has revived the use of organic fertilizers worldwide. Nutrient limitations in legume production result from deficiencies of not only major nutrients but also micronutrients such as molybdenum (Mo), zinc (Zn), boron (B) and iron (Fe) (Graham, 1981). Poultry manure is an excellent source of plant nutrients, as it contains high nitrogen, phosphorous, potassium and other essential nutrients (Mitchell and Donald, 2012). In contrast to mineral fertilizers, poultry manure adds organic matter to the soil, which improves soil structure, nutrient retention, aeration, soil moisture-holding capacity and water infiltration (Mitchell and Donald, 2012)

MATERIALS AND METHODS

Experimental Site

Experimental trials were conducted during the 2020 and 2021 rainy seasons at Samaru farm Mani, Katsina State. The experimental site falls under the Sudan savanna agro-ecological zone of Nigeria. The area has an annual rainfall range of 400 – 800 mm and mean annual temperature ranging from 15^0C to 45 ^{0}C (NiMet, 2018). Soil samples from the experimental site were collected randomly at 0 – 30 cm soil depths diagonally across the field from the experimental sites before establishing the trial. A tubular auger was used in taking the samples from 12 different points. The composite sample was analyzed for some physical and chemical properties using standard procedures as described by Black, (1968). The soil of the area is sandy loamy with a ph of 6.26 and organic carbon of 2.1, respectively. Data on rainfall distribution, temperature, sunshine and relative humidity for 2020 and 2021 growing seasons were collected during the research. The field was cleared, harrowed and ridged. The ridges were subdivided into plots of four ridges per plot at 3 meters length and 0.75m in between rows (3m x 3m = ($9m^2$) and. The net plot consists of two inner rows at a spacing of 0.75m x 3m = 2.25 x 2 given a total of $4.5m^2$. The total area of $9m^2$ x 8plots x 3Reps (216 m^2). A passway of 1m was made between the demarcated experimental site and 1m between the replications. The seeds of the two varieties (SAMNUT 25 and SAMNUT 26) were sourced from Katsina State Agricultural and Rural Development Authority (KTARDA). The seeds were treated with Apron Star @10g per 3kg of seed before planting to protect the seeds against soil pathogens and pests. The seeds were sown manually at inter and intra-row spacing of 75cm x 20cm at 5cm depth using two seeds per hole. The seeds were sown on 6th July, 2020: 23rd July, 2021. Different types of fertilizer were applied as per treatment by broadcasting while NPK fertilizer at the rate of 30:30:30 was applied two weeks after planting as per treatment. The first and second weeding were conducted manually with a hoe at 4 and 8WAS to control weeds and improve soil aeration. Harvesting was done manually by using a hoe to uproot the entire plant at full maturity (browning of leaves, drying of pods, full coloration of kernel and darkening of inner part of the pod). The data on plant growth was collected at 3, 6 and 9WAS from five (5) sample plants per plot while the yield was computed from the entire net plot area. The harvested groundnut were lifted out and laid on the ridges to sundry for 7 days. Shelling was done by carefully removing the pods to obtain the kernels. Growth parameters were collected from five (5) plants per plot, Selected randomly from the net plot. Data collected were subjected to statistical analysis of variance (ANOVA) as described by Gomez and Gomez, (1984) using SAS (2003) package. The treatment means were separated for the significant difference using the Duncan Multiple Range Test (DMRT) Duncan, (1955) at 5% level of probability ($P \leq 0.05$) (Steel and Torrie, 1980).

RESULTS

The number of leaves per plant of two groundnut varieties at 3, 6 and 9WAS was affected by a different types of fertilizers at Samaru Farm (Table 1). The result showed that there was a significant ($P<0.05$) difference between the two varieties of groundnut observed on a number f leaves per plant during the experiment where SAMNUT 25 recorded the higher number of leaves per plant than SAMNUT 26 at 3 and 6WAS during 2020 growing season. Among the four different types f fertilizers used in the experiment organic manure and poultry manure significantly ($P<0.05$) outperformed better than NPK fertilizer at 3, 6 and 9WAS on a number of leaves per plant observed at the two growing seasons. The interaction between variety and different types of fertilizers was not significant ($P>0.05$) at the two growing seasons.

Leaf area index (cm) of two groundnut varieties at 3, 6 and 9WAS was affected by different types of fertilizers at Samaru Farm (Table 2). The result showed that there was a significant ($P<0.05$) difference between the two varieties of groundnut observed on leaf area index per plant during the experiment where SAMNUT 25 recorded the higher number of leaf area index per plant than SAMNUT 26 at 3, 6 and 9WAS during 2020 and 2021 growing season. Different types of fertilizers had significant ($P<0.05$) on leaf area index, however, poultry manure significantly ($P<0.05$) performed better than organic manure and NPK fertilizer at 3, 6 and 9WAS on leaf area index per plant observed at the two growing seasons. The interaction

between variety and different types of fertilizers was not significant (P>0.05) at the two growing seasons Table 2.

The number of days to 50% flowering of two groundnut varieties at 3, 6 and 9WAS was affected by a different types of fertilizers at the two growing seasons (Table 3). The result indicated that variety had a significant (P<0.05) effect on the two groundnut varieties on a number of days to 50% flowering and SAMNUT 25 recorded the highest number of days to 50% flowering at the two growing seasons with 22.3 and 23.0 than SAMNUT 26 with 23.2 and 24.3 respectively. On a different types of fertilizers the result indicated that there was a significant (P<0.05) effect between the four types of fertilizers used in the experiment and poultry manure (24.8) outperformed better than the rest followed by organic manure (24.1), NPK fertilizer (23.0) and 0F (21.7) respectively. The interaction between variety and four different types of fertilizers was not significant (P>0.05) at the two growing seasons.

Table 1: - Effect of variety and Different types of fertilizer on Number of leaves per plant (cm) on groundnut varieties at 3, 6 and 9WAS during the 2020 and 2021 wet season

	Number of leaves per plant					
	3WAS		6WAS		9WAS	
Treatments	**2020 Season**	**2021Season**	**2020 Season**	**2021Season**	**2020 Season**	**2021Season**
Varieties (V)						
SAMNUT 25	51.4[a]	46.7	102[a]	74.3	147	120
SAMNUT 26	44.7[b]	48.8	93.2[b]	73.4	139	110
S.E(±)	2.47	2.18	2.35	4.09	4.04	4.98
Significance	*	NS	*	NS	NS	NS
Type of Fertilizer						
0F	36.8[c]	41.7[b]	94.3[b]	60.8[b]	126[b]	94[b]
Organic Manure	49.0[b]	47.6[a]	105[a]	76.5[a]	151[a]	119[a]
NPK 30:30:30	48.5[b]	51.2[a]	96.8[b]	77.8[a]	143[a]	121[a]
Poultry Manure	56.5[a]	50.6[a]	95.2[b]	80.2[a]	151[a]	126[a]
S.E(±)	2.47	2.18	2.35	4.09	4.04	4.98
Significance	*	*	*	*	*	*
Interactions						
V x F	NS	NS	NS	NS	NS	NS

Note *= Significant, NS= Not Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 2: - Effect of variety and Different types of fertilizer on Leaf area index per plant (cm) on groundnut varieties at 3, 6 and 9WAS during the 2020 and 2021 wet season

	Leaf area index per plant (cm)					
	3WAS		6WAS		9WAS	
Treatments	**2020 Season**	**2021 Season**	**2020 Season**	**2021 Season**	**2020 Season**	**2021 Season**
Varieties (V)						
SAMNUT 25	1.07[a]	0.71[a]	1.58	1.02[a]	2.07[a]	2.02
SAMNUT 26	0.90[b]	0.57[b]	1.41	0.86[b]	1.80[b]	1.90
S.E(±)	0.05	0.04	0.08	0.05	0.08	0.05
Significance	*	*	NS	*	*	NS
Type of Fertilizer						
0F	0.80[b]	0.63	1.21[c]	0.88[b]	1.57[b]	1.81[c]
Organic Manure	1.06[a]	0.66	1.50[b]	0.99[a]	2.09[a]	1.95[b]
NPK 30:30:30	1.01[a]	0.64	1.52[b]	0.92[a]	1.99[a]	1.95[b]
Poultry Manure	1.08[a]	0.65	1.75[a]	0.99[a]	2.08[a]	2.09[a]
S.E(±)	0.05	0.04	0.08	0.05	0.08	0.05
Significance	*	NS	*	*	*	*
Interactions						
V x F	NS	NS	NS	NS	NS	NS

Note *= Significant, NS= Not Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 3: - Effect of variety and Different types of fertilizer on Days to 50% flowering per plot on groundnut varieties during the 2020 and 2021 wet season

	Days to 50 % Flowering per plot	
Treatments	**2020 Season**	**2021 Season**
Varieties (V)		
SAMNUT 25	22.3[b]	23,0[b]
SAMNUT 26	23.2[a]	24.3[a]
S.E(±)	0.34	0.55
Significance	*	*
Type of Fertilizer		
0F	21.1[c]	21.7[c]
Organic Manure	22.8[b]	24.1[a]
NPK 30:30:30	22.2[b]	23.0[b]
Poultry Manure	24.3[a]	24.8[a]
S.E(±)	0.34	0.55
Significance	*	*
Interaction		
V x F	NS	NS

Note *= Significant, NS= Not Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

DISCUSSION

Growth Parameters

SAMNUT 26 significantly performed better than SAMNUT 25 in all the two growing seasons on a number of days to 50% flowering. This could be due to the genetic makeup of the varieties. The poor performance of SAMNUT 25 on days to 50% flowering was also due to its varietal effect. This result is in line with findings by Stephen, (2009) who reported that SAMNUT 26 has erect bunch growth habit and flowered earlier than SAMNUT 25. However, the significant difference recorded on a number of leaves per plant and leaf area index at the two growing seasons on SAMNUT 25 over SAMNUT 26 could also be attributed to the genetic compositional makeup of the varieties and their habitual interaction with climatic factors. This result is in line with another finding by Usman, (2015). The varietal differences recorded could be attributed to variations in their genetic makeup and gene interaction with the environment (moisture, abundant sunshine, soil fertility) as well as crop management (weed control and poultry manure treatments employed). Mouri, *et al.*, (2018). Also reported that the significant effect recorded from the growth component of two groundnut varieties was due to genetic differences of the varieties. However, the significant effect recorded by poultry manure could be attributed to the fact that poultry manure contains higher nitrogen content, phosphorous and potassium in addition to other micronutrients such as calcium, magnesium that are essential for groundnut production. This report is in line with findings by Schilling and Gibbons, (2002). Apart from the nutrient supplying power of poultry manure, it also provides an excellent source of organic matter, which improves the structural characteristic of the soil. The structural improvement results in increase water holding capacity, aeration and drainage which enhance good root growth and development. Usman, (2015) also reported that the application of essential nutrients which are available in poultry manure was responsible for the significant increase in the growth and yield of plots where poultry manure was applied. Nitrogen helps in photosynthetic activities, vigorous growth and the dark green color of the leaves (Kamara, *et al.*, 2011).

CONCLUSION

Based on the findings of this study, it can be concluded that SAMNUT 25 and application of poultry manure had a better performance on growth yield component of groundnut although SAMNUT 25 and application of organic manure also recorded a significant effect and statistically the same in some of the growth components. However, the use of SAMNUT 25 with the integration of poultry manure ranked first and the best while organic manure was ranked second best and was recommended for growing groundnut during the rainy season in the study area.

The following recommendations are made after careful consideration of the research findings: -

(i) SAMNUT 25 was found to be the highest on growth components and is recommended for production during the rainy season in the study area

(ii) Poultry manure application is also recommended for groundnut production in the study area.

(iii) Organic manure can also be used as the second-best type of fertilizer when poultry manure is not available in the study area.

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