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EVALUATION OF YIELD AND YIELD ATTRIBUTES OF FIVE SWEET POTATO (*IPOMOEA BATATA (L)Lam*) VARIETIES IN OWERRI - IMO STATE.

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ABSTRACT
Five sweet potato varieties (Ex –igbariam local, TIS 86/0356, TIS 8441, TIS 87/0087, and TIS 2532.OP.1.13) were evaluated for yield and agronomic performance in Imo State University Farm, Owerri. The experiment was laid out in a randomised complete block design with three replications. The planting density was 33,000 plants/ha and NPK (15:15:15) fertilizer was applied blanket at the rate of 100kg/ha. Significant (p= 0.05) differences were obtained in the performance of the varieties in fresh tuber yields, vigor at six weeks after planting, leaf area/plant, fresh biomass, tuber dry matter and biomass dry matter yields. Variety TIS 86/0356 gave significantly (p= 0.05) the highest mean fresh tuber yield of 7.38 t/ha and a significantly (p=0.05) high mean biomass dry weight of 3.08 t/ha, whereas the variety TIS 8441 gave the lowest mean fresh tuber and biomass dry matter yields of 1.28t/ha and 1.29t/ha, respectively. Variety TIS 86/0356 was therefore recommended for sweet potato growers in the region.
Key words: *Sweet potato, varieties, yield evaluation.*
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INTRODUCTION
Sweet potato (*Ipomoea batatas (L) Lam*) is a major root crop widely grown throughout the tropics. It is one of the important root crops used for food by man, feed for livestock and for industrial production of alcohol. It combines well with a wide variety of tastes and provides key vitamins while enhancing the protein quality of wheat and rice. Nigeria produces about 1.34 million tonnes per annum and has an average yield of 40 tonnes per hectare in research plots (NRCRI, 2002). Yields of 5-10 t/ha in village gardens are common (Janssen, 2001; Onwubiko *et al.,* 2006). Sweet potato ranks third in the value of production and fifth in contribution of calories in developing countries (Horton, 1988). Nigeria alone produces about 0.48 million tonnes per year on 45,000 ha, thereby contributing to about 0.24% of World production (CIP, 1991; Nwokocha, 1992).

High dry matter content is a desirable property of sweet potatoes and the most important factor that makes it a better competitor in the feed and starch industry (Tsou *et al.*,1987). Sweet potato cultivars with high dry matter content have better marketing appeal for feed and starch extraction. High dry matter also contributes to longer post harvest storage of sweet potato roots (Tsou *et al.,* 1987). The field evaluation of newly developed potato varieties for stability of performance is essential for successful selection of high yielding and consistently better performing varieties. Yield reliabilities from year to year is of great significance to subsistence farmers than wide spatial adaptation (Evans, 1993)

The concern about possible harmful environmental effects of inorganic fertilizers has stimulated a lot of interest in improving N-fertilizer use efficiency. Improved index of crop response to applied N and quantification of the influence of factors affecting this response would make a substantial contribution to the improvement of N-fertilizer use efficiency (Okorie,1992). Quantifying varietal responses to applied N in specific environments therefore becomes inevitable. Field evaluation of newly developed sweet potato varieties for their response to N-fertilizer under the humid tropics is essential for the successful selection of consistently high yielding and stable cultivars. This research work evaluates the yield and yield variation of five sweet potato varieties: Ex-igbariam local; TIS 86/0356; TIS 8441; TIS 87/0087 and TIS 2532.OP.1.13 in Owerri, Imo State of Nigeria.

MATERIALS AND METHODS

Experimental location and field conditions

The experiment was conducted under rain-fed conditions at Imo State University farm Owerri, Imo State. The area is located between latitude 05^0 26'N, longitude 07^0 02'E and altitude 91m above sea level. This part of the humid tropics in Southeastern Nigeria is characterized by a warm wet season from mid-March to October; and a hot dry season in November to mid-March. The annual precipitation ranges from 1,810 - 2,260 mm and most of it falls during the wet season. This is broken by a short duration drought of about 10 days in August. During the wet season, much of the daytime has a near saturation point relative humidity with maximum and minimum temperatures of 30^0C and 21^0C, respectively.

Experimental procedure and field planting

The experimental plot measured 30m x 12m ($360m^2$). Each plot was further sub divided into 15 sub–plots measuring 5m x 3m each, with a 1m path between the sub-plots. The soil was cleared, ploughed and harrowed before planting. A composite soil sample from 9 representative positions was obtained for physical and chemical analyses before commencement of planting. Planting materials were freshly harvested vine cuttings of the varieties with 4 nodes each. The vines were planted at an angle of 45^0 with two nodes under the ground. The planting distance was 1.0m x 0.3m (50 plants per sub-plot of $15m^2$), giving a total plant population of 33,000 plants/ha.

The five sweet potato varieties (Ex-igbariam local; TIS 86/0356; TIS 8441; TIS 87/0087 and TIS 2532.OP.1.13) were randomised in the sub–plots with 3 replications using randomized complete block design (RCBD). There was a blanket split fertilizer-N (NPK 15:15:15) application rate of 100kg/ha. The planting was in late June when the rains have stabilized. The plots were weeded twice manually at 2 weeks and 6 weeks after planting. Harvesting was done at 4 months after planting.

Data Collection and Analytical Techniques

The data on important crop and yield attributes were collected from each block and for each variety (sub-plots). Two rows were randomly selected for sampling. Fresh tuber and fresh

biomass yields (kg/ha) were evaluated immediately after harvesting using a Satorius electronic balance (Model 48, Germany). In estimating the dry matter yield, samples were first dried in an oven at a temperature of 105^0C for 48 hrs. Establishment count for the varieties was obtained by counting the number of established vines at 6 weeks after planting. Plant vigour was also estimated at this age by adding the average vine length to the average leaf area. The leaf area (cm^2) was estimated using the linear method. The number of leaves per plant was obtained by counting the number of leaves present on the vines at the time of measurement. The degree of infection or the pest score was evaluated using the method of Adebisi *et al,* (2001). This is based on a five point visual scale rating as follows: 1= no infestation, 2 = low infestation, 3 = intermediate infestation, 4 = high infestation, 5 = all tubers infested.

Data analysis was carried out using the combined analysis of variance (ANOVA) technique in a generalised linear model procedure of SAS package (SAS Institute, 1992). Means were separated using the Duncan's New Multiple Range Test (DNMRT). The means and coefficients of variation (CV) of the yield and yield attributes evaluated were calculated.

RESULTS

The mean yield and yield attributes of the sweet potato (*Ipomoea batatas (L) Lam*) varieties evaluated is shown on Table 1. The soil analysis result at the experimental site is shown on Table 2. The soil is typical of the ferrallitic acid sands of this region. They is generally highly leached, acidic and poor in nitrogen (N) and phosphorous (P). The soil is sandy loam in texture, pH 6.2, with 0.47% N, 11.00 ppm P and 0.24 me/100g K (Table 2).

Mean fresh and dry matter tuber yield

There were significant variations in the fresh and dry matter tuber yields of the sweet potato varieties evaluated. Varieties TIS 86/0356 and TIS 2532 OP.1.13 gave the highest mean fresh tuber yields of 7.38t/ha and 6.15t/ha respectively, significantly (p = 0.05) different from all others (Table 1). The variety TIS 8441 gave the lowest mean fresh tuber yield of 1.29 t/ha significantly (p = 0.05) different from all others.

The mean tuber dry matter yield followed a similar trend of variation like the fresh tuber yield. The highest mean tuber dry matter yield of 2.44 t/ha and 2.03 t/ha were obtained from varieties TIS 86/0356 and TIS 2532.OP.1.13, respectively. These were statistically the same but significantly (p = 0.05) different from all others. Variety TIS 8441 gave the least mean tuber dry matter yield of 0.43 t/ha significantly (p= 0.05) different from all others.

Mean fresh and dry matter biomass yields

Variety TIS 2532 OP.1.13 had the highest mean fresh biomass yield of 8.56 t/ha, although not significantly (p = 0.05) different from 7.33 and 6.89 t/ha obtained from varieties TIS 86/0356 and Ex-Igbariam local, respectively (Table 1). The variety TIS 8441 gave the lowest mean fresh biomass yield of 3.00 t/ha, significantly (p = 0.05) different from all others.

The dry matter biomass yield was relatively high for variety TIS 2532 OP.1.13 with a value of 3.59 t/ha, but not significantly (p = 0.05) different from 3.08 and 2.76 t/ha obtained from varieties TIS 86/0356 and Ex-Igbariam local, respectively. Variety TIS 8441 gave the lowest dry matter biomass yield 1.29 t/ha significantly (p = 0.05) different from all others (Table 1).

Mean leaf area per plant (LAP) and vigor at 6 weeks after planting

Variety TIS 86/0356 had the highest mean leaf area/plant (LAP) of 138.03 cm^2 significantly (p = 0.05) different from all others. This was closely followed by variety Ex-Igbariam local with a mean LAP value of 114.87 cm^2. The variety TIS 2532 OP.1.13 had the lowest mean 'LAP' with a value of 72.11 cm^2 significantly (p = 0.05) different from all others except for variety TIS 87/0087 with a mean 'LAP' value of 75.85 cm^2 (Table 1).

Mean plant vigor estimates for the varieties at 6 'WAP' was highest for variety TIS 86/0356 which was 4.67, but is statistically the same with a value of 4.33 obtained for variety Ex-Igbariam local. The variety TIS 8441 gave the lowest plant vigor estimates of 1.00, significantly (p= 0.05) different from all others. Varieties TIS 87/0087 and TIS 2532 OP.1.13 have mean plant vigor estimates ranging from 2.33- 2.67 and are statistically the same.

Mean leaf number per plant and mean vine length (cm).

There were no significant (p = 0.05) differences observed between the varieties in both the mean leaf number per plant and the mean vine length. The mean leaf number per plant values ranged from 26.47 in variety TIS 86/0356 to 55.33 in TIS 87/0087. The mean vine length ranged from 49.00 cm in variety TIS 86/0356 to 104 cm in TIS 87/0087 with a high coefficient of variation values of 29.24 and 22.76, respectively.

DISCUSSION

The mean fresh tuber yields ranges of the sweet potato varieties evaluated ranges from 1.29-7.38 t/ha. The mean fresh tuber yield obtained irrespective of variety was 4.29 t/ha. This resulted from the application of NPK (15 :15 : 15) fertilizer at the rate of 100 kg/ha to five sweet potato varieties in a sandy-loam soil with 0.47% N, 11.00 ppm P and 0.24 me/100kg K. Generally, the performance of these varieties was poor. Variety Ex-Igbariam local gave a mean fresh tuber yield of only 2.19 t/ha. Although variety TIS 87/0087 gave an average mean fresh tuber yield of 4.45 t/ha, variety TIS 86/0356 gave the highest mean fresh tuber yields of 7.38 t/ha but the variety TIS 8441 gave the lowest mean fresh tuber yield of 1.29 t/ha. The generally higher coefficient of variation (CV) values ranging from 15.02 – 65.69% obtained with respect to mean fresh tuber yields indicates higher yield fluctuations with respect to fresh tuber yields.

The biomass dry matter yields of the five sweet potato varieties evaluated were also generally low. The mean biomass dry matter yields obtained irrespective of variety was 2.57 t/ha. Variety TIS 2532.OP.1.13 which gave the highest biomass dry matter yield of 3.59 t/ha, also produced a high mean fresh tuber yield of 6.15 t/ha, although not significantly (p = 0.05)

different from variety TIS 86/0356 that gave the highest mean fresh tuber yield of 7.38 t/ha. Except for varieties TIS 86/0356 and TIS 2532.OP the mean fresh tuber yield value for the five sweet potato varieties evaluated are below the African average of 5.00 t/ha (Onwubiko, 2003). Onwubiko *et al.*, (2006) obtained mean fresh tuber yields ranging from 4.55 -9.38 t/ha using variety TIS 87/0087 with the application of 200-600 kg/ha NPK (15: 15 : 15) fertilizer in an ultisol of Southeastern Nigeria. Although the yields of some of the sweet potato varieties evaluated using only 100kg/ha NPK (15: 15: 15) fertilizer are above the African average, they are still well below the yield value of 20-30 t/ha obtained under improved conditions both in Nigeria and some other countries (NRCRI, 1988; Janssens, 2001).

Apart from the month of June when the total rainfall was relatively low (69.30 mm), the mean monthly total rainfall for the four months of this study (June - September) was adequate. The monthly mean total rainfall values were 69.30mm, 226.40mm, 345.10mm and 472.90mm (June - September). Minimum and maximum temperatures ranged from 23-34^{0}C, respectively. Reduced crop yields in tropical soil have been attributed to high intensity rainstorms, high temperatures and prolonged droughts which in many cases results to serious soil erosion, soil acidity and desertification (Amanor, 1994; Okorie, 2001). The soil is acidic and with low organic matter content. Soil acidity and low organic matter contents have been identified as important limitations on the productivity of tropical soils due to the toxicities of Al, Mo, Mn and Fe; including the deficiencies of P, Ca, Mg and K (Brewbaker, 1985; Eleweanya *et al*., 2006).

CONCLUSION AND RECOMMENDATION

The variable response of the five sweet potato varieties evaluated to the applied N-fertilizer may be attributed to the environmental and soil condition of the area which affected the expression of variable genetic attributes of the crop. The marked or reduced effect of the environment or the interaction component of variability is an advantage for genetic advance under selection (Okorie, 2001). The sweet potato varieties that showed both higher tuber and biomass dry matter yields have higher selection values. Variety TIS 86/0356 gave the best performance in terms of fresh tuber and dry matter biomass yield and is therefore recommended for farmers in and around this part of Southeastern Nigeria.

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Table 1: Mean yield and yield attributes of sweet potato (*Ipomoea batatas (L) Lam*) varieties in Owerri

	Ex-Igbariam-Local (Var. A)		**TIS 86/0356 (Var. B)**		**TIS 8441 (Var. C)**		**TIS 87/0087 (Var. D)**		**TIS 2532. OP 1.13 (Var. E)**	
	AX	#Cv (%)	BX	Cv (%)	CX	Cv (%)	DX	Cv (%)	EX	Cv (%)
Fresh tuber (kg/ha)	2,188.87 (c)*	60.66	7,382.20 (a)	50.39	1,288.87 (d)	65.69	4,448.87 (b)	58.32	6,148.87 (a)	15.02
Vigor at 6 wap	4.33 (a)	10.88	4.67 (a)	10.10	1.00 (c)	0.00	2.67 (b)	17.68	2.33 (b)	20.20
Leaf No./ Plant (NS)	41.8	53.59	26.47	28.01	35.80	22.30	25.33	24.52	48.4	13.33
Vine length (cm) (NS)	90.67	24.11	49.00	29.24	60.67	24.24	104.00	22.76	95.48	4.89
Leaf area /plt. (cm^2)	114.87 (b)	9.83	138.03 (a)	1.66	89.45 (c)	1.75	75.85 (d)	7.40	72.11 (d)	3.44
Fresh Biomass (kg/ha)	6,88.87 (a)	22.81	7,333.33 (a)	23.77	3,000.00 (c)	24.00	3,888.87 (b)	24.58	8,555.55 (a)	10.23
Tuber Dry Matter (kg/ha)	766.11 (c)	4.41	2,436.18 (a)	8.06	425.33 (d)	5.56	1,557.10 (b)	5.87	2,029.13 (a)	8.79
Biomass Dry Matter (kg/ha)	2,755.55 (a)	16.58	3,080.00 (a)	3.42	1,290.00 (c)	1.67	1,750.01	112.39	3,593.33 (a)	11.02
Degree of Infestation (NS)	1.03	2.00	0.81	73.96	1.17	51.99	1.92	16.27	1.56	14.09

*Means on a row followed by the same letter not significantly different (p=0.05). #Cv = Coefficient of variation.

Key: NS = Non-significant difference (p=0.05); wap = weeks after planting;

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Table 2: Soil analysis results from Owerri experimental site

OM (%)	N (%)	Mg (me/100g)	Ca (me/100g)	K (me/100g)	Na (me/100g)	P (ppm)	pH
2.97	0.47	2.00	1.60	0.24	0.36	11.00	6.20

% sand = 72.72; % Clay = 8.4; % Silt = 18.88; Texture – Sandy Loam

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