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Research Paper

Comparative effects of chicken manure and NPK on the yield of *Ipomoea batatas*

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Abstract. Sweet potato is rarely grown by rural farmers in Akwa-Ibom State, making its demand to be higher than supply. Thus, there is need to explore crop management options to increase its production in the area. In this study, we determined the effect of manures on the yield of sweet potato in Uyo metropolis. Two improved varieties of sweet potato (TIS87/0087 and NRSP 05/022) were evaluated under chicken manure versus NPK Mg (12:12:17:2) fertilizers. There was no significant yield difference between TIS 87/0087 and NRSP 05/022 varieties under chicken manure. It was recommended among others that, fertilizers with high proportion of potassium (NPK. Mg (12:12:17:2) be used by sweet potato farmers in Akwa-Ibom State in order to boost yield and maintain soil fertility.

Keyword: chicken manure, NPK, soil fertility and yield of *ipomea batatas*.

INTRODUCTION

Sweet potato *(Ipomoea batatas)* is a warm season root crop widely grown in the tropics. 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 about the third most important root crop following after cassava and yam. It is also ranked about the seventh among the world's major food crops from the perspective of total production value as an agricultural crop product. In 1994, the world's production of sweet potato was 124 million metric tonnes.

Sweet potato belongs to the botanical family called Convolvulaceae. It is commonly called morning glory and is the only member of the genus *Ipomoea* whose roots are edible (Wardell, 2006). The root-tuber is used as food for man and livestock in many countries of the world. It serves as raw materials for the manufacture of starch, glucose and alcohol. The leaves are used as vegetables in some communities in Nigeria (Akwa-Ibom State in particular) and widely as fodder for livestock.

The increasing interest in sweet potato cultivation in West Africa has been encouraged by research works of the National Root Crops Research Institute and the International Institute for Tropical Agriculture (IITA). The yield of sweet potato like other crops is influenced by climatic, biological and soil factors (Udo et al., 2005; NRCRI, 2008). Among soil factors, fertility is the most important for sweet potato production. Use of manures is a traditional method of boosting soil fertility although use of inorganic fertilizers like NPK (Mg) is becoming increasingly important in the state.

Sweet potato is widely accepted and consumed in Akwa-Ibom state, but its production and supply does not match with consumption since it is not extensively cultivated. Even among the few growers, sweet potato production is abysmally low. Thus Akwa-Ibom State is among the least sweet potato producing states in Nigeria and local demand is only met by imports from other states (Robert, 2012). The poor yield of sweet potato in Akwa-Ibom State may not be unconnected with poor soil fertility due to heavy erosion and leaching. Farmers who cultivate this type of soil do not take cognizance of the quality of the

soil and the requirements of sweet potato for better productivity (Antiaobong and Bassey, 2008; Robert, 2012). Udo et al (2005) reported that plant nutrient deficiency significantly accounted for the low crop yield in traditional farming. Njoku et al. (2001) found that nitrogen and potassium were critical to sweet potato production. Hoa et al. (2000) reported an optimal yield at chicken manure rates of 8 to 15 tonnes/ha while Elmundo et al. (2009) showed a significant increase in sweet potato yield with fertilizer application.

The objective of this study was to locally compare the effect of chicken manure versus NPK Mg (12:12:17:2) on the yield of two sweet potato cultivars (TIS 87/0087 and NRSP 05/022).

MATERIALS AND METHODS

The study was conducted at the experimental site of the Vocational Agriculture Education Research Farm, University of Uyo (5.0232309°N; 7.9238892°E, FRN, 2007), Nigeria, during the 2012 cropping season under rain fed conditions. The experimental plots occupied a land area of 10 m × 69 m (69 m^2). The site was cleared, ploughed and ridged. The planting materials were two improved varieties of sweet potato (TIS 87/0087 and NRSP 05/022). Vine cuttings were obtained from National Root Crops Research Institute, Umudike, Abia State, Nigeria. Prior to actual planting, a viability test was performed on the vines. Ten vine cuttings were sown at different sites and the sprouting vigor ascertained before use on the research plot. All the vine cuttings sprouted between 7 and 8 days after planting.

Field planting

The two sweet potato varieties were propagated by vine cuttings of 25 to 30 cm long with five nodes, planted at 90 × 60 cm. During planting, older leaves were removed except at the terminal regions. A sprouting count was taken in the second week after sowing and 98.5% sprouting was achieved, while the unsprouted cuttings were replanted immediately. Weeding was done regularly using local hoe. There were two experimental and one control plots sown without any form of manures but with the same sweet potato varieties.

Fertilizer treatment

On the fourth week after planting, chicken manure and N.P.K.Mg (12:12:17:2) were applied into two experimental plots respectively on the same day. And on the twelfth week of planting a booster dose was applied. Both fertilizers were applied using ring method of application. Other cultural practices such as weeding and mulching were done at appropriate times to encourage the crops to grow well.

Harvesting

Harvesting was done manually on the fifth month of planting (20 weeks), when the leaves turned yellowish. The tubers were dry-cleaned; the number of tubers per stand was taken and tubers were weighed in kilograms per treatment for comparison.

Data were analysed using t-test and analysis of covariance (ANCOVA).

RESULTS

Testing of null hypotheses

Null hypothesis one

There is no significant difference between the yield of TIS 87/0087 and NRSP 05/022 varieties of sweet potato sown with poultry dungs.

Table 1 shows the calculated t-value of 1.07 which is less than the critical t-value of 2.06 at 26 degree of freedom at 0.05 level of significance. The null hypothesis one was upheld in view of the no significant difference recorded in the yield of the two varieties of sweet potato sown with poultry dungs.

Null hypothesis two

There is no significant difference between the yield of TIS 87/0087 and NRSP 05/022 varieties of sweet potato sown with N.P.K. Mg (12:12:17:2).

Table 2 reveals the calculated t-value of 0.19 less than the critical t-value of 2.06. The null hypothesis two was upheld on account of no significant difference recorded. This implies that both varieties of sweet potato experimented upon do not differ significantly in the yield when sown with N.P.K. Mg (12:12:17:2).

Null hypothesis three

There is no significant difference in the yields of TIS 87/0087 and NRSP 05/022 varieties of sweet potato sown without manure, those sown with poultry dungs and those sown with N.P.K. Mg (12:12:17:2).

Table 3 shows the calculated F value of 9.57 greater than the critical F-value of 3.23 at 0.05 level of significance.

Table 1a. Yield 9 kg/ha of two sweet potato cultivars under chicken manure and NPK Mg.

TIS 87/0087	
Chicken manure	12.04
NPK Mg	12.20
Control	7.25
LSD (5%)	No significant difference
NRSP	
Chicken manure	14.80
NPK Mg	14.50
Control	8.20
LSD (5%)	No significant difference

Table 1b. The mean yield difference between TIS 87/0087 and NRSP 05/022 varieties sown with poultry dungs.

Source of variation	N	X	df	t-cal	t-crit	Decision at > 0.05
TIS 87/0087	14	1.0	26	1.07	2.06	NS
NRSP 05/022	14	0.87				

Table 2. The mean yield difference between TIS 87/0087 and NRSP 05/022 varieties sown with N.P.K. Mg (12:12:17:2).

Source of variation	N	X	df	t-cal	t-crit	Decision at > 0.05
TIS 87/0087	14	1.06	26	0.19	2.06	ns
NRSP 05/022	14	1.04				

Table 3. The mean yield difference in the yields of TIS 87/0087 and NRSP 05/022 varieties of sweet potato sown with manures and those without manures.

Source of variation	df	Sum of squares (ss)	Mean squares (Ms)	t-cal	t-crit	Decision
Non effect	2	4.56	2.32	9.57	3.23	*
Interactions	39	9.48	0.24			

Therefore, the null hypothesis three was rejected. This implies that there was significant difference in the yields of the two varieties of sweet potato sown without manures, those sown with poultry dungs and those sown with N.P.K. Mg. (12:12:17:2).

Findings of the study

1. There was no significant difference between the yields of TIS 87/0087 and NRSP 05/022 varieties of sweet potato sown with poultry dungs.
2. There was no significant difference between the yields of TIS 87/0087 and NRSP 05/022 varieties of sweet potato sown with N.P.K. Mg. (12:12:17:2).
3. There was significant mean difference among the sweet potato varieties sown without any form of manures, those sown with poultry dungs and those sown with N.P.K. Mg. (12:12:17:2).

These findings reveal that soil fertility has great influence on the yield of sweet potato. The reason for the poor yield and the subsequent poor level of investment in potato production in Akwa-Ibom State is attributed to non-use of fertilizers or organic manures to boost soil fertility.

The farmers who allow sweet potato to respond to natural fertility of the soil always record poor yields. The poor yields recorded over the years are a source of discouragement leading to reluctance in the cultivation of sweet potato in commercial quantities in Akwa-Ibom State.

DISCUSSION

The findings of this study indicated that TIS 87/0087 and NRSP 05/022 varieties of sweet potato do not differ significantly in yields when both varieties were treated with poultry dung or N.P.K. Mg. (12:12:17:2). The higher yield and the quick response of the varieties to fertilizer was a direct result of the quick release of the absorbable nutrients ions. Udo et al. (2005) stated that nutrient availability significantly account for good yield of crops.

The significant yield decline in the two varieties when no fertilizer was applied may be due to poor accessibility of the roots to soil nutrients as occurs in traditional farming systems (Singer and Munns, 1999; Udo et al., 2005). This implies that the TIS 87/0087 and NRSP 05/022 varieties of sweet potato though adaptable to Akwa-Ibom soils could be profitably cultivated only with well planned manures application regimes. There is tremendous potential of soils in Akwa-Ibom State to increase yield of crops by use of organic and inorganic manures to boost the already exhausted soil nutrients due to excessive usage, erosion and rapid mineralization and mobilization of the nutrient elements in the soils.

Educational implications of the study

The usage of organic and inorganic manures in Akwa-Ibom State should follow some preliminary soil test to determine the deficient nutrients before such nutrients are supplied. It must be noted that nutrient ions in the organic manures are slowly released, while nutrient ions in inorganic manures are easily eroded and leached. The implication is that the methods of application of any form of manures and the time of application must be suitable and in line with the recommended agronomic practices if nutrient losses and poor yield of crops must be avoided.

Conclusion

The poor level of involvement of farmers in sweet potato cultivation in Akwa-Ibom State is attributed to persistent poor yield over the years. This is caused by poor soils due to excessive exploitation without adequate replacement of the lost nutrients. Our findings have shown that crops can only do well in rich fertile soils and that fertility could be increased through application of organic or inorganic manures.

RECOMMENDATIONS

With reference to the findings and conclusion of this study, the following recommendations were made:

1. Soils in Akwa-Ibom state are prone to erosion and leaching of plant nutrients due to heavy rainfall, therefore fertilizers with high proportion of potassium (N.P.K. Mg) at the ratio of 12:12:17:2 should be used for growing sweet potato to achieve high yield and maintain the fertility of the soil.
2. Organic manure (poultry dung) should be incorporated into the soil during land preparation for sweet potato production if the soil is found to be of low fertility status.
3. NRSP 05/022 was seen to be more responsive and adaptable to the soil and climatic factors of Akwa-Ibom State. Therefore, it is strongly recommended to sweet potato farmers in Akwa-Ibom State.
4. Fertilizers should be made accessible to sweet potato farmers at subsidized rate and on time by the government.
5. Sweet potato farmers should be sensitized and educated by the government agencies such as Agricultural Development Programme, on the best varieties of sweet potato adaptable to Akwa-Ibom State soils and climate and the appropriate fertilizers to use.
6. The time of sowing and harvesting of improved varieties of sweet potato in Akwa-Ibom State is very important. From this study, mid-April when rain is fully established is recommended for sowing activities since Akwa-Ibom State farming is rain fed.

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