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Research Article

The Effect of Different Types of Fertilizer on Groundnut (*Arachis hypogaea* L.) Varieties

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Abstract

Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crops grown in semi-arid and subtropical areas of the world. The crop is not able to meet market demands due to poor yield. The objective of this was to investigate the effect of different types of fertilizer on groundnut (*Arachis hypogaea* L.) VARIETIES in Katsina State. Two field experiments were conducted during the 2020 and 2021 rainy seasons at Basic vocational Agricultural research farm Gidan Kwakwa Katsina 13.00530N, 7.58540E. Treatments consisted of two varieties of groundnut (SAMNUT 25 and SAMNUT 26) and four different types of fertilizer (zero fertilizer, organic manure, NPK fertilizer, and poultry manure) replicated three times. A combination of eight treatments was factorized and laid out in a randomized complete block design (RCBD)). The study revealed that there was a significant ($P \leq 0.05$) effect of different types of fertilizer applications on the number of branches per plant, plant height, and canopy spread at 3, 6 and 9 WAS and SAMNUT 25 significantly ($P \leq 0.05$) performed better than SAMNUT 26 groundnuts. Poultry manure recorded a significant ($P \leq 0.05$) effect on plant height at 3, 6 and 9 WAS, canopy spread at 3, 6 and 9 WAS, and the number of branches per plant at the two growing seasons. However, the study revealed that SAMNUT 25 and poultry manure application on growth parameters proved to be most effective in the study area.

Keywords: Groundnut Varieties; Growth; NPK Fertilizer; Organic Manure; Poultry Manure

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crops grown in semi-arid and subtropical areas of the world by [2]. It is an annual legume crop also called as peanuts, monkey nut and goobers. The crop is from the Family: *Fabaceae*, Sub-Family: *Papilionaceae,* Genus: *Arachis and* Species: *hypogaea.* The origin of the crop was Central America and was also being cultivated since 1000 B.C. The crop was later introduced into present Nigeria in the 16th Century by Portuguese traders [21]. The leading producing states are Northwest of Nigeria (Kano, Katsina, Jigawa, Zamfara, Kebbi, Sokoto, Niger and Kaduna) and North eastern part of Nigeria (Adamawa, Yobe, Borno, Taraba, Platuea, Nasarawa, Bauchi and Gombe) [23]. Thin most cases groundnut in intercropped with cereals crop or planted in sole cropping in the tropics and sub-tropics [19]. The crop was rank as13th world most important annual food crop and 4th in oil seed production crop while soybean, cottonseed and rape seed were rank 1st 2nd and 3rd respectively [9]. The World production figure of groundnut in 2019 was 48.8 million tonnes from 29.6 million hectares with average production of 1647 kg ha^{-1} [11]. The production of groundnut is concentrated in Asia and Africa, where the crop is grown mostly by smallholder farmers under rain-fed conditions with limited inputs [25]. Asia, Africa and South America are the highest producing countries of the world with over 95% groundnut yield and 97% total world groundnut area. However, Asian countries especially India and China have the capacity of producing (2217 kg ha^{-1}) and Africa including Nigeria, Niger and Sudan produce (929 kg ha^{-1}) which is very poor as compared to Americas (3632 kg ha^{-1}) [10]. The third largest producing country of groundnut in Africa as of 2019 was Nigeria with annual production of 4.4 million tonnes after China

17.1 million tonnes and India 6.7 million tonnes [11]. It is estimated that 3.9 million hectares were planted in 2019 with groundnut in Nigeria [11]. In west Africa Nigeria is the largest groundnut producer with 51% of the total production [18]. The country produces 10% and 39% of the World and Africa's total production respectively. Prior to 1980s, groundnut production declined significantly due to rosette incidence and drought. However, since 1984, production has been increasing at a growth rate estimated to 8% resulting both from area expansion (6%) and increased productivity of 2% [18]. Before 1980s, there was a significant decrease in groundnut production which was due to the problems of rosette disease and drought. From 1984, groundnut production has been increasing up to 8% resulting both from (6%) area expansion and 2% increase in productivity [18]. It is a major cash crop for many households accounting for 21% of rural cash earnings and is a major source of employment [25]. With biological nitrogen fixation (BNF) significant increase in total value of groundnut production per hectare was reported through (intensifying cereal - based cropping systems through intercropping, relay cropping and rotation cropping). Groundnut is a well nutritious cook, fried and processed food which contributes in improving health of the rural people. It is rich in protein content, oil and nutrients including iron and zinc. The amino acid contents of the crop also complement those of cereals, such that taking them combination with cereals raises the nutritional effectiveness of both. Higher content of iron and zinc are significantly beneficial for women and children at risk of anemia and have proven to be genetically effective [17]. The main problems limiting production of groundnut include non-availability of seed of improved varieties for a particular ecology, inappropriate crop management practices, inadequate weed management, pest and diseases high labor demand for groundnut production, lack of mechanization and market constraints [1]. Groundnut requires a well-drained light sandy in color or sandy loam soil and a loosed friable soil with optimum moisture in pod zone and means daily temperature of 25 to 30°C [3]. Nutrient limitations to legume production result from deficiencies of not only major nutrients but also micronutrients [6]. However, as a general practice, optimal supply of macronutrients to crops is usually ensured while that of micronutrients is ignored. However, involvement of micronutrients such as zinc and iron in different physiological and biochemical activities of the legume plants is well stored and the correlations between micronutrient supply groundnut on crop growth and productivity have often been documented. Soils problems such as acid, alkaline or sandy soils are often deficient in one or more trace elements [4]. Therefore, the application of trace element as foliar or soil amendments is very important in achieving optimum groundnut productivity in the northern Guinea savanna type of soil.

Manures application to the soil is a good source of Nitrogen and other micronutrients for plants (phosphorus (P), potassium (K), calcium (Ca), iron (Fe), zinc (Zn) and copper (Cu) that can make valuable contributions to soil's organic matter, to also improve the soil fertility, and are a center for biological activities [14]. The addition of organic matter can also improve plant health beyond the nitrogen (N) fertility value [5]. They contribute to plant growth significantly through their favorable effects on the physical, residual, and biological properties of soil. The significant effects of organic and inorganic sources on soil nutrients, crop yields, and maintenance of soil organic matter have been studied in field experiments [16]. The trial is worth adopting in the groundnut production area in order to increase its productivity by maintaining and improving the soil organic content of the soil in the area of study.

Objective of the study

In an effort to raise the yield of groundnut production in the study proper agronomic practices such as suitable varieties of groundnut for production, type of fertilizer to be used and its appropriate rate must be adopted. In view of the above, this research was made with the following objectives

- To determine the most suitable variety of groundnut for production under rainfed conditions in Katsina state Nigeria.
- To evaluate the growth parameters of groundnut varieties as affected by different types of fertilizer in Katsina state of Nigeria.
- To assess the interaction between the performance of groundnut varieties and different types of fertilizers used in the study area.

Materials and Methods

Experimental site

Two field experiments were carried out during the 2020 and 2021 rainy seasons at Basic vocational Agricultural research farm Gidan Kwakwa Katsina State 13.0053^{0}N, 7.5854^{0}E Sudan savannah Nigeria. The area has an annual rainfall range of 550 - 700 mm and

a mean annual temperature ranging from 15°C to 41°C [20]. 2x4 factorial combination of Treatments were factorized and laid out in a randomized complete block design (RCBD) and replicated three times. Soil samples were collected randomly from the experimental site at 0 - 30 cm soil depths diagonally across the field before conducting the trial. Tabular soil 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 [7]. 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 the 2020 and 2021 growing seasons were collected during the research. The climate is characterized by daily temperatures ranging from 15 to 45^0C. The field was cleared, harrowed, and ridged. The ridges were also divided into plots of 4 ridges per plot at 3 meters in length and 0.75m in between rows (3m x 3m = ($9m^2$) while the net plot consisting of two inner rows at a spacing of 0.75m x 3 = 2.25 x 2 given a total of 4.5 m^2. A total area of $9m^2$ x 8plots x3Reps (216 m^2). Passway of 1 m was made between the boundary of the trial 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 Difenoconazole @10g per 3 kg of seed prior to planting to protect the seeds against soil pathogens and pests. The seeds were sown manually at inter and intra-row spacing of 75 cm x 20 cm at 5 cm depth using two seeds per hole. The seeds were sown on 6th July 2020 and 23rd July, 2021. A different type of fertilizer was applied as pretreatment by broadcasting while NPK fertilizer at the rate of 30:30:30 was applied two weeks after planting as pretreatment. At 4 and 8 WAS 1st and 2nd weeding was done manually with a hoe to control weeds and improve soil aeration. Manually harvesting was done using a hoe by gently uprooting the entire plant at full maturity as follows: 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 Data collected were subjected to statistical analysis of variance (ANOVA) as described by [13] using SAS [23] package. The treatment means were separated for the significant difference using Duncan Multiple Range Test (DMRT) Duncan, [8] at 5% level of probability ($P \leq 0.05$).

Results

Result indicated that Plant height had a significant effect (($P \leq 0.05$) on different types of fertilizer applications at 6 and 9WAS during the 2020 and 2021 rainy seasons. Plant height progressively increases from 6 to 9 WAS and SAMNUT 25 significantly ($P < 0.05$) performed better than SAMNUT 26 in all the growing seasons. However, the application of poultry manure had a significant effect ($P < 0.05$) on plant height at 3, 6, and 9 WAS at the two growing seasons. The interaction between variety and different types of fertilizer was not significant ($P > 0.05$) at the two growing seasons (Table 1).

Canopy spread was significantly ($P < 0.05$) affected by different types of fertilizer on two groundnut varieties at 3, 6, and 9 WAS as presented in (Table 2). SAMNUT 25 significantly outperformed SAMNUT 26 at the two growing seasons. Different types of fertilizer has a significant effect ($P < 0.05$) on canopy spread at 3, 6 and 9WAS at the two growing seasons, and application of poultry manure recorded the highest number of canopy spread at the two growing seasons. The interaction between variety and different types of fertilizer was not significant ($P > 0.05$) at the two growing seasons.

Number of branches per plant had a significant (($P \leq 0.05$) effect on different types of fertilizer applications on groundnut at the two growing season (Table 3).

The result indicated that SAMNUT 25 (11.29 and 11.2) significantly ($P < 0.05$) performed better than SAMNUT 26 with 9.72 and 9.58 respectively in terms of number of branches per plant at the two growing seasons. Different types of fertilizer also recorded a significant ($P < 0.05$) effect on number of branches per plant and application of poultry manure recorded the highest number of branches per plant (11.5 and 11.3) followed by application of organic manure with 11.2 and 10.2, NPK 30:30:30 with 11.0 and 11.2 although they are statistically the same and the least was obtained from zero application of fertilizer with 8.83 and 8.50 respectively (Table 3). The interaction was not significant ($P > 0.05$) at both two growing seasons.

Discussion

SAMNUT 25 significantly outperformed SAMNUT 26 on plant height; canopy spread and the number of branches per plant at the two growing seasons. This could be due to the genetic compositional makeup of the varieties. However, the significant different differences recorded at the two growing seasons could be attributed to climatic differences recorded from the two growing sea-

	3WAS		Plant height (cm) 6WAS		9WAS	
Treatments	**2020 Season**	**2021Season**	**2020 Season**	**2021Season**	**2020 Season**	**2021Season**
Varieties (V)						
SAMNUT 25	23.7	23.1	40.5	34.4[a]	55.4[a]	49.8[a]
SAMNUT 26	23.7	22.3	39.7	30.9[b]	48.8[b]	44.8[b]
S.E(+)	1.08	1.08	1.44	1.25	2.19	1.56
Significance	NS	NS	NS	*	*	*
Type of Fertilizer						
0F	20.2[b]	19.0[c]	34.4[c]	27.5[b]	42.2[c]	40.5[c]
Organic Manure	22.0[b]	21.3[b]	38.3[b]	33.0[a]	51.7[b]	49.0[b]
NPK 30:30:30	27.7[a]	25.2[a]	41.8[b]	35.7[a]	54.7[b]	48.5[b]
Poultry Manure	24.8[b]	25.2[a]	45.0[a]	34.5[a]	59.8[a]	51.3[a]
S.E(+)	1.08	1.08	1.44	1.25	2.19	1.56
Significance *	*	* *	*	*	NS	NS
Interactions						
V x F	NS	NS	NS	NS	NS	NS

Table 1: Effect of Variety and Different sources of fertilizer on plant height per plant (cm) on groundnut varieties at 3, 6 and 9WAS during the 2020 and 2021 wet season.

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.

	3WAS		Canopy spread per plant (cm) 6WAS		9WAS	
Treatments	**2020 Season**	**2021 Season**	**2020 Season**	**2021Season**	**2020 Season**	**2021Season**
Varieties (V)						
SAMNUT 25	8.57[a]	8.08	10.9[a]	10.1[a]	20.4[a]	12.5[a]
SAMNUT 26	7.27[b]	7.38	8.95[b]	8.97[b]	18.3[b]	11.0[b]
S.E(±)	0.43	0.32	0.43	0.25	0.75	0.40
Significance	*	NS	*	*	*	*
Type of Fertilizer						
0F	6.00[b]	7.01[b]	8.20[b]	8.57[b]	16.3[b]	10.1[b]
Organic Manure	8.88[a]	7.85[a]	10.6[a]	10.2[a]	21.2[a]	12.8[a]
NPK 30:30:30	7.87[a]	7.90[a]	10.2[a]	9.55[a]	19.7[a]	11.8[a]
Poultry Manure	8.92[a]	8.02[a]	10.6[a]	9.92[a]	20.0[a]	12.3[a]
S.E(±)	0.43	0.32	0.43	0.25	0.75	0.40
Significance *	*	*	*	*	NS	NS
Interactions						
V x F	NS	NS	NS	NS	NS	NS

Table 2: Effect of variety and Different sources of fertilizer on canopy spread per plant (cm) on groundnut varieties at 3, 6 and 9WAS during the 2020 and 2021 wet season.

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.

	Number of branches per plant	
Treatments	**2020 Season**	**2021 Season**
Varieties (V)		
SAMNUT 25	11.29[a]	11.2[a]
SAMNUT 26	9.72[b]	9.58[b]
S.E(+)	0.45	0.48
Significance	*	*
Type of Fertilizer		
0F	8.50[b]	8.83[b]
Organic Manure	11.2[a]	10.2[a]
NPK 30:30:30	11.0[a]	11.2[a]
Poultry Manure	11.5[a]	11.3[a]
S.E(+)	0.45	0.48
Significance	*	*
Interaction		
V x F	NS	NS

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

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.

sons which indicates that SAMNUT 25 respond more favorably to the growing condition of the study area. However, SAMNUT 25 is genetically better than SAMNUT 26 on growth and development as result indicated throughout the two growing seasons. Improved varieties are much more efficient at partitioning assimilates to the seeds than the old land races and this is because improved varieties had higher CGR [24]. The difference in growth and yield attributes of groundnut were associated with differences in their genetic compositions. However, the varietal differences recorded with reference to growth components could be attributed to the genetic makeup and the habit of the varieties [12]. The significant effect of different types of fertilizer application recorded on plant height; canopy spread and number of branches per plant at 3, 6 and 9 WAS during the experiment could be attributed to the nutrient variation of the fertilizers which also affect soil organic matter, microbial activities and micronutrient content. However, the positive effect of poultry manure on groundnut at the two growing seasons against other fertilizer type of fertilizers could be due to its high contribution of organic matter to soil fertility which also increases the macro and micronutrient and enhances the physico-chemical properties of the soil which could lead to its high vegetative growth. The productivity of groundnut variety is hampered by its effect, nutrient availability and Maintenance of optimum soil moisture by [25].

Conclusion

The significant differences in groundnut varieties recorded in this experiment show that SAMNUT 25 is significantly better on growth parameters than SAMNUT 26. The application of poultry manure produced the highest plant height, canopy spread, and number of branches per plant at the two growing seasons. However, SAMNUT 25 and application of poultry manure on growth parameters proved to be most effective in the study area. Similar research could be made on SAMNUT 25 variety being the best with application rate of poultry manure in order to assess the effect of poultry manure rate on the variety in the study area.

Recommendation

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

- SAMNUT 25 is the highest yielding among the tested varieties and is recommended for cultivation during the rainy season in the study area
- Application of poultry manure is also recommended for use in the study area. Because the research indicated that the application of poultry manure significantly outperformed better on growth parameters.
- Organic manure can be used as the second-best type of fertilizer when poultry manure is not available in the study area.

Conflict of Interests

The author declares that he has no conflicting interests.

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