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GROWTH AND YIELD COMPONENTS OF GROUNDNUT (*Arachis hypogea* L.) VARIETIES AS INFLUENCED BY PHOSPHORUS FERTILIZATION IN SUDAN SAVANNA OF NIGERIA

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ABSTRACT

Field trials were conducted at Teaching and Research Farm of Federal University, Dutsina, Katsina State and Institute for Agricultural Research Station, IAR, Minjibir Kano State during 2019 wet season. The experiment was carried out to evaluate the growth, Yield and Yield Components of Groundnut varieties as influenced by phosphorus fertilization in Sudan Savannah of Nigeria. The treatments consisted of three Groundnut varieties (SAMNUT 23 and SAMNUT 24 and SAMNUT 25) and four phosphorus fertilizer rates (0kg P/ha, 20kg P/ha, 30kg P/ha and 40kg P/ha), laid out in Randomized Complete Block Design (RCBD) with three replications. The results indicated that SAMNUT 23 had performed significantly ($P \leq 0.05$) better than SAMNUT 24 and SAMNUT 25 in terms of plant height, number of leaves per plant, number of pods per plant, pod weight kg/plot, 100 seed weight and grain yield kg/ha at both locations while 40kg P/ha significantly ($P \leq 0.05$) outperformed 30kg P/ha, 20kg P/ha and 0kg P/ha in terms of plant height, number of leaves, number of pods per plant, pod weight kg/plot, 100 seed weight and grain yield kg/ha at both locations . the study identified SAMNUT 23 and 40 kg P/ha to be the best option for increased groundnut production in the study area.

Keywords: Groundnut Varieties, Phosphorous Fertilization, Sudan Savannah

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is an important food grain legume and cash crop worldwide due to the higher nutritive value of its grain seeds which is considered to be rich in protein and fat/oil content in addition to other vital components (Debjani and Rabindra, 2014). The economic and nutritional potential of groundnut is high and it's also important to peasants farmers in poor tropical countries including Nigeria as a cash crop (John, 2020). Being the second largest source of vegetable oils, after soyabean, Groundnut is also a good source of groundnut paste/flour, groundnut proteins and groundnut milk are other important product used in human consumption. Groundnut oil is also used in cooking and making salads, margarine, soap, lubricants as well as a source of fatty acids.

Groundnut is one of the world's most popular grain legume crops cultivated throughout the tropical and subtropical areas where annual precipitations between 1000-1200mm for optimum growth of the crop. In Nigeria groundnut is an excellent food containing 60% highly digestible protein, 22% carborhydrate, 4% minerals and about 8% fat. In Nigeria, the low level of productivity of groundnut particularly the Sudan savannah has been ascribed to several constrains among which is the poor agronomic practices the farmers practice; particularly the use of unimproved, low yield, local varieties of groundnut and low or non-availability of nutrients especially phosphorus which is essential for root and kernel development, increased number, density and efficiency of nodules which can significantly increase the uptake of water and other nutrients (Iro *et al.,* 2019). The use of local/unimproved groundnut varieties results in low yield in Sudan Savannah of Nigeria. The current average groundnut yield in Nigeria is a little above 1ton/ha, and it has a potential yield of between 2 to 3 tons/ha while in advance countries groundnut production can reach up to 3.5tons/ha (Tran Thi, 2003).

Nutrients in tropical soils particularly nitrogen and phosphorus are inherently low in (Iro *et al.,* 2019). One of the most needed elements for crop production in many tropical soils among others is phosphorus. It is deficiency therefore is one of the most limiting plant nutrient for food grain leguminous crop production in most tropical soils. Phosphorus is highly essential for grain Legume crops; they require phosphorus for growth, seed development, yield and most especially nitrogen fixation which is an energy driven process (Nkaa *et al.,* 2014). Phosphorus is extremely important to growth and yield of most crops particularly legumes crops such as improved photoperiod insensitive varieties because of its multiple effects on nutrition.

It does not only increases legume seed yield but also enhances nodulation (Haruna and Aliyu, 2011).

In Nigeria farmers still use local unimproved, locally sourced groundnut varieties despite the availability of improved, high yielding and disease/drought resistant varieties, thus resulting in low yield of groundnut as well as non- usage of fertilizer and or sometimes farmers use insufficient nutrient base input, non-usage of phosphorus fertilizer level appropriately may result in low productivity. Inefficiency in phosphorus fertilizer use coupled with low/poor soil fertility and use of unimproved groundnut varieties in Nigeria are important limiting factors in achieving desirable groundnut yield. Thus, this trial was carried-out to determine the effect of phosphorus level on growth and yield of improved groundnut varieties in Sudan Savannah of Nigeria.

MATERIALS AND METHODS

The experiment was carried-out at Teaching and Research Farms, Federal University Dutsin-ma, Katsina State latitude $12^0 27'18''$ longitude $7^0 29'29''$E 605m above sea level and Institute of Agriculture and Research Station, Minjibir, Kano State (Lat $11^0 50'$N $08^0 36'$E, 458m above sea level) both in Sudan Savannah ecological zone of Nigerian. The treatments consisted of three groundnut varieties (SAMNUT 23 SAMNUT 24 and SAMNUT 25) and four levels of phosphorous fertilizer levels (0kg P/ha, 20kg P/ha, 30kg P/ha and 40kg P/ha). The experiment was laid out in a randomized complete block design (RCBD) with factorial combination of varieties and phosphorus rates and replicated three times. The seed (groundnut) was sourced from seed unit of Institute for Agricultural Research, Ahmadu Bello University, Zaria, Soil sample was collected at random for different points at the two locations from 0-30cm depths with the aid of soil auger. Thereafter samples were collected from the composite sample for analysis at the soil analytical laboratory of Department of Agronomy, Faculty of Agriculture Ahmadu Bello University Zaria. The field was cleared, harrowed twice then ridged before sowing. Sowing of the three varieties was carried out immediately after the rainfall has established on 10^{th} July, 2019 at Dutsima and 17^{th} July, 2019 at Minjibir at depth of 5cm at spacing of 25cm x 75cm (inter and intra row spacing). The net plot was 4.0 m x 3m net plot while gross plot was 4m x 4.5m. Single super phosphorus fertilizer was immediately applied after sowing using ring method of 5cm radius. Weeding was then carried out using hand held hoe twice within the first 6 weeks after sowing. Data was collected on the following growth and yield parameters; plant height, number of leaves, number of branches at 2, 4, 6, and 8 weeks after sowing (WAS) days to 50% flowering, number of pods per plant,seed yield and biomass yield at harvest. Data collected was subjected to analysis of variance and means separated using Duncan multiple Range Test (DMRT) at 5% level of probability ($P \leq 0.05$) using SAS Package (2005).

RESULTS

The Soil Physical and Chemical Properties at Dutsin-ma and Minjibir

The detail of physical and chemical properties of the analyzed soil from the experimental sites prior to sowing is shown in table 1. The result shows that the soil was predominantly sandy loam in texture at both locations. The soil was slightly acidic with pH value of 5.5 at Dutsima and 5.3 at Minjibir. The availability phosphorus was very low at Dutsima (2.0 ppm) and at Minjibiar (1.9 ppm) while organic carbon in g/kg was also very low 0.5 and 0.4 for Dutsima and Minjibir respectively. The exchangeable cations were low especially K, Ca, Mg and Na were low in both locations. The soil was therefore low in nutrient status.

Table 1: Physical and Chemical Properties of the Soil (0-30cm depth) at both Dutsin-ma and Minjibir during the 2019 Cropping Season

Soil Characteristics	Location	
	Dutsima	Minjibir
Particle Size Distribution g/kg^{-1}		
Sand	760	730
Silt	140	120
Clay	100	150
Textural Class	Sandy Loam	Sandy Loam
Chemical Composition		
pH in Water (1:25)	5.5	5.3
pH in 0.01 M$CaCl_2$ (1:2.5)	4.6	4.9
Organic Carbon (g/kg^{-1})	0.5	0.4
Total Nitrogen (g/kg^{-1})	0.45	0.43
Available Phosphorus (ppm)	2.0	1.9
Exchangeable Basis (cmol/kg^{-1})		
Ca ppm	3.2	3.5
Na ppm	0.4	0.5

Mg ppm	0.4	0.7
K cmol/kg^{-1}	0.09	0.13
Cation exchange Capacity cmol/kg^{-1}	3.1	3.4

Source: Soil Analytical Laboratory of Department of Agronomy A.B.U. Zaria

Plant Height (cm)

The (Table 2) shows that there was significant difference (P<0.05) among groundnut varieties used on plant height where SAMNUT 23 and SAMNUT 25 produced significantly taller plants than SAMNUT 24 across all sampling periods in both locations. The application of 30kg P ha^{-1} and 40kg P ha^{-1} was at per on plant height but produced significantly (P<0.05) taller plants than application of 20 kg P ha^{-1}. Application of zero or no phosphorus at 4, 6 and 8 WAS recorded the shortest plants at both location. Application of Phosphorus was not was not significant at 2 WAS at both locations. The interaction between variety and Phosphorus was not significant (P<0.05) on plant height.

Table 2: Effect of Groundnut varieties and Phosphorus Fertilizer on Plant Height (cm) at Dutsin-ma and Minjibir during 2019 Wet Season

	Plant Height							
	Dutsinma				Minjibir			
	2 WAS	**4 WAS**	**6 WAS**	**8 WAS**	**2 WAS**	**4 WAS**	**6 WAS**	**8 WAS**
Varieties (V)								
SAMNUT 23	5.887	11.825^{a}	15.983^{a}	17.981^{a}	4.986	10.311^{a}	14.398^{a}	16.975^{a}
SAMNUT 24	4.575	09.991^{b}	13.285^{b}	15.231^{b}	4.457	9.214^{b}	12.285^{b}	15.231^{b}
SAMNUT 25	5.395	10.351^{ab}	14.791^{a}	16.417^{a}	4.839	10.011^{a}	13.927^{a}	16.214^{a}
SE±	0.2	0.42	1.67	1.25	0.21	0.40	1.67	1.25
LS	NS	*	*	*	NS	*	*	*
Phosphorus Fertilization (P)								
0kgp/ha	2.484	4.751^{c}	8.306^{c}	11.431^{c}	2.142	3.751^{c}	7.326^{c}	10.436^{c}
20	3.518	8.967^{b}	10.606^{b}	16.978^{b}	3.314	8.967^{b}	9.691^{b}	14.975^{b}
30	5.600	11.331^{a}	14.656^{a}	21.881^{a}	4.956	10.334^{a}	13.432^{a}	79.718^{a}
40	6.884	12.584^{a}	15.971^{a}	25.791^{a}	5.788	12.210^{a}	14.521^{a}	23.714^{a}
SE±	0.31	0.60	1.94	1.48	0.31	0.58	1.99	1.59
LS	NS	*	*	*	NS	*	*	*
Interaction V x P	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same superscript(s) within the same treatment group and locations are statistically the same using DMRT at 5% levels of significance. NS – Not Significant, LS – Level of Significance

Number of Leaves

The variety effect was significant (P<0.05) on number of leaves of groundnut where SAMNUT 23 and SAMNUT 25 produced significantly higher number of leaves than SAMNUT 24 (Table 3) in all sampling periods in both Dutsin-ma and Minjibir. Application of Phosphorus was significant (P<0.05) on number of leaves (Table 3),where there was no significant difference among application of 20, 30 and 40 kg P ha^{-1} on number of leaves at 2, 6 and 8 WAS but these rates produced significantly higher number of leaves than application of no Phosphorus at 2, 6 and 8 WAS in both locations. Application of Phosphorus was not significant (P<0.05) on number of leaves at 4WAS at both locations. The interaction between variety and Phosphorus was not significant (P<0.05) on number of leaves.

Table 3: Effect of Groundnut Varieties and Phosphorus Fertilizer on Number of Leaves at Dutsin-ma and Minjibir during 2019 Wet Season

	Number of Leaves							
	Dutsinma				**Minjibir**			
	2 WAS	**4 WAS**	**6 WAS**	**8 WAS**	**2 WAS**	**4 WAS**	**6 WAS**	**8 WAS**
Varieties (V)								
SAMNUT 23	6.897[a]	16.092[a]	26.642[a]	28.741[a]	4.529[a]	14.714[a]	26.642[a]	24.741[a]
SAMNUT 24	5.867[b]	13.667[b]	24.125[b]	25.126[b]	3.271[b]	12.711[b]	24.125[b]	24.126[c]
SAMNUT 25	6.244 [ab]	15.311[a]	25.921[a]	26.214[a]	4.231[a]	13.948[a]	25.971[a]	23.241[b]
SE±	0.28	0.89	1.48	1.56	0.26	0.84	1.36	1.56
LS	*	*	*	*	*	*	*	*
Phosphorus Fertilization (P)								
0kgp/ha	2.434	10.284	19.901[b]	20.223[b]	2.124	13.948	24.141[c]	24.941[c]
20	2.851	12.351	21.331[a]	22.641[a]	2.652	14.534	24.933[a]	25.214[a]
30	2.951	17.668	23.984[a]	25.998[a]	2.858	14.944	25.432[a]	25.998[a]
40	3.651	16.483	26.243[a]	29.424[a]	3.105	15.743	25.942[a]	26.341[a]
SE±	0.44	0.85	0.33	0.75	0.45	0.75	0.34	0.65
LS	NS	NS	*	*	NS	NS	*	*
Interaction V x P	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same superscript(s) within the same treatment group and locations are statistically the same using DMRT at 5% levels of significance. NS – Not Significant, LS – Level of Significance

Number of Branches

Table 4 showed significant ($P<0.05$) differences was observed between the groundnut varieties at both locations. SAMNUT 23 outperformed SAMNUT 25 and SAMNUT 24 in terms of number of branches a both location. 40kg P ha^{-1} recorded highest number of branches at 4WAS (8.34), 6Was (16.47), 8WAS (29.87) at Dutsin-ma than other phosphorous rates applied. Application of phosphorous fertilizer at 40kgpha^{-1} also recorded highest number of branches at Minjibir at 4WAS (5.98), 6WAS (16.27) and 8WAS (26.47) than other rates of phosphorous fertilizer applied. The interaction between variety and Phosphorus was not significant ($P<0.05$) on number of branches.

Table 4: Effect of Groundnut Varieties and Phosphorus Fertilizer on Number of Branches at Dutsin-ma and Minjibir during 2019 Wet Season

	Number of Branches							
	Dutsinma				**Minjibir**			
	2 WAS	**4 WAS**	**6 WAS**	**8 WAS**	**2 WAS**	**4 WAS**	**6 WAS**	**8 WAS**
Varieties (V)								
SAMNUT 23	1.950[a]	6.231[a]	15.852[a]	25.814[a]	1.434	5.921[a]	15.934 [a]	25.994[a]
SAMNUT 24	1.589[b]	4.317[b]	15.394[a]	25.421[b]	1.248	4.241[b]	15.139[b]	25.341[b]
SAMNUT 25	1.920[a]	5.159[a]	15.521[a]	25.798[a]	1.443	5.749[a]	15.433[a]	25.697[a]
SE±	0.06	0.47	0.48	0.42	0.05	0.46	0.48	0.45
LS	*	*	*	*	NS	*	*	*
Phosphorus Fertilization (P)								
0kgp/ha	2.034	4.283	10.901[c]	19.999[c]	2.344	3.984	14.243[c]	24.741[c]
20	2.451	5.431	12.643[b]	21.748[b]	2.477	4.345	15.174[b]	25.348[b]
30	2.951	6.984	14.274[ab]	26.321[b]	2.671	5.167	15.974[a]	25.943[b]
40	3.951	8.341	16.478[a]	29.874[a]	2.743	5.987	16.271[a]	26.474[a]
SE±	0.19	0.94	0.95	0.97	0.12	0.91	0.95	0.97
LS	NS	NS	*	*	NS	NS	*	*
Interaction V x P	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same superscript(s) within the same treatment group and locations are statistically the same using DMRT at 5% levels of significance. NS – Not Significant, LS – Level of Significance

Days to 50% Flowering

Days to 50% flowering (table 6) was significant (P<0.05) among the groundnut varieties where SAMNUT 23 took more number of days to reach 50% flowering than SAMNUT 25 and SAMNUT 24 while SAMNUT 24 gave the least number of days to 50% flowering at both locations.

Application rate of 30kg P ha^{-1} and 40kg P ha^{-1} significantly (P<0.05) reduced days to 50% flowering at Dustin-ma and Minjibir (tables 5 and 6).There was no significant (P<0.05) difference between zero application of Phosphorus and 20 kg P ha^{-1} on number of days to 50% flowering at both locations but higher in days than days obtained with application of 30 and 40kg P ha^{-1} in both locations (tables 5 and 6). The interaction between variety and Phosphorus was not significant (P<0.05) on number of branches.

Table 5: Effect of Groundnut Varieties and Phosphorus Fertilizer on Days to 50% Flowering, Number of Pods/Plants, 100 Seeds weight (g) Biomass Yield (t/ha) at and Seed Yield t/ha Dutsin-ma during 2019 Wet Season

	Days to 50% Flowering	No. of Pods/Plant	100 Seed Weight (g)	Biomass Weight (t/ha)	Seed Yield (t/ha)
Variety (V)					
SAMNUT 23	30.512[a]	34.522[a]	52.081[a]	5.243[a]	1.753[a]
SAMNUT 24	27.755[c]	29.210[c]	35.984[c]	3.597[c]	1.164[c]
SAMNUT 25	29.512[b]	32.504[b]	49.537[b]	4.789[b]	1.347[b]
SE±	0.42	1.37	0.80	0.04	0.03
LS	*	*	*	*	*
Phosphorus Fertilization (P)					
0kgp/ha	29.975[a]	19.745[c]	35.948[d]	3.439[d]	1.168[d]
20	28.509[a]	26.506[b]	41.080[c]	4.186[c]	1.348[c]
30	22.222[b]	29.009[b]	44.593[b]	4.789[b]	1.758[b]
40	30.503[b]	34.208[a]	50.194[a]	5.429[a]	2.286[a]
SE±	0.52	1.37	0.85	0.04	0.03
LS	**	**	**	**	**
Interaction V x P	NS	NS	NS	NS	NS

Means followed by the same superscript(s) within the same treatment group and locations are statistically the same using DMRT at 5% levels of significance. NS – Not Significant, LS – Level of Significance

Table 6: Effect of Groundnut Varieties and Phosphorus Fertilizer on Days to 50% Flowering, Number of Pods/Plants, 100 Seeds Weight (g) Biomass Yield (t/ha) and seed Yield (t/ha) at Minjibir during 2019 Wet Season

	Days to 50% Flowering	No. of Pods/Plant	100 Seed Weight (g)	Biomass Weight (t/ha)	Seed Yield (t/ha)
Variety (V)					
SAMNUT 23	26.545[a]	31.516[a]	50.196[a]	5.019[a]	1.276[a]
SAMNUT 24	20.145[c]	26.416[c]	32.747[c]	3.419[c]	1.078[c]
SAMNUT 25	24.515[b]	29.508[b]	47.528[b]	4.578[b]	1.149[b]
SE±	0.40	1.37	0.80	0.04	0.03
LS	*	*	*	*	*
Phosphorus Fertilization (P)					
0kgp/ha	10.774[a]	18.561[c]	30.293[d]	3.017[d]	1.064[d]
20	18.415[a]	22.471[c]	35.414[c]	3.618[c]	1.174[c]
30	22.357[b]	26.508[b]	34.586[b]	3.949[b]	1.477[b]
40	26.929[b]	29.504[a]	41.365[a]	4.217[a]	1.818[a]
SE±	0.50	1.30	0.81	0.04	0.03
LS	**	**	**	**	**
Interaction V x P	NS	NS	NS	NS	NS

Means followed by the same superscript(s) within the same treatment group and locations are statistically the same using DMRT at 5% levels of significance. NS – Not Significant, LS – Level of Significance

Number of Pods per Plant

The result (tables 5 and 6) showed that significant differences ($P<0.05$) exists among the groundnut varieties on number of pods per plant at both location. SAMNUT 23 produced significantly highest number of pods/plant at Dutsin-ma (32.50) and Minjibir (34.21) than SAMNUT 24 SAMNUT 25. Application of 4o kg pha^{-1} performed significantly better than other phosphorus rates tested on number of pods per plant in both locations (tables 5 and 6). Zero phosphorus application produced the least values on number of pods per plant in both locations. The interaction between variety and phosphorus was not significant on number of pods per plant.

100 Seed Weight (g)

Tables 5 and 6 further showed the effect phosphorous fertilizer had on groundnut varieties on 100 seed weight where SAMNUT 23 produced significantly heavier 100 seed weight than any other variety at both locations. Phosphorous fertilizer rate of 40 kg P ha^{-1} produced the heaviest 100 seed weight at both Dutsinma (50.14) and Minjibir (41.35) and zero application of phosphorus had the least 100 seed weight (Tables 5 and 6) relative to other rates applied. The interaction between variety and phosphorus was not significant on 100 seed weight(g).

Biomass Weight (t/ha)

The variety effect was significant ($P<0.01$) on biomass yield of groundnut where SAMNUT 23 produced significantly higher biomass yield than SAMNUT 24 and SAMNUT 25 (Tables 5 and 6) in both Dutsin-ma and Minjibir. Application of phosphorus was significant on groundnut biomass yield where application of 40 kg P /ha recorded the highest biomass weight at both Dustinma (5.42) and Minjibir (4.21t/ha) and no phosphorus application produced the least response on biomass yield of groundnut. The interaction between variety and phosphorus was not significant on biomass yield.

Seed Yield (t/ha)

The effect of variety was significant ($P<0.01$) on biomass yield of groundnut where SAMNUT 23 produced significantly higher seed yield than SAMNUT 24 and SAMNUT 25 (Table 5 and 6) in both locations Dutsin-ma and Minjibir. Phosphorus rate of 40 kg P /ha recorded highest total yield at Dutsin-ma (2.29t/ha) and Minjibir (1.82t/ha) and zero application of phosphorus produced the least groundnut seed yield (Table 5 and 6). The interaction between variety and phosphorus was not significant on groundnut seed yield.

DISCUSSION

SAMNUT 23 outperformed SAMNUT 25 and SAMNUT 24 in plant height, number of leaves and number of branches. This could be due to the genetic compositional make up of SAMNUT 23 which has an intermediate maturing duration (90-100days) while SAMNUT 24 (80-90 days) SAMNUT 25 (85-90days) are extra early maturing varieties. SAMNUT 23 stayed a little longer in the field thereby continually harnessing all the growth factors like adequate moisture, nutrients, sunlight etc. longer than the other varieties thus having a higher value of plant height, number of leaves and branches than other varieties evaluated. This is in line with the report of Tran Thi (2003) who reported that the longer the crop variety stays in the field, the more time to take in and harness all the resources necessary for better growth and yield performance. Significant difference was observed before the groundnut varieties as regards days to 50% flowering. SAMNUT 23 took more days to attain 50% flowering tha SAMNUT 24 and SAMNUT 25. This could be due to its genetic composition as it takes longer time to grow and matures than other varieties evaluated in both locations. From the result obtained with regards to number of pods per plant and 100 seed weight, there was significant difference among the groundnut varieties. SAMNUT 23 consistently had a higher values of number of pods per plant and 100 seed weight than other varieties evaluated. This is probably due to its genetic makeup that allows it to grow in the field longer than other varieties evaluated. This is in line with the findings of Tran Thi (2003) who attest to this fact that more number of days a crop takes to grow and mature, the more number of pods will develop as well as the weight of 100 seeds will be heavier. The findings of this research revealed that there was a significant difference among groundnut varieties where SAMNUT 23 outperformed SAMNUT 24 and SAMNUT 25 in both biomass yield and seed yield probably due to its genetic makeup.

The significant increases observed in groundnut growth after application of phosphorus could be attributed/linked to the role of phosphorus in the development of more extensive root system which enhances proper absorption of water and nutrients from the soil (Iro *et al*., 2019; Imam *et al*., 2014). Application rate of 40 kg Pha^{-1} had more effect than other levels at all sampling periods. This is in line with the report of Kabir *et al*.,(2013) who reported that the higher amount of phosphorus applied per ha will significantly increase plant height. Application of different levels of phosphorous showed different response with regards to plant height. Application rate at 40kgpha^{-1} has more effect than other levels at all sampling periods. This is in line with the report of Kabir *et al.*,

(2013) who reported that the higher amount of phosphorous applied per ha will significantly increase plant height.

Furthermore, the maximum data values for both number of leaves and branches were obtained by 40kgpha^{-1} application. This is similar to Kamara *et al.,* (2011) who reported that application of phosphorous 40-60 kg P ha^{-1} increases the growth (vegetable) of groundnut. Phosphorous increases the development of more of branches, thus resulting in more leaves per plant (Iro *et al.,* 2019). Phosphorous fertilizer application rate of 40 kg P ha^{-1} attained 50% flowering earlier than other treatments. This result is in line with that of Rahman (2006) who reported that at early growth stages, increasing the application of phosphorous fertilizer stimulated and promotes and stimulate cell division rapidly, reduces days to maturity and hastened maturity of groundnut. Phosphorous fertilizer 40 kg P ha^{-1} increases the number of pods per plant as well as gaining heavier 100 seeds weight. This is in line with the report of Kabir (2010) who reported that an increased application of phosphorous fertilizer (40-60 kg P ha^{-1}) result in increase in number of pods per plant because it promoted the formation of nodes and pods in groundnut and other legumes. Also the effect of phosphorous on weight of 100 seeds was significant. This is in line with El-habbasha *et al.,* (2005) who stated that increasing phosphorous levels increased 100 seed weight.

Shiyam (2010) revealed that different phosphorous levels insignificantly affected biomass but conversely, on the other hand the results obtained from the result of this work are consistent with the results reported by Ibrahim and Eleiwa (2008) where significant increase in both seed and straw yield was obtained. This report is also supported by the findings of Gobara *et al.,* (2006) and Kabir *et al.,* (2013) who reported increased yield and yield components in response to increasing phosphorous levels up to 40 kg P ha^{-1} such increase in phosphorous is known to help in developing extensive root system that helps plants to absorb water and nutrients efficient which will in turn enhances plants to produce more assimilates which will be reflected in higher biomass.

CONCLUSION

Varietal differences observed in this research showed that SAMNUT 23 had a better performance in terms of plant height, number of leaves per plant and number of branches per plant, days to 50% flowering, number of pods per plant, 100 seed weight, biomass yield (t/ha) and total seed yield (t/ha) than SAMNUT 24 and SAMNUT 25. Application of 40 kg P ha^{-1} produced the highest plant height, number of leaves and branches, days to 50% flowering, number of pods per plant biomass yield and seed yield than other rates applied. Thus, SAMNUT 23 seems to be best variety among the tested ones in the study area and application of 40 kg P ha^{-1} is adequate for the growth and yield of SAMNUT 23 in the study area.

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