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Effects of organic manure and NPK fertilizer on the yield and performance of sweet potato varieties (*Ipomoea batata*s(L)Lam in Nyanya, FCT, Abuja

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Abstract

In Nigeria, one of the major problems confronting agriculture is poor soil fertility replenishment strategy that could allow sustainable crop production. A field trial was conducted at National Root Crops Research Institute Nyanya Out-Station with the aim of studying the Effects of organic manure and NPK fertilizer on the performance and yield of sweet potato varieties (*Ipomoea batatas* (L)Lam). The Research was conducted during the 2019 farming season. The experiment comprises of six treatments of sole and combined inorganic fertilizer (N.P.K 15:15:15) and organic (Poultry manure) fertilizer as follows: Control (0kg/ha),400kg ha-^{1}NPK,3t/ha-^{1}poultry manure (PM),200kgha-^{1}NPK+1.5t/ha-^{1}PM,300kg/ha-^{1}NPK+0.75t/ha-^{1}PM,100kg/ha-^{1}NPK+2.25t/ha-^{1}NPK+2.25t/ha-^{1}PM.Two varieties of sweet potato (butter milk and umuspo 1) were used. It was a factorial experiment and laid out in a randomized complete block design, with three replications. Results indicates that vine length increased as the week's progresses after planting. At 4 weeks after planting, control gave the least(50.27cm), longest vine(90.08cm) was obtained with application of 100kg ha-^{1}NPK+2.25 t ha-^{1} PM. However, number of tuber increased from control (20.17) and peaked at 200kg ha-^{1}+1.5t ha-^{1}PM. It is therefore recommended that with application of 200kg ha-^{1} NPK+1.5 t ha-^{1}poultry manure should be adopted for the cultivation of sweet potato in the study area.

Keywords: Poultry manure, Sweet Potato, NPK

Introduction

Sweet potato (*Ipomoea batatas)* is a warm season root crop widely grown in the tropic. According to udo *et al. (*2005), the largest producer of sweet potato outside the tropics is Japan. However, China and United States of America also produce substantial quantities. Sweet potato is ranked the third most important root crops after cassava and yam. The root tubers are used as food for man and livestock in many countries of the world, it also serves as raw materials for the manufacture of starch, glucose and alcohol. The leaves are used as vegetables in some communities in Nigeria. Plant nutrients are essential for the production of quality crop. Plant nutrients are vital components of sustainable Agriculture; increase in crop relies on the type of fertilizer and manure used to supplement essential nutrients for plant growth. Intensive use of chemical fertilizers was advocated for crop production in the tropics in order to alleviate these nutrient deficiencies (Anonymous, 2000). The yield of sweet potato like other crop is influenced by climatic, biological and soil factors (Udo *et al.*, 2005; NRCRI, 2008). Among the soil factors fertility is the most important for sweet potato production. Use of organic manure is a traditional method of boosting soil fertility although the use of inorganic fertilizer like NPK is becoming increasingly important. Therefore, the objective of this study was to determine the effect of organic and inorganic fertilizer combination on the performance of sweet potato

Materials and Methods

The study was carried out at National Root Crops Research Institute Nyanya-Out Station, Abuja (Latitude 9.06°733°E and Longitude 7.62°318°N) during the 2019 cropping season. Abuja is located in the southern guinea savanna ecological zone of Nigeria. The gross plot is 41x 8 (328 m^2). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The plot size for each replicate was 2x2 (4 m^2) with 12 plots in each with a distance of 1m between the replicates and 1m between the treatments. The experiment comprises six (6) treatments which is made up of control (0kg/ha), 400kg ha^{-1}, 3tha^{-1}poultry manure (PM), 200kg ha^{-1}NPK+1.5tha^{-1}(PM), 300kg ha^{-1}NPK+0.75tha^{-1}(PM), and 100kg ha^{-1}NPK+2.25tha^{-1}(PM).

Data collected were vine length, number of tubers, and number of damage tubers which were subjected to analysis of variance using SAS (2008). Means were separated using Student-Newman Keuls Test at $p<0.05$.

Results and Discussion

Table 1 shows the result of physical and chemical properties of the experimental site. Results shows that the pH is 6.8 which is at neutral level. The result also showed that textural class of the soil is sandy loam. The available phosphorus of the soil analyzed has a value of 7.31 $mgkg^{-1}$,which indicates that the available Phosphorous was low which signifies that the soil will show substantial response to applied phosphorous fertilizer for sweet potato production. The organic carbon is low with a value of 8.13 gkg^{-1} this may be as a result of poor vegetation, continuous cropping and subsequent bush burning which are characteristics of savanna soil. Therefore, maintenance of a satisfactory organic matter status in this soil is essential, Onyekwere and Ezenwa (2009) reported that mineralization of most of the nitrogen and half of the phosphorous in the soils, if the potato field were unfertilized. The total nitrogen is 0.78 which is low this may be due to continuous use of land over the years and could be as a result of the organic carbon content of the soils (Onyekwere and Ezenwa, 2009).The exchangeable calcium of the soil was moderate with a mean value of 0.9 cmolkg-1.Soils of the study area had mean value above 4cmolkg-^{1} regarded as lower limit for fertile soils (Onyekwere *et al.*,2001).Also, the exchangeable magnesium content of the soils studied was moderate with a mean value of 0.54cmol kg-^{1},the soils are well furnished with exchangeable magnesium, exchangeable sodium content of the soil was high with a value of 1.55cmol kg-^{1}.The soils had exchangeable sodium above 0.2cmol kg-^{1} considered as the critical value needed in soils(Onyekwere, *et al.,* 2018)

The result in table 2 shows the effect of fertilizer and sweet potato variety on the performance of sweet potato vine length. Results indicate that vine length increased with increase in the number of weeks of observation after planting. At 4 weeks after planting, control gave the least (50.03 cm) while the longest vines (90.08 cm) were obtained with 100kg ha-^{1} NPK+2.25 t ha-^{1} pm. This value was significantly higher($p<0.05$) than the vine length obtained with the control and 3t ha-^{1} poultry manure but was however not significantly different from the rest treatments. At 6 weeks after planting, the vine lengths did not differ significantly, the values however ranged from 87.72cm at the control site to 136.89 at 100kg ha-^{1} NPK+2.25t ha-^{1} poultry manure. The results obtained at week 8 after planting were statically similar to those obtained at 6 weeks after planting. Significant differences were obtained at 10 weeks after planting($p<0.05$) where control produced the shortest (629.83cm) vines. However, the application of 400kg ha-^{1}NPK,200kg ha-^{1} NPK+1.5t ha-^{1}poultry manure(pm),300kg ha-^{1} NPK+0.75t ha-^{1} poultry manure and 100kg ha-^{1}NPK+2.25t ha-^{1}poultry manure were significantly different from one another in the length of vines. This could be due to high nitrogen uptake (Owudike, 2010), while the shortest vine lengths were observed in the control at 4, 6, 8, and 10 WAP. This result is in line with the findings of Ebregt *et al.*,2004 and Nodolo *et al.*,2007 who reported that survival of sweet potato

vine is more related to the conditions of the Agro-ecological zones and that the most common cause of planting material failing to take off is drought. A significant difference was also observed in vine length between both varieties at 4, 6, 8, and 10 WAP. Butter milk variety consistently recorded longer vine lengths compared to Umuspo1.There was no significant difference($P>0.05$) in the interaction effects across treatments and sweet potato varieties on vine length.

Table 3 shows the effect of fertilizers and variety on sweet potato yield and other yield attributes of sweet potato. Results indicates that no significant differences were observed in the number of tubers and number of damaged tubers.Lowest numbers of tubers(20.17) were observed in control while highest(35.27) was recorded where 200kg ha-^{1}+1. 5 t ha-^{1} poultry manure was applied. According to Yeng *et al* (2012) the integrated application of poultry manure and inorganic fertilizer increase growth and yield of sweet potato. Santhi and Selvakumari (2000) were of the view that the addition of organic manure sources to chemical fertilizer could increase the yield of crops through improving soil productivity and higher fertilizer efficiency. For the number of damaged tubers,300kg ha-^{1} NPK+0.75t ha-^{1} poultry manure had the least (2.17) while the highest (3.50) was obtained with 200kg ha-^{1} NPK+1.5t ha-^{1} poultry manure. Tuber yield ranged from 3.16 t ha-^{1} at the control site to 6.18 t ha-^{1} at 200kg ha-^{1} NPK+1.5t ha-^{1} poultry manure. There were no significant differences among the treatments in damaged tubers. However, the results obtained from all the treatments in the number of tubers were not statistically different from one another. The varieties did not show any significance differences in the number of tubers and number of damaged tubers. However, the tuber yield (5.85) was obtained with butter milk which was significantly higher than that of umuspo 1 variety.

Table 1: Physical and chemical properties of soil of the experimental site

Parameters	Value
Particle size distribution (g kg^{-1})	
Sandy	662
Silt	225
Clay	113
Textural class	Sandy loam
Chemical properties	

pH (1:2.5) soil water ratio	6.8
$CaCl_2$	6
Organic Carbon (g kg^{-1})	8.13
Total N (g kg^{-1})	0.78
Available P (mg kg-^{1})	7.31
Exchangeable bases	
Ca^{2+} (cmol kg^{-1}))	0.9
Mg^{2+} (cmol kg^{-1})	0.54
K^{+} (cmolkg^{-1})	0.58
Na^{+}	1.55
Exchangeable acid (cmol kg^{-1})	0.14

Table 2: Effect of Organic and Inorganic Fertilizer Combination on Sweet Potato vine length

	Vine length (cm)			
	Weeks after planting			
Treatment (T)	4	6	8	10
Control	50.03b	87.72a	276.67a	629.83c
400 kg ha^{-1} NPK	58.57ab	95.05a	341.15a	798.84ab
3 t ha^{-1} PM	50.27b	108.82a	291.13a	698.67bc

200 kg ha^{-1} NPK + 1.5 t ha^{-1} PM	66.30ab	124.42a	361.23a	911.67a
300 kg ha^{-1} NPK + 0.75 t ha^{-1} PM	74.03ab	128.27a	359.70a	871.17a
100 kg ha^{-1} NPK + 2.25 t ha^{-1} PM	90.08a	136.89a	391.97a	877.83a
SE±	9.04	21.44	84.09	101.14
Variety (V)				
Butter milk	88.23a	147.49a	173.32b	1006.00a
Umuspo1	41.54b	77.92b	495.63a	590.00b
SE±	5.24	8.66	21.26	33.47
Interaction				
TxV	NS	NS	NS	NS

Means with the same letter(s) in a column are not significantly different at 5% level of probability using SNK.

NS: Not significant

NS=Not Significant, PM=Poultry Manure

Table 3: Effect of Organic and Inorganic Fertilizer Combination on number of tubers, damaged tubers and yield of Sweet Potato tubers

Treatment (T)	Number of tubers	Damaged tubers	Tuber yield (Kg/ha)

Control	20.17a	3.33a	3.16b
400 kg ha^{-1} NPK	29.67a	2.50a	5.42ab
3 t ha^{-1} PM	34.17a	3. 33a	5.41ab
200 kg ha^{-1} NPK + 1.5 t ha^{-1} PM	35.27a	3.50a	6.18a
300 kg ha^{-1} NPK + 0.75 t ha^{-1} PM	25.33a	2.17a	5.72a
100 kg ha^{-1} NPK + 2.25 t ha^{-1} PM	29.33a	3.00a	5.96a
SE±	2.89	0.48	0.40
Variety (V)			
Butter milk	29.50a	3.22a	5.85a
Umuspo1	28.61a	2.72a	4.76b
SE±	2.21	0.28	0.4
Interaction			
TxV	NS	NS	NS NS

Means with the same letter(s) in a column are not significantly different at 5% level of probability using SNK.

NS=Not Significant, PM=Poultry Manure

CONCLUSION

The result from this study shows that combined application of organic (poultry manure) and inorganic fertilizer performed better than sole application. The application of 200 kg t ha-¹ of NPK + 1.5 t ha-¹ poultry manure gave the best yield of 6.18 t/ ha while butter milk performed better than umuspo l. Therefore, the application of 200 kg t ha-¹ NPK + 1.5 t ha-¹ of poultry and

cultivation of butter milk are recommended for sustainable sweet potato cultivation in the study area.

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