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RESEARCH PAPER

Effects of nutrient sources and variety on the growth and yield of groundnut (*Arachis hypogaea*) grown in Makurdi

*Madina P.[1], Esang D. M.[1], Nwanojuo M. N.[1] and [2] Eche C.O.[2]

[1]Department of Crop Production, College of Agronomy, Joseph Sarwun Tarka, University Makurdi

[2]Department of Crop and environmental protection, College of Agronomy, Joseph Sarwun Tarka, University Makurdi, (JOSTUM) Nigeria

*Corresponding Author

*Madina P.

[1]Department of Crop Production, College of Agronomy, Joseph Sarwun Tarka, University Makurdi

*Corresponding Author Email: madinapaul26@yahoo.com[1]

Abstract

Field experiments were conducted in the rainy seasons of 2019 and 2020 to evaluate the Effects of Variety and Nutrient Sources on the Growth and Yield of Groundnut Grown in Makurdi in 2019 and 2020. Three nutrients sources used for the study were, SSP, NPK, noddle max and control. The treatments were combined in 3x4 factorial experiment laid out in a Randomized Complete Block Design (RCBD). With three replications (SAMNUT 23, SAMNUT 24, and SAMNUT 26) and nutrient sources (SSP, NPK, Noddle Max and control) served as the two factors with 100/ha^{-1} indicated in parentheses. Data obtained were combined and subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) version 9.1 (2002). The means were separated using least significant difference (LSD). Results shows that plant height, number of leaves per plant, number of branches per plant, number of pod per plant, 100 seed weight per hectare and pod yield per hectare differed significantly depending on variety and fertilizer applied. The Samnut 24 variety was superior to Samnut 23 and Samnut 26 in all parameters measured. 100 kg ha^{-1} of SSP maintained a consistent advantage over NPK, noddle max and control in all the measured variables. Groundnuts grown in 2020 rainy season were significantly ($P \leq 0.05$) better on the measured variables as compared with 2019 rainy season. Groundnut farmers in Makurdi, are therefore advised to grow Samnut 24 with the application of SSP fertilizer at the rate of 100 kg ha^{-1} for optimum yield.

Key words; Variety, Nutrient source, Growth, Yield and Groundnut.

Introduction

Groundnut (*Arachis hypogaea* L.) is a leguminous oilseed crop cultivated in the semi-arid and subtropical regions of the world. The crop originated in South America where it was cultivated as early as 1000 B.C. It is grown in nearly 100 countries on six continents between 400 N and S of the equator on nearly 24.6 m ha, with a production of 41.3 m.t. and productivity of 1676 kg ha-1 in 2012. China, India, Nigeria, USA and Myanmar are the leading groundnut producing countries in the world 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, (Arslan 2005).

However, there are many advantages of using a biorational fertilize such as noddle max. Most importantly they work in synergy with the plant's microbiome by feeding and/or not killing beneficial microbes. These beneficial microbes will in turn enhance the growth of the crop (for full details see the previous post under Mode of Action). Clearly using noddle max is advisable when growers are applying microbial inoculant products (such as rhizobia and mycorrhizae) but in addition there is hardly any form of growing plants that does not see benefit from beneficial microbes being stimulated, even if it goes on unknowingly to the farmer/grower! Therefore, using biorational fertilizers and pesticides allow you to have multiple tools working to maximise nutrient and pest management.

The important of nutrients, like NPK, Noddle max and Phosphorus for legume production has been recognized for a long time. Franco and Avillio (1976) suggested that legumes may require more phosphorus than non-legumes because of their high requirement of noddle max phosphorus for symbiotic nitrogen fixation. Anil *et al*., (2008) stated that among the essential plant nutrient phosphorus and noddle max is the most important for seed production, helping to form healthy and sound root system which is essential for nutrient uptake from the soil. Furthermore, NPK and phosphorus is a component of adenosine diphosphate (ADP) and adenosine triphosphate (ATP). Nutrients, such as NPK and Phosphorus plays a role in cell division, flowering and crop maturation, root development and nodulation (Tarawali and Quee, 2014). Phosphorus deficiency is the most frequent nutrient stress for growth and development of grain legumes including groundnut (Karama *et al*., 2008). One of the most important soil nutrients for crop production is phosphorus. NPK at early stage and phosphorus plays an important role in maturation of crop, root development, photosynthesis, nitrogen fixation and other vital physiological processes. In order of important to crop performance, phosphorus is rated second to nitrogen (Gervey, 1987). Sharma and Yaday (1997) reported that phosphorus noddle max plays a beneficial role in legume growth by promoting extensive root development and thereby ensuring a good yield. Balasubramanian *et al*., (1980) observed in a fertility study that phosphorus and noddle max application results in better nodulation and seed yield. Rhodes (1983) reported that noddle max and phosphorus application improved nodulation and seed yield of cowpea. El-Dsouky and Attia (1999) also attributed increased number and weight of nodules, nitrogen activity and groundnut yield to noddle max phosphorus fertilization. The objective of the work is to evaluate the effects of variety and nutrient sources on the growth and yield of Groundnut in the study area.

Materials and Methods

Field experiments were conducted in the rainy seasons of 2019 and 2020 at Teaching and research farm university of Agriculture, Makurdi, Benue State, Nigeria. The experimental site lies (Latitude 07°45’- 07° 50’N, Longitude 08° 45’- 08° 50’E at an altitude of 98m) above sea level. Three varieties of Groundnut: Samnut 23, 24 and 26 were used as test crop gottern from IAR Zaria. The three nutrients source used were SSP, NPK, noddle max and control. The three groundnut varieties and four nutrient source (including control), a 3x4 factorial arrangement fitted into a randomized complete block design (RCBD) replicated three times. Each year, land was harrowed before the plots of 3 m by 3 m dimension were marked out. Each plot was separated from the next one by 0.5 m border where as the replications were separated by 1 m borders. Each replication has 12 plots, giving a total of 36 plots for the study. Sowing was done at a depth of 3 - 5 cm with intra and inter row spacing of 25 cm and 75 cm respectively, this gave a total of 36 plants per plot (40,000 plants per hectare). Fertilizer application was done before sowing; the fertilizer was thoroughly incorporated into the soil. Weed control was manually done at 4 and 8 weeks after sowing using hand hoe to obtain weed free plots and avoid weed – crop competition. All the data were collected within the net plot of 4m². A total of 10 plants were selected at the centre of the plots and tagged using a coloured rope for easy identification and for the data collection within each net plot. The data collected were plant height, number of leaves, number of branches, number of pod, 100 pod weight and pod yield. The data were subjected to Analysis of Variance (ANOVA) using Statistical Analysis System (SAS) version 9.1 (2002). The means were separated using least significant difference (LSD).

Result and Discussion

Table 1 shows the main effect of variety and nutrient source on plant height of groundnut grown in 2019 and 2020 rainy season in Makurdi, where significant difference ($P<0.05$) was recorded in both variety and nutrient source. The variety Samnut 24 shows progressive increase in height from 6-10 weeks after planting where it recorded taller plants when compared to Samnut 23 and Samnut 26, this is not far from the fact that Samnut 24 has adopted to the environment and strive more than the other varieties, it could be attributed to the genetic make-up of the Samnut 24 leading to vegetative growth as supported by the finding of Tran Thi (2003) Who started that plants that adopt to a certain environment are liable to grow vegetatively,

On nutrient source the application of NPK shows superiority over the use of SSP and noddle max in plant height, this is true because NPK is a compound fertilizer that is need by plant for both vegetative and reproductive growth, this work is in conformity with the finding of Gervey (2000) Who started that applying NPK as started dose don’t only aid in nodulation but also plays an important role in early vegetative growth of groundnut, he added that phosphorus is rated second to nitrogen in order of importance to legumes. On season, 2020 rainy season recorded taller plants when compared with 2019 rainy season; this could be as a result of improvement in cultural practice, rainfall pattern and climatic conditions as reported by Arslan (2005).

Table 1: Effect of Variety and nutrient source on Plant Height of Groundnut in 2019 and 2020 rainy season in Makurdi

Treatments	Plant Height (cm)			
Variety (V)	**4WAP**	**6WAP**	**8WAP**	**10WAP**
Samnut-23	11.15b	17.21c	23.91c	31.05c
Samnut-24	10.94c	19.38a	30.34a	38.96a
Samnut-26	11.41a	19.35b	27.79b	36.08b
F-LSD (P≤0.05)	NS	1.36	1.23	1.37
Nutrient sources (N)				
Control	10.25d	16.31c	23.17d	30.33d
SSP	12.75b	19.69b	29.05b	37.00b
NPK	13.15a	20.41a	31.01a	38.19a
MAX	10.99c	19.13c	28.04c	36.83c
F-LSD (P≤0.05)	NS	1.75	1.58	1.74
Season (S)				
2019	10.52b	19.99b	29.56b	33.12b
2020	11.11a	21.63a	30.91a	38.23a
F-LSD (P≤0.05)	NS	1.63	1.21	1.12
Interaction				
VXN	NS	NS	NS	NS
NXS	NS	NS	NS	NS
VXS	NS	NS	NS	NS

Max= noddle max, LSD=least significant difference at 5% level of probability, *=95%, NS= Not Significant, VXS=variety and nutrient source, NXS=nutrient and season, VXS=variety and season

Table 2 shows the main effects of variety and nutrient source on number of branches of groundnut in 2019 and 2020 rainy season in Makurdi, where significant difference (P<0.05) existed between varieties and not nutrient sources. The variety Samnut 23 recorded higher number of branches when compared with other varieties under consideration form 6-10 weeks after planting, which could be attributed to inherent character of variety, this accretion is supported by the finding of Karama *et al* (2007) who reported that higher number of braches is one of the attribute of high yielding varieties/genotype of plants mostly found inherent. On nutrient source, plots treatment with noddle max recorded higher number of branches than other nutrient source but do not differed significantly, this might be as a result of rhizobium activities in the soil leading to the production of higher number of branches, this work collaborate with the finding of Kwari (2005) who reported that nodule max initiate noddle formation through the activities of rhizo-bacta which in turn supply the plant nutrient that lead to vegetative growth and eventually increase yield. On season, 2019 rainy season, even though there are statistically similar had higher number of braches when compared with 2020 rainy season, this could be as a result of temperature, rainfall, relative humidity and also probably agronomic practice, this finding agrees with the work of Ogah and Madina (2020) who reported that climate variability, temperature and agronomic practice affects plant vegetative growth either positive or negative.

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Table 2: Effect of Variety and nutrient source on number of branches of Groundnut in 2019 and 2020 rainy season in Makurdi

Treatments	Number of Branches			
Variety (V)	**4WAP**	**6WAP**	**8WAP**	**10WAP**
Samnut-23	4.92b	7.88a	9.48a	9.88a
Samnut-24	5.18a	7.36b	8.70b	9.08b
Samnut-26	4.80c	5.88c	6.00c	6.12c
F-LSD (P≤0.05)	NS	1.45	1.26	1.55
Nutrient sources (N)				
Control	5.00b	6.53d	7.20d	7.93d
SSP	4.93c	7.00c	8.03c	8.33c
NPK	4.87d	7.20b	8.60a	8.87a
MAX	5.10a	7.53a	8.47b	8.53b
F-LSD (P≤0.05)	NS	NS	NS	NS
Season (S)				
2019	4.56a	6.42b	7.01b	7.92b
2020	4.23b	7.21a	8.01a	8.23a
F-LSD (P≤0.05)	NS	NS	NS	NS
Interaction				
VXN	NS	NS	NS	NS
NXS	NS	NS	NS	NS
VXS	NS	NS	NS	NS

Max= noddle max, LSD=least significant difference at 5% level of probability, *=95%, NS= Not Significant, VXS=variety and nutrient source, NXS=nutrient and season, VXS=variety and season

Table 3 shows the effects of variety and nutrients source on leaf area of groundnut grown in 2019 and 2020 rainy season. Significant different was observed in all varieties across all the weeks but nutrient sources associated with leaf area was statistically similar across all the weeks under consideration. On variety Samnut 24 became outstanding form 6-10 weeks after planting when compared to the other varieties used, this could be as a result of inherent genetic make-up enabling the plant to be able to intercept solar radiation for photosynthesis which later translate to food formation, this is in agreement with the work of Nathe (2012) who reported that the larger the leaf area the better for solar radiation interception which is one of the attribute of Samnut 24. On nutrient source the use of noddle max had higher leaf area from 4-8 weeks after planting with NPK having larger leaf area in week 10 after planting, this could be attributed to partitioning of nutrients which later manifested in 10 week after planting, this work is not in agreement with the work of Karama *et al*., (2011) who reported that NPK produce larger leaf area at early stage is more efficient in the manufacturing of assimilate and partitioning of same to the productive sink which later translate such assimilate to pods formation, IITA (2015) reported that noddle max treated plants do have larger leaf area due to microbial activities which is same with this report as shows in Table 3, from 4-8 weeks after planting. On season, 2020 rainy season had plant with larger leaf area when compared with 2019 rainy season; this could be related to climatic factors as reported by FAO (2014).

Table 3: Effect of Variety and nutrient source on Leaf area of Groundnut in 2019 and 2020 rainy season in Makurdi

Treatments	**Leaf Area (dm^2)**			
Variety (V)	**4WAP**	**6WAP**	**8WAP**	**10WAP**
Samnut-23	8.27c	10.24c	9.61c	10.33c
Samnut-24	11.69b	15.67a	15.05a	15.63a
Samnut-26	12.34a	15.07b	14.76b	14.52b
F-LSD (P≤0.05)	1.55	1.51	1.49	1.54
Nutrient sources (N)				
Control	10.16d	12.74d	11.96d	12.16d
SSP	10.55c	13.65c	13.54b	13.71c
NPK	10.66b	14.17a	13.28c	14.43a
MAX	11.43a	13.91b	13.72a	13.80b
F-LSD (P≤0.05)	NS	NS	NS	NS
Season (S)				
2019	10.23b	11.89b	12.87b	13.23b
2020	10.89a	12.23a	13.23a	14.00a
F-LSD (P≤0.05)	NS	NS	NS	NS
Interaction				
VXN	NS	NS	*	*
NXS	NS	NS	*	*
VXS	NS	NS	NS	NS

Max= noddle max, LSD=least significant difference at 5% level of probability, *=95%, NS= Not Significant, VXS=variety and nutrient source, NXS=nutrient and season, VXS=variety and season

Table 4 shows the effects of variety and nutrient source on yield and yield related characters of groundnut grown in 2019 and 2020 rainy season, significant difference (P<0.05) was recorded in both varieties and nutrient sources, where Samnut 24 was statistically superior to other varieties in number of pods per plant, dry pod weight, 100 seed weight, shelling percentage and seed yield, this could be attributed to variety/genotype variability as reported by Tarawali and quee (2014). Form the trend of what had happen plant height, number of branches, leaf area has contributed to the yield and yield related characters in Samnut 24 which could have affected the yield positively, this accretion is supported by the finding of Animasaun *et al*., (2014) who reported that vegetative/ floral development in groundnut plays an important role in crop yield.

Table 4: Effect of Variety and nutrient source on Yield characters of Groundnut in 2019 and 2020 rainy season in Makurdi

Treatments	**Number of Pods/Plant**	**Pod Dry Weight (kg/ha)**	**100-Seed Weight (g)**	**Shelling (%)**	**Seed Yield (t/ha)**
Variety (V)					
Samnut-23	30.80a	698.80b	37.77b	61.62b	8.66b
Samnut-24	27.00b	714.26a	41.44a	70.00a	9.80a
Samnut-26	26.40c	656.86c	36.82c	74.99c	7.53c
F-LSD (P≤0.05)	1.36	21.45	1.61	1.39	1.07
Nutrient sources (N)					
Control	24.33d	587.37d	36.23d	66.57d	6.87d
SSP	30.80a	783.30a	49.67a	79.22a	9.18a
NPK	29.27b	755.53b	39.03b	69.93c	7.60c
MAX	27.73c	647.13c	37.53c	70.60b	8.10b
F-LSD (P≤0.05)	1.75	20.87	2.08	1.80	1.89
Season (N)					
2019	29.23b	769.12b	47.48b	76.12b	8.90b
2020	30.01a	789.90a	50.01a	78.23a	9.21a
F-LSD (P≤0.05)	1.12	21.22	1.01	1.23	1.01
Interaction					
VXN	*	*	*	*	*
NXS	*	*	*	*	*
VXS	NS	NS	NS	NS	NS

Max= noddle max, LSD=least significant difference at 5% level of probability, *=95%, NS= Not Significant, VXS=variety and nutrient source, NXS=nutrient and season, VXS=variety and season

On nutrient source, the application of SSP remain outstanding (differed significantly) in number of pods per plant, dry pod weight, 100 seed weight, shelling percentage and seed yield, this is not far from the facts that SSP have ability to initiate pod formation in legumes as supported by the finding of Rajkishore (2005) who reported increase in number of pods per plant, total number of pods and over all yield with the application of SSP, Karama (2011) also reported that increase dry matter weight and overall yield is affected positively with the application of SSP. This result is not in conformity with the finding of IITA (2018) who reported that noddle max have ability to Increase groundnut vegetative growth, yield and yield related characters. Sharma and Yaday (2000) reported that phosphorus plays a beneficial role in legume growth by promoting extensive root development and thereby ensuring a good yield. Balasubramanian *el al*., (2021) observed in fertility study that phosphorus application results in better nodulation and seed yield. On seasons, 2020 rainy season had recorded more number of pods per plant, dry pod weight, 100 seed weight, shelling percentage and seed yield when compared with 2019 rainy season, this could be a result of improvement in agronomic practice, rainfall, and also adoptability of the crop to the environment, Anil *et al*., (2018) lend support to the above accretion.

Table 5 shows interaction between variety and nutrient source on yield and yield related characters of groundnut grown in 2019 and 2020 rainy season, where a perfect interaction exist between the application of SSP and Samnut 24 recorded statistical higher number of pod per plant when compared with other nutrients source and verities, this could be attributed to SSP when compared with noddle max it might have played an important role in the initiation of pod couple with the variety/genotype which led to higher number of pod. This work is in agreement with the work of Rajkishore (2005) who stated that the application of phosphorus influences pod initiation and overall yield

Table 5 equally record the interaction between variety and nutrient source on dry pod weight, where Samnut 24 is differed significantly with all the nutrients source with SSP having the weightier pods, this is not far from the fact that SSP not only initiate pod formation but also plays an important role in pod filling leading to heavier pod, this finding is in conformity with the report of Tran (2003) who stated that the application of SSP result in heavier pod in legumes.

Same table 5 shows an interaction between nutrient source and variety on 100 seed weight when compared the application of SSP and Samnut 24 recorded heavier 100 seeds, this could be related with dry pod weight translating to 100 seed weight, this work collaborate with the finding of FAO (2006) which stated that the 100 seed weight is a product of pod dry weight, but El-Dsouky and Attia (1999) in their work suggest that pod dry weight is miss leading to conclude it lead to heavier 100 seeds weight.

Table 5 Interaction between variety and nutrient source on yield and yield related characters of Groundnut grown in 2019 and 2020 rainy season

Nutrient source	**Samnut 23**	**Samnut24**	**Samnut 26**
Number of pod/plants			
Control	25.27d	29.53d	27.03d
SSP	28.73a	33.13a	30.53a
NPK	26.36c	30.69c	29.92c
MAX	27.89b	31.92b	30.24d
F-LSD (P≤0.05)	1.42	1.62	1.73
Pod dry weight (kg/ha)			
Control	591.21d	691.41d	601.21d
SSP	672.11a	781.41a	711.34a
NPK	600.24c	710.01c	631.89c
MAX	631.04b	771.31d	682.56d
F-LSD (P≤0.05)	20.14	21.02	22.3
100 seed weight (g)			
Control	38.34d	45.21d	43.32d
SSP	43.85a	51.32a	50.14a
NPK	40.32c	47.92c	46.34c
MAX	41.49b	49.32b	45.68b
F-LSD (P≤0.05)	1.32	1.29	1.11
Shelling (%)			
Control	62.31d	70.44d	70.11d
SSP	78.32a	85.34a	81.34a
NPK	73.42c	77.21c	75.11c
MAX	75.11b	80.54b	78.24b
F-LSD (P≤0.05)	1.12	2.00	1.73
Yield (t/ha)			
Control	5.27d	6.21d	6.01d
SSP	7.73a	9.32a	8.21a
NPK	5.99c	7.89c	6.90c
MAX	6.87b	8.45b	7.67b
F-LSD (P≤0.05)	1.21	1.11	0.73

Max= noddle max, LSD=least significant difference at 5% level of probability, *=95%, NS= Not Significant

Table 5 also show an interaction between variety and nutrient source on shelling percentage, where Samnut 24 and the application of SSP had significant higher shelling percentage when compared with other treatment used, this prove that SSP do not only led to pod formation but also aid in pod filling and quality of seeds, this work agrees with the finding of Velmurugan *et al*., (2007) who stated that shelling percentage is mostly affected with the application of nutrient and it affects seeds quality and weight.

Table 5 equally record an interaction between variety and nutrient source on over all yield of groundnut, with a perfect interaction between Samnut 24 and SSP significantly yielding higher when compared with other treatment used, from the foregoing it is clear that number of pod, dry pod weight, 100seed weight, shelling percentage could have led to higher yield, this accretion is reported in the finding of Fagam (2015) who started that crop over all yield is a constituent of yield related characters such as number of pod, dry pod weight, 100seed weight, shelling percentage.

Table 6 show the interaction between Season and nutrient source on yield and yield related parameter, interaction differed significantly between 2020 rainy season and of SSP which supersede all other nutrient source in 2019 rainy season on number of pod, dry pod weight, 100seed weight, shelling percentage and over all yield, this is not far from the fact that, agronomic practice, rain pattern, temperature, relative humidity and the 'easy to decomposite' ability of SSP as well as the ability of the assimilate to be absorb by the plants could have led to increase in overall yield. This finding is in agreement with the work of Ado (2001) who stated that residual effects of SSP used in the previous year, agronomic practice, both biotic and abiotic factor influences crop yield significantly.

Table 6: Interaction between season and nutrient source on yield and yield related characters of Groundnut grown in 2019 and 2020 rainy season

Season	Control	SSP	NPK	MAX
Number of pod/plants				
2019	30.15b	33.41b	31.21b	32.19b
2020	31.99a	36.13a	32.04a	33.83a
F-LSD (P≤0.05)	1.02	2.05	1.58	1.14
Pod dry weight (kg/ha)				
2019	591.11b	662.45b	501.21b	592.76b
2020	621.24b	792.45a	632.84a	662.11a
F-LSD (P≤0.05)	22.02	27.05	23.58	25.14
100 seed weight (g)				
2019	39.11b	46.21b	43.24b	44.21b
2020	40.24a	49.11a	45.09a	46.34a
F-LSD (P≤0.05)	1.24	2.34	2.58	3.24
Shelling (%)				
2019	69.21b	74.31b	70.61b	72.24b
2020	73.21b	80.21a	75.09a	77.21a
F-LSD (P≤0.05)	2.02	4.05	4.58	3.14
Seed yield (t/ha)				
2019	6.75b	8.21b	7.26b	7.99b
2020	7.89a	9.43a	8.81a	8.98a
F-LSD (P≤0.05)	1.01	1.05	1.11	0.81

Max= noddle max, LSD=least significant difference at 5% level of probability, *=95%, NS= Not Significant

Conclusion

The investigation in this work revelled that Samnut 24 variety was superior to Samnut 23 and Samnut 26 in all parameters measured. 100 kg ha^{-1} of SSP maintained a consistent advantage over NPK, noddle max and control in all the measured variables. Groundnuts grown in 2020 rainy season were significantly (P ≤ 0.05) better on the measured variables as compared with 2019 rainy season. Groundnut farmers in this location are therefore advised to grow Samnut 24 with the application of SSP fertilizer at the rate of 100 kg ha^{-1} for optimum yield.

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