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EFFECT OF PLANTING DATES AND FERTILIZER RATES ON THE GROWTH AND YIELD OF SWEET POTATO *(Ipomoea batatas* L.*)* IN WUKARI, TARABA STATE

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ABSTRACT: *A field experiment was conducted at the teaching and research farm of the Federal University Wukari, Taraba State, Nigeria to determine, evaluate and compare the effect of planting dates and fertilizer rates on growth and yield of sweet potato, using three planting dates: planting date one (July 4), planting date two (July18) and planting date three (August 1) for both 2017 and 2018 cropping seasons, and four fertilizer rates: F0 (0kg/h), F1 (30kg/h), F2 (60kg/h) and F3 (90kg/h). The treatments were arranged in 3 x 4 split plot factorial design combinations replicated three times. Measurements were taken on the growth and tuber yield at harvest such as the length of primary veins, number of secondary veins, number of leaves, number of tubers and tuber weight. Data collected were analyzed using ANOVA and the significant means separated using Duncan multiple differences at 5% probability level. The result of the experiment indicated that both main effects (planting dates and fertilizer rates) had significant influence on all of the traits measured. Similarly, the interactive effect of planting dates and fertilizer rates significantly affected all of the traits measured, except leaf area which is not significantly influenced by the interactive effect of planting dates and fertilizer rates. The significantly highest weight of tuber per plant was obtained from the planting dates at PD1, PD2 and PD3 (1.09, 1.56 and 1.10 respectively in 2017 cropping season and 1.00, 1.51 and 1.03 respectively for 2018 cropping season). Fertilizer rates enhanced growth and yield performance on the planting dates used. Highest yield values were observed in planting date 2 (PD2). Highest value in all the yield characters measured was observed in planting date 2 (PD2) at fertilizer rates of F3 and F2 (90kg/h and 60kg/h respectively). Based on the findings from this research, planting date 2 (PD2) with 60kg/ha (F2) of fertilizer application rate is recommended. Generally, all traits except the leaf area were significantly affected by the interactive effect of planting date and fertilizer rate, indicating that determining fertilizer rate for each planting date by considering their vegetative growth and yield habit is very important in crop production. Further research should be repeated under rainfed conditions at different locations.*

KEYWORDS: Planting Dates, Fertilizer Rates (NPK 15:15:15), Sweet Potato.

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INTRODUCTION

Sweet potato (*Ipomea batatas*) is one of the major food crops in the world and it ranks second to yam in Nigeria as a major important tuber crop, contributing to the food requirement of the people (Karam *et al.*, 2009). It is consumed locally as it serves as a famine relief crop at the end of the rainy season, and it has increased the income of farmers through its exportation as a result of its high demand internationally (Karam *et al.*, 2009). Despite its importance as a food crop, its productivity is becoming low mainly due to poor soil fertility of the most arable fields. Fertilizer, either as organic or inorganic, is one of the most important inputs responsible for increasing the productivity of crops (Anonymous, 1997; Ali *et al.*, 2009). Leytem and Westermann (2005) reported the important effects of fertilizers on the yield of potatoes. Potatoes are highly responsive to N-fertilization and Nitrogen is usually the most limiting essential nutrient for their growth and development (Errebhi *et al.*, 1998). Inorganic fertilizer, when applied to crops, usually has a quick-release formula making nutrients rapidly available to plants. Among the conventional fertilizers, urea and NPK fertilizers are mostly used by farmers for crop production in Nigeria (Negassa *et al.*, 2001; Tirol-padre *et al.*, 2007).

Factors that affect quality of sweet potato are planting date, rate of fertilizer application, variety selection, mineral nutrients, plant population, water, soil moisture and rainfall, pest management, harvesting time, harvesting method, pacing and storing (Amajor *et al*., 2011). Planting season for sweet potato is in the middle of July in most parts of the northeast of Nigeria (Ukom *et al.*, 2009). Vines are buried inside the soil in the middle, one node at each and kept exposed.

Generally, food security is a focal point to enhance food sustainability globally. The yield of sweet potato compared to yam is low and is gradually being replaced by higher yielding starch crops such as cassava. There is a need to improve this underutilized food security crop to sustain food accessibility (Opoku-Agyeman *et al*., 2007).

This study provides information on the appropriate planting date and fertilizer rate for the growth and tuber yield of sweet potato.

The objective was to evaluate the results of planting dates and rates of NPK 15:15:15 fertilizer application levels in order to resolve the issue of low production of sweet potato. It was furthermore to determine the effect of planting dates on the growth and tuber yield of sweet potato, evaluate the effect of different rates of fertilizer application on the growth and tuber yield of sweet potato, and study the interactive effect of planting dates and different fertilizer rates on the performance of sweet potato.

MATERIALS AND METHODS

The experiment was carried out at the teaching and research farm of the Federal University Wukari, Taraba State, Nigeria. Taraba state lies between latitude 60 30, 80 30N of the equator and between longitude 90 and 120E of the Greenwich meridian with a land mass of 54.426km². It shares borders with Bauchi and Gombe State in the North, Adamawa State in the East and Cameroon Republic in the Southwest. The state has a tropical wet-dry climate, well drained alluvial soils and has both savannah and rainforest vegetation. The rainfall ranges between 1000mm to 2500mm per annum in the north with the driest and wettest seasons lasting from

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December to February and July to September respectively. The physical and chemical properties of the soil are as in table 1. The materials for the experiment, such as potato vine, were collected from local farmers in Wukari, while the NPK 15:15:15 fertilizer was purchased from an open market in Wukari.

Experimental Design and Treatments

The field was measured 31.5m in length and 14.5m in width, which gave a total area of 457m^2. The experiment was laid in a split plot design with three replications. The treatments consisted of three different planting dates viz planting date one (PD1) July 4, planting date two (PD2) July 18 and planting date three (PD3), as main treatments which were allocated to main plots, and four different rates of fertilizer application (0kg/ha, 30kg/ha, 60kg/ha and 90kg/ha) as subplot treatments combined in a factorial layout. The size of the gross plot was 3m x 3m = 9m^2. There was a 0.5m pathway between each plot and 1m between each replication. The field was ploughed, demarcated and the beds raised. Sweet potato stem cuttings were planted on a bed of 3m x 3m at a spacing of 50cm x 100cm with the total number of 36 plots. The NPK 15:15:15 fertilizer was applied four weeks after planting.

DATA COLLECTION AND ANALYSIS

Data were collected on the growth and tuber yield components at harvest. The Dat6a collected were: length of primary vine, number of leaves, number of secondary vine, number of tubers per plant, weight of tubers per plant and tuber yield. The data collected were subjected to analysis of variance (ANOVA) appropriate for split-plot design. Statistical analysis system (SAS) was used to determine the significance of the F-test and the treatment means were separated using Duncan's Multiple Range Test (DMRT) at 5% probability level.

Result

The result obtained from analysis of variance showed that differences existed between planting dates for most of the growth parameters such as length of primary vine, number of secondary vine, number of nodes and number of leaves in both planting seasons, and that they were highly influenced. The observation is in conformity with Amajor *et al*., (2011) who reported that factors which affect quality and growth parameters of sweet potato are planting date, variety selection, plant population, fertilizer application and rainfall. This therefore suggests that any improvement through planting date and fertilizer application could be helpful while the growth parameter that showed no significant difference, like leaf area, should not be considered if the aim was to improve yielding ability.

Sweet potato was affected at the various growth periods by fertilizer application for F3 (90kg/ha) which consistently recorded the longest primary vine (289.11), followed by F2 (60kg/ha) at 279.78, at all sampling periods. The differences in length of primary vine could be attributed to fertilizer rate on the plants. This result is in total agreement with the findings reported by Satapathy *et al*. (2005) and Mitra, (2012) who noted that a high rate of fertilizer application encourages vine growth rather than storage root development.

Fertilizer application also increased the number of tubers of sweet potato in this study. Similar results were previously reported by Byji, (2004) who reported that fertilizer is needed as an

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important nutrient for the development of storage root for yield increase, and the storage root enlargement occurs when the nitrogen to potassium ratio is average, because high nitrogen concentrations promote vine growth and also affect storage roots.

The highest value in all the yield characters measured were observed in planting date 2 (PD2) at fertilizer rate of 60kg/ha (F2). This corresponded with the findings of Bourke, (2005) who reported that planting early in the season is the best so that the rainy season can be utilized, since water is critical in the early stage of the crops. Sebastian *et al.* (2006) and Biswal (2008) reported that a moderate dose of fertilizer 60kg/ha is optimum for root production in sweet potato.

Weight of tubers (1.97) at PD2 F3 increased compared to the recommended rate of F2 (60kg/ha). It was observed that an increase in fertilizer application also increased the weight of tubers. This result concurs with the findings of Patel *et al*., (2009) who observed that more or less fertilizer is needed as an important nutrient component for the development of storage roots.

Planting date 2 (PD2) showed the highest tuber yield parameter compared to planting date 1 (PD1) which is the early planting date and planting date 3 (PD3) which is the late planting date. This shows that planting at the appropriate time has a big effect on production. This contradicts the findings of Bourke, (2008) who reported that planting earlier in the season is the best so that the rainy season can be utilized.

The performance in the interaction of the vegetative growth parameters showed that there was a significant difference between the planting dates and fertilizer rates.

Generally, in comparing 2017 and 2018 farming season data analysis, it showed that there was a significant difference ($p<0.05$) between the two seasons. 2017 cropping season had the highest vegetative growth parameter and also had the highest tuber yield parameter in all sampling points. This could be attributed to variability in climatic factors. This result is in conformity with the findings of Harlin *et al*., (2005) who observed that yield of sweet potato, like other crops, is influenced by climatic, biological and soil factors.

CONCLUSION

In conclusion, one of the main objectives of this research was to evaluate the performance of the planting dates in Wukari local government area of Taraba State. It will give an opportunity for farmers to select the best planting date suitable for their agronomic practices.

This research identified planting date 2, which is July 18 (PD2), as the highest in terms of number of tubers per plant as well as the weight of tubers per plant. PD2 had the highest ton per hectare. Planting date 1, which is July 4 (PD1), was the least in terms of yield parameters as well as in vegetative growth parameters, but planting date 3, which is August 1 (PD3), had the highest vegetative growth parameter in some instances. PD2 had the highest tuber yield performance.

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Contribution to Knowledge

The findings of this study have revealed the appropriate planting date for sweet potato to be the third week of July. This confirmation will help the local farmers as well as commercial farmers on the best practices and most effective way of farming sweet potato. The information will also guarantee farmers an expected increase in the yield of sweet potato.

Secondly, the outcome of this research has also revealed the appropriate level or rate of fertilizer application. This knowledge will help farmers on the specific rate of fertilizer application that will yield a desirable result.

Generally, this information will help the farmers and the researchers to adjust their date(s) of plant practices to the appropriate planting date for their sweet potato vegetative growth and tuber yield production.

RECOMMENDATION

- Planting date 2 (PD2) at fertilizer rate 60kg/ha (F2) is recommended to farmers wishing to farm sweet potato for tuber yield production.
- To those farming for vegetative production, planting date 3 (PD3) at 60kg/ha (F2) is recommended**.**
- Based on these findings, it is necessary however that more research should be conducted on these planting dates and fertilizer rates to ascertain their stability.

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APPENDIX

Table 1: Effects of planting date and fertilizer rate on the growth parameters of sweet potato.

Treatments	Length of primary veins (cm)	Number of secondary veins	Number of leaves	Number of tubers per plant
PD1= planting date 1 = July4	1.89 a	2.23 a	5.92 a	2.50 ab
PD2 = planting date 2 = July18	1.92 a	2.35 a	9.08 b	2.83 a
PD3 = planting date 3 = August1	1.72 a	2.34 a	10.83 b	2.58 ab
FO = Control (0kg/ha)	1.02 a	1.74 a	3.58 a	2.17 ab
F1 = 30kg/ha	1.44 a	2.32 a	6.03 a	2.25 ab
F2 = 60kg/ha	1.94 a	2.96 b	8.60 b	1.33 b
F3 = 90kg/ha	1.67 a	2.22 a	8.79b	1.36

Source: Balogun et al. (2019) Federal University Wukari, Taraba State, Nigeria

Table 2: Effects of planting dates and fertilizer rates on tons per hectare, weight of tuber per plant (in kg) and number of tubers per plant in 2017/2018 merged

Planting date	Ton /Ha	WTPP (kg)	NTPP
PD1	2.22b	1.05b	3.54c
PD2	3.33a	1.53a	6.21a
PD3	2.43b	1.07b	4.04b
Fertilizer rate			
F0	2.23b	1.10c	3.11d
F1	2.22b	1.01c	4.06c
F2	2.98a	1.29b	5.22b
F3	2.73a	1.46a	6.00a

Means with the same letter(s) within a column are not significantly different.

KEY:

PD1 = Planting date one (July 4)
PD2 = Planting date two (July 18)
PD3 = Planting date three (August 1)
FO = Control (0kg/ha)
F1 = 30kg/ha (N:P:K 15:15:15 Fertilizer)
F2 = 60kg/ha (N:P:K 15:15:15 Fertilizer)
F3 = 90kg/ha (N:P:K 15:15:15 Fertilizer)

WTPP = Weight of tubers per plant
T/ha = Tone per hectare
NTPP = Number of tubers per plant

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Table 3: Effects of planting dates and fertilizer interaction on tons per hectare, weight of tuber per plant and number of tuber per plant 2017/2018 merged.

Planting date /Fertilizer rate	Ton/Ha	WTPP	NTPP
PD1 F0	2.11a	0.88cd	2.67g
PD2 F0	2.00a	1.13bc	4.00def
PD3 F0	2.22a	1.28b	2.67g
PD1 F1	2.22b	0.95cd	3.33fg
PD2 F1	2.67ab	1.25b	5.33c
PD3 F1	2.44b	0.82d	3.50fg
PD1 F2	2.33b	1.10bc	3.67ef
PD2 F2	3.54a	1.77a	7.33b
PD3 F2	2.87ab	1.02bcd	4.67cd
PD1 F3	2.66ab	1.25b	4.50cde
PD2 F3	3.22ab	1.98a	8.17a
PD3 F3	3.00ab	1.15bc	5.33c

Means with the same letter(s) within a column are not significantly different.

KEY:

WTPP = Weight of tubers per plant
T/ha = Tone per hectare
NTPP = Number of tubers per plant

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