Productivity of Sweet Potato (*Ipomoea batatas* (L.) Lam.) Cultivars in Ibadan, Nigeria

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ABSTRACT

A field experiment was conducted to evaluate the productivity of 20 sweet potato (Ipomoea batatas (L.) Lam.) cultivars in Ibadan, Nigeria. The cultivars evaluated were obtained from the Department of Agronomy sweet potato germplasm multiplication field and were planted 30cm apart on the crest of ridges 3m long in a randomized block complete design (RCBD) with four replications. Observation and data were collected on number of leaves, main vines length, percentage survival, percentage ground cover, number of tubers per plant, fresh root and shoot yield. Result showed that there were significant differences (P < 0.05) among the cultivars evaluated. The number of leaves produced by the cultivars ranged from 109 to 205. Cultivar Eruwa-cream produced the highest number of leaves, while cv 'Barth' had the least at 12 WAP. Mean length of the main vine ranged from 84.69cm (cv TIS 86/0356) to 231.54cm (cv 440293). Percentage survival and percentage ground cover ranges from 80.0% (cv V005) to 100.0% (cv TIS 86/0356) and 25.3% (cv V003) to 79.0% (cv V084) at 10 WAP respectively. Maximum number of tubers (3.45/plant) was produced by cultivar 199034.1; this was significantly higher than the least (0.65/plant) which was obtained from cultivar V003. Cultivars V087 and Benue produced maximum fresh root yield (17.72 to 18.92 t/ha) while cultivars 440293, Benue, TIS 86/0356 and Eruwa-cream produced significant higher fresh shoot yield than all the other cultivars (12.13 to 16.42 t/ha). This study revealed the potentials of different cultivars for diverse use ranging from breeding, weed suppression, to consumption.

INTRODUCTION

Sweet potato, *Ipomoea batatas* (L.) Lam, is an important perennial crop which belongs to the morning glory family or Convolvulaceae (Senanayake *et al*., 2013). It originated from Central and South America and is cultivated worldwide, primarily throughout tropical and sub-tropical Asia and Africa, in hot semi-arid regions where the possibilities of abiotic stresses are acute (Ramamoorthy *et al*., 2022). Lebot (2009), reported that sweet potato is a versatile plant offering various products such as fresh food, processed starch, alcohol and foliage for animal feed. Its storage roots are considered an essential human diet due to their nutritional quality and fibers (of which 40% is soluble fiber, which helps to lower sugar and cholesterol in the blood), which make it the ideal food for people with diabetes, pregnant women and children (Betty, 2011; Allen *et al*., 2012). According to Aladesanwa and Adigun (2008); Islam *et al*., (2014), sweet potato is used as cover crops for weed suppression. Its growth habit which is predominantly prostrates and a rapidly expanding horizontal vine system makes it a good ground cover.

Sweet potato is ranked as the fifth most important food crop in the tropics and seventh in world food production after wheat, rice, maize, potato, barley and cassava (FAO, 2016). It roots and foliage yields more per unit area when compared to other root crops (Sankari *et al*, 2019). Sweet potato fulfills a number of basic roles in global food system, all of which have fundamental implications for meeting food requirements, reducing poverty, and increasing food security (El-Sheika and Ray 2017).

The production, marketing and utilization of sweet potato have expanded in the last decade to almost all ecological zones in Nigeria (NRCRI, 2009). According to FAOSTAT, (2017), Nigeria is the largest producer of sweet potato in Africa and second largest producer in the world with an estimated average production (2010-2014) of 3.67 million tons harvested from 1.38 hectares of land and a total estimated yield of 2.6 tons per hectare.

According to Carpena (2009), several sweet potato cultivars are maintained by various national gene banks all over the world, however, only a few, up to just two in some cases, predominates the sweet potato growing areas in each major sweet potato producing country. The choice of cultivar to grow depends largely on yield (fresh root and shoot yield) and how the produce is utilized.

Therefore, the objective of this study is to evaluate the productivity of 20 sweet potato cultivars under Ibadan conditions and recommend cultivars with better field performance

Materials and Methods

Experimental site

The study was carried out at the experimental field of the Department of Agronomy, University of Ibadan, Nigeria from September to December, 2012. The study areas lies between Latitude 7^o 27` N and Longitude $3^o$ 45` E and has an elevation of about 210m above sea level. The mean annual rainfall of the area is 1250mm and its pattern of distribution is bimodal. Two seasons prevails in the area, namely wet season and dry season. The wet season extends from April to October while the dry season is between November and March. The land area occupied by the experimental field is 418m^2. Table 1 gives the summary of rainfall and temperature pattern of the experimental site during the period of the field trial.

Table 1: Meteorological conditions of the experimental site during the period of the field trial in Ibadan, Nigeria, 2012

Month	**Rainfall (mm)**	**Min Temp (^{O}C)**	**Max Temp (^{O}C)**
September	224.4	21.9	28.9
October	197.4	22.9	30.2
November	27.5	22.1	33.1
December	0	22.2	31.3
Total	449.3		

Source: International Institute for Tropical Agriculture (IITA) Ibadan weather station, 2012.

Experimental design

The experimental design used was randomized complete block design (RCBD) with four replications. Sweet potato vines of length 25cm per cultivars were planted 30cm apart on the crest of ridges 3m long with a furrow space of 1m left in between two ridges. Each ridge had 10 plants per cultivar per replicate thereby giving a total plant population of 800 plants in all.

Soil sampling and analysis

Soil samples were randomly collected from different parts of the experimental site at depth 0 -30cm with the aid of soil auger. The soils were later bulked together and a representative sample was used for the determination of physical and chemical properties of the soil before trial establishment. The soils of the experimental site are homogenous and have a sandy-loam texture as shown in Table-2.

Table 2: Physical and chemical characteristics of soils at the experimental site prior sweet potato establishment in Ibadan, 2012.

Parameter	Value
Sand (%)	72.0
Slit (%)	14.8
Clay (%)	13.2
Textural class	Sandy-Loam
Chemical Characteristics	
pH (H_2O)	6.60
Organic Carbon (g/kg)	13.6
Available Phosphorus (mg/kg)	19.4
Total Nitrogen(g/kg)	1.90
Exchangeable Bases	(Cmol/Kg)
Ca	1.10
Mg	0.90
K	0.50
Na	0.10
Total Exchangeable Bases	2.60
Exchangeable Acidity	0.50

Observation and data collection

Observation and data were collected at different stages of plant growth and at harvest. Data on length of main vine and number of leaves were collected at 4, 8 and 12 weeks after planting (WAP). Data on percentage ground cover was collected at 5 and 10 WAP. For percentage survival, it was collected at 4 and 8 WAP while root and shoot variables were collected at harvest

Cultural practices

Weeding was done manually at 3 and 7 WAP. The dominant weeds observed during the growth of the sweet potato plants were *Chromolaena odorata*, *Talinium fruticosum*, *Imperata* cylindrical, *Tithonia diversifolia* and *Ageratum conyzoides*. There were no fertilizer, herbicide and pesticide applications. Weevil damage was moderate thereby indicating that most of the sweet potato cultivars are moderately resistant to weevil infestation.

Harvesting

Harvesting was carried out when the plants were exactly 16 weeks old. At the time of the harvest, the shoots have shown sign of senescence and drying which are some of the indicators of maturity in sweet potato plants. Harvesting was done by cutting off the shoots, carefully digging out tubers in other to avoid bruises. The harvesting was carried out manually with the aid of a hoe.

Data analysis

Data obtained from the agronomic characteristics and yield parameters of the 20 sweet potato cultivars evaluated were subjected to analysis of variance (ANOVA) using Genatat Discovery, edition 4, 2011 version. Where means were significantly different, separation was carried out using Duncan's Multiple Range Test (DMRT).

RESULTS

Number of leaves

The number of leaves produced by the 20 sweet potato cultivars evaluated differ significantly ($p < 0.05$). At 4 WAP, cultivar Benue produced the highest number of leaves than all other cultivars except cultivar 199034.1. Cultivar Barth produced significantly lower number of leaves than all others except Arrow Tip and V003 cultivars. At 8 WAP, cultivar Eruwa cream produced significantly higher number of leaves than all cultivars. Cultivar V094 also produced significantly higher number of leaves than all other cultivars and is comparable to the numbers produced by Ex- Oyunga but lower to the numbers produced by cultivar Eruwa-cream mentioned earlier. Cultivars Arrow Tip and Shaba produced significantly lower number of leaves than all other cultivars. At 12 WAP, cultivar Eruwa-cream produced significantly higher number of leaves than all cultivars except that of cultivars Benue, V094, Ex-Oyunga, and V087. Cultivars 440293, 199062.1 and TIS 8164 also produced significantly higher number of leaves but lower when compared to those cultivars earlier mentioned. Cultivars Barth, TIS 8441, Shaba, Arrow Tip and Akoroda produced significantly lower number of leaves than all other cultivars as presented in Figure-1.

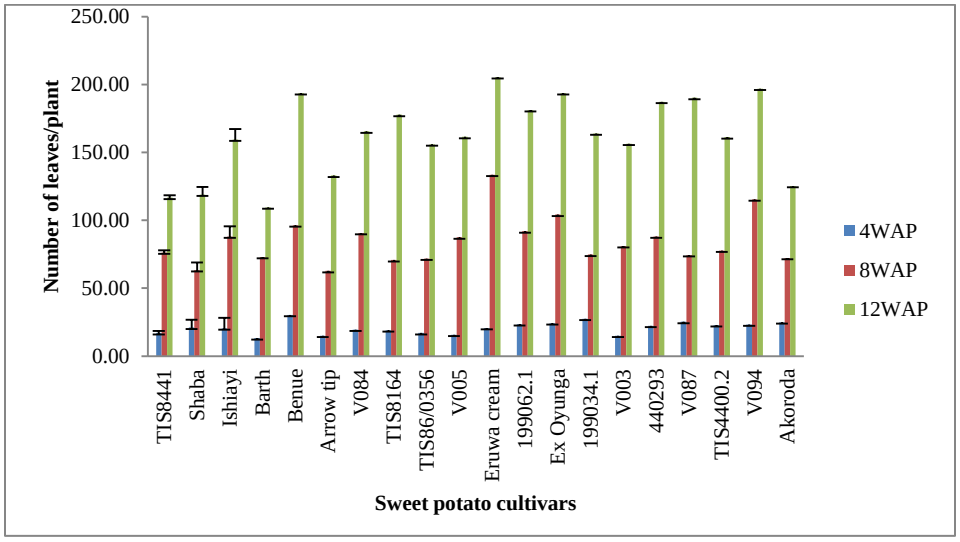


Figure 1: Mean number of leaves of sweet potato cultivars evaluated at the experimental field in Ibadan, Nigeria, 2012.

Length of main vine

The length of main vine among the 20 sweet potato cultivars evaluated differ significantly ($p < 0.05$). At 4WAP, cultivars Shaba and 440293 gave significantly longer length of main vine than all other cultivars except cultivar Benue. Cultivars Ishiayi also gave significantly longer length of main vine than all other cultivars but lower than those earlier mentioned. Cultivars V005, V003 and TIS 86/0356 produced significantly shorter length of main vine than all cultivars except cultivar TIS 8164. At 8 WAP, cultivar 440293 produced significantly longer length of main vine than all other cultivars. Cultivars Shaba, Ishiayi and Benue also gave significantly longer length of main vine but lower when compared to 440293. Cultivars TIS 86/0356 produced significantly shorter length of main vine than all other cultivars. At 12 WAP, cultivars Shaba, Ishiayi and Benue produced significant length of main vine but lower when compared to cultivar 440293. Cultivars TIS 86/0356 produced significantly shorter length of main vine than all other cultivars except cultivars V005 and V003 as presented in Figure-2.

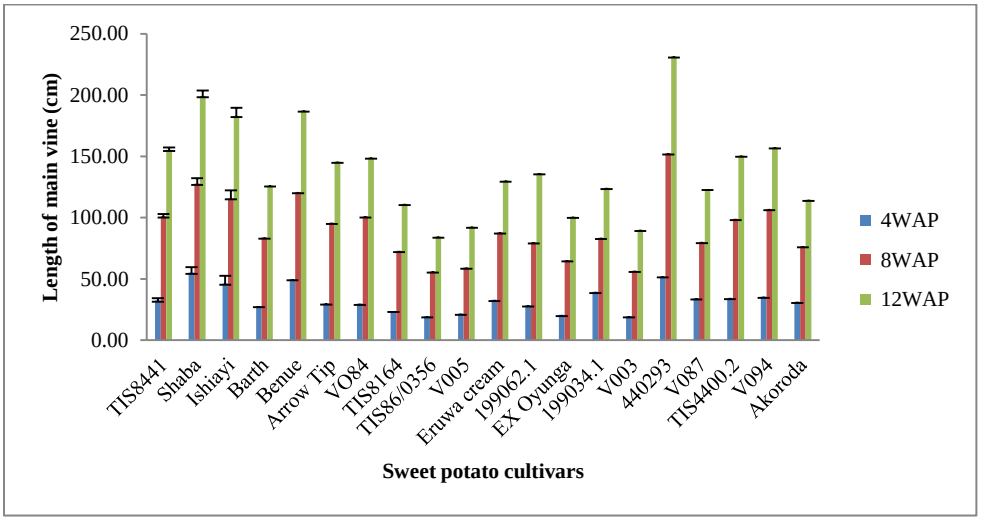


Figure 2: Mean length of main vine (cm) of sweet potato cultivars evaluated at the experimental field in Ibadan, Nigeria, 2012.

Percentage survival and Percentage ground cover

Percentage survival differ significantly ($p < 0.05$) among the sweet potato cultivars evaluated at 4 and 8 WAP. At 4 WAP, cultivars TIS 8441, Shaba, V084, TIS 86/0356, 199034.1, 440293, V087, Barth and Akoroda had significantly higher percentage survival than all other cultivars and comparable to that of Ishiayi, Benue, Arrow Tip and Eruwa- cream. At 8 WAP, cultivars TIS 86/0356, 440293, and V087 had significantly higher percentage survival than all other cultivars but comparable to cultivars Shaba, Barth, Benue, V084, TIS 8164, Akoroda, Eruwa- cream, 199062, V003 and 199034.1

Percentage ground cover also differs significantly at ($p < 0.05$) among the 20 sweet potato cultivars evaluated at 5 and 10 WAP. At 5 WAP, cultivars V084 and 440293 had the widest ground coverage of 44.0% and 42.5%. These were significantly higher than all other cultivars but comparable to that of cultivars TIS 8441, Benue, V087, TIS 8164, Eruwa-cream and Shaba. At 10 WAP, Cultivar V084 gave the widest ground coverage than all other cultivars evaluated. Cultivar 440293 also gave significantly wider coverage than all other cultivars except that of cultivars Benue as presented in Figure-3.

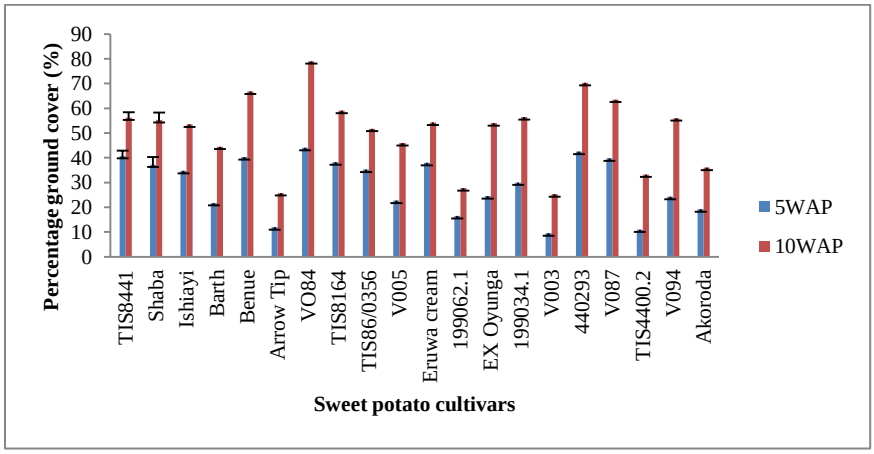


Figure 3: Percentage ground cover of sweet potato cultivars evaluated at the experimental field in Ibadan, Nigeria, 2012.

Tuber and Shoot yield

The fresh tuber and shoot yield produced among the 20 sweet potato cultivars differ significantly ($p < 0.05$) among the 20 sweet potato cultivars. For fresh shoot yield, cultivar 440293 produced significantly higher fresh shoot yield than all other cultivars. Cultivars Benue, TIS 86/0356 and Eruwa-cream also produced significantly higher fresh shoot yield than all other cultivars but lower than 440293 mentioned earlier.

For fresh tuber yield, cultivars TIS 8164, V087 and Benue produced significantly higher fresh tuber yield than all others except that of cultivar 199034.1 but lower than those mentioned earlier. Cultivar 199034.1 also had significantly higher tuber yield than the remaining cultivars except that of cultivar V084. Table -3 shows the mean yield components of the 20 sweet potato cultivars evaluated.

Table 3: Mean yield components of sweet potato cultivars evaluated at the experimental field in Ibadan, Nigeria, 2012.

Varieties	No of tubers/Plant	Fresh tuber weight (t/ha)	Fresh shoot weight (t/ha)
TIS 8441	1.95de	5.05gh	7.17ef
Shaba	2.05cde	5.49fgh	7.61ef
Ishiayi	1.33fg	3.43hij	8.67cde
Bath	1.03gh	2.40ijk	7.92def
Benue	**2.93b**	**17.73a**	**13.29b**
Arrow Tip	0.90gh	4.74gh	9.79c
V084	**2.03cde**	**12.54cd**	**13.50b**
TIS 8164	**2.10cde**	**18.92a**	**7.67ef**
TIS 86/0356	1.98cde	9.04e	13.08b
V005	**0.83gh**	1.56jk	3.94h
Eruwa Cream	**2.50bc**	**15.61b**	**12.13b**
199062.1	1.23fg	6.35fg	**3.83hi**
Ex-Oyunga	1.73ef	**1.17k**	5.34g
199034.1	**3.45a**	**14.17bc**	**9.29cd**
V003	0.65h	1.09k	2.50i
440293	2.48bcd	11.45d	**16.42a**
V087	**2.98ab**	**18.58a**	**6.46fg**
TIS 4400.2	1.15gh	1.48jk	9.69c
V094	1.88e	7.54ef	8.17de
Akoroda	1.15gh	4.47ghi	5.44g
Mean	1.81	8.14	8.60
Std dev.	0.17	0.70	0.47
CV (%)	18.68	17.1	11.02

Means followed by the same alphabets in a column are not significantly different ($p>0.05$)

DISCUSSION

The amount of rainfall received during the experimental period was 449.3mm. This was considered fairly adequate for sweet potato growth and development. According to Onwueme and Charles, (1994), sweet potato does best in region having 750- 1000 mm of rainfall per annum, with about 500mm of this rainfall falling during the growing season. Bergh *et al*., (2012), also reported that sweet potatoes are well adapted to unfavorable environmental conditions and their maturity period ranges between 3-6 months depending on variety.

The soil in the experimental plot was found to have a pH of 6.6 and a sandy loam textural class. This was considered suitable for sweet potato cultivation. According to Onwueme and Charles (1994), soils having a pH range of 5.6 - 6.6 are the most preferred for sweet potato production while Lebot (2009), reported that the preferred soils for sweet potato production are sandy loam soils that are leveled or slightly sloped and well drained.

Ground cover is a field characteristic of sweet potato crop and it is cultivar specific. According to Stanthers *et al*., (2005), sweet potato cultivars with good ground cover are used as cover crop to control weeds or as ground cover to prevent soil erosion. Cultivars V084 and 440293 with percentage ground coverage of 79.0% and 70.3% are good possible inclusion into farming systems where they can serve as cover crop either to control weeds or protect soil from erosion.

Yield is the most important characters which farmers desire in crop production. The physical components of yield in sweet potato are the number and mean the size of storage roots at harvest, which depends on foliage characteristics, the pattern of storage root growth, their mean weight and shape. According to Lebot (2009), all these characteristics vary significantly between cultivars and are under genetic control. The sweet potato cultivars evaluated in this study varies widely for both tuber and fresh shoot yield. This is in agreement with the result obtained by Ulasi *et al*., (2021), who reported between 2.00- 16.02 tons/hectare of fresh storage root yield

among 36 sweet potato genotypes during 2015 and 2016 cropping seasons, in Umudike, Nigeria. These yield variations may be as a result of growing conditions, cultivars or season.

CONCLUSION

Among the major root and tuber crops, sweet potato is the only one that has a positive per-capita annual rate of increase in production in Sub-Saharan Africa. Therefore, the selection of cultivars that has high productivity rate becomes imperative. The following conclusions can be made from this study:

1. Cultivars Benue, TIS 8164 and V087 produced highest tuber yield than other cultivars and are considered productive to growers who are more interested in tuber production.
2. Cultivars Eruwa-cream and 199034.1, could be considered more productive for their high fresh tuber and shoot yield
3. Cultivars 4440293 produced high biomass than other cultivars and may be considered productive if shoot yield is more important to the grower.
4. Cultivars V084 and 440290 produced the widest percentage ground cover and are considered as cover crop either for weed suppression or for soil erosion control

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