CHAPTER 23

EVALUATION OF SOME ORANGE FLESHED SWEET POTATO (Ipomeae batatas) GENOTYPE FOR YIELD AND FLOWER PRODUCTION

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Abstract

A field experimented was conducted in 2018 planting seasons to evaluate some orange fleshed sweet potato genotypes for yield and flower production. The experiment was laid out in a randomized complete block design with a single factor having ten treatments (potato genotypes) replicated three times. The potato genotypes were; Delvia, Kwara, Mascot-12, Naspot-71, Naspot 8, TIS 8164, TIS 8710087, umuspo-1, umuspo-2 and umuspo-3. Some growth parameters (vine length (cm), petiole length (cm), internodes length (cm), number of branches, days to anthesis, number of flowers per plant) were collected at 18 WAP. Also yield parameters (Number of root per plant, roots girth, root weight per plant and root yield per hectare t/ha) were also collected at the maturity of the roots. 18 WAP vine length at 18 WAP, was highest in TIS 8164 (221.32cm) followed by Naspot-8 (213.51cm) through not significant but significance was observed with some other varieties, while the least performer was TIS 8710087. Mean petiole length equally revealed significance, with TIS 8164 producing the highest this significantly differed from others the least here is TIS 8710087 2.05. Significant differences were recorded in terms of number of branches per plants 18 WAP umuspo/2 had the highest (9.9), then Delvia 9.20 and lastly TIS 81864 (3.9). These significantly differed from others table 2. Early flowering was recorded from Delvia (32.6 days) and TIS 8164 (37.0 days) while late flowering from umuspo/3 (58.3 days) although highest number of flowers was obtained from umuspo/3 (14.6) and umuspo/1(14.3) with some significant differences. Also significant differences were observed terms of yield parameters root length and girth, with TIS 8164 revealing the highest root length (18.1 cm), TIS 8710087 as next (17.8cm), and umuspo 3 having the least value of 13.7 cm). Naspot-8 had highest root girth (19.6cm) followed by umuspo/2 (18.5 cm) and mascot-12 (1804 cm) while umuspo/3 had the least (16.4 cm).other yield paraterslike number of roots per plant indicated that TIS 8164 and umuspo-3 had the highest (6.1), Roots weight per plant revealed highest values 2.2

from TIS 8164 of then (1.4kg) in two genotypes; mascot-12 and umuspo 0-3. In terms of root yield per hectare (t/ha), highest values were from TIS 8164 (31.7)umuspo/3 (20.5), mascot-12 19.4 and umuspo-1 (19.3) respectively while the least from TIS 8710087 (12.8) and it significantly differed from the others above.

Keywords: Ipomeabatatas. Genotype, Growth Yield Anthesis, Flowering Potency

INTRODUCTION

Sweet Potato (Ipomeabatatas) is a dicotyledonous plant from the family, convolvulaceae. It is aarge gems composed of more than 400 species most of which are annual and perennial herbal ceous vines with a few erect shrubs found in the tropic (Lebot 2010). Woolfe (1992) indicated that sweet potato originated from central/North west south America around 8,000-6000 B.C but that its, entry into cultivation according to O'Brien (1972) occurred about 3000 B.C. It is a vine like perennial herb which spreads on the surface of the ground. It's main parts consists of root, stem, leaf, flower, fruit and seed (Onwueme and Charles 1994). There are several thousand cultivars of sweet potato with great variation in form and growth habit. Some were developed through systematic breeding efforts while others appeared through natural hybridization and mutations.

In terms of importance, sweet potato is an important staple crop in regions of sub-saharan Africa (Onwueme and Sinha, 1991). The storage roots may be eaten fresh, boiled, fried into chips or roasted and eaten pounded or mixed with yam and eaten with vegetable some or made into a porridge, used in preparing kunnu drink etcand leaves used as forage for livestock or eaten as a vegetable (Agro dock 2013). Sweet potato comes in varieties with skin and flesh colour ranging from white to yellow, orange and deep purple (Loebenstein, 2013). Recently, the national root crops research institute Umudike produced some varieties (Umuspo 1, 2, 3 and 4) three out of the four varieties are orange fleshed sweet potatoes (OFSP). The OFSP's are rich in Beta Carotene which is converted into vitamin A in the human body (SASHA 2011, LOW et al; 2017). Vit A is an essential nutrient that prevent blindness in children and pregnant women (IFRI 2009) and is commonly deficient among people in most sub-saharan African countries resulting in increased risk of severe infection and even death from common diseases such as diarrhea and meascles (WHO 2011). The orange fleshed sweet potato is extremely rich in bioavailable betacarotene, which the body converts into vitamin A. According to sweet potato knowledge (2012), one small root (100-125grams) of most orange fleshed sweet potato varieties can supply the recommended daily allowance of vitamin A for children under five years of age it also contributes significant amount of vitamins C, E, K and several B vitamins. OFSP can substitute for potato in making chips and crips and serve as special substitute (20-50%) for wheat flour in bakens products. Also, they have a golden clour that make it easy for marketing campaigns and so increases demand. As a result of the food benefit of OFSP, the challenge is to introduce the beta carotene rich varieties and promote their production, uptake and consumption. Not withstanding these benefits, is production is constrained by a lot of challenges. For instance average yield of the crop is still very low; 3.0 t/ha compared with yield values of 15-30 t/ha obtainable from other sweet potato producing nations like China (Onwueme and Sinha 1991, Odebode 2004).

Among the factors contributing to low yield, are lack of well defined seed system, poor agronomic practices use of low-yielding varieties and kind races (Kou 1991). However in Nigeria for instance, annual recycling if vines heavily – loaded with pests and diseases (such as virus disease (Jende, 2004), Islam et al 2002) and Scarcity of quality seed materials as Sorense 2009 observed are the major hallenges. Although some high yielding varieties with reasonable resistance and high level of tolerance to sweet potato virus disease (SPVD) have been developed to assist farmers. They include Umuspo 1, Umuspo 2,umuspo 3, umuspo 4, and umuspw / 2 from national root crops research institute Umudike NRCRI). Umudike within a sweet potato collection, a wide variation is observed in their flowering habits, some don't evenflower or have scanty flowering while others flower profusely. Many flower characteristics can help venity, if two or moreaccessions are duplicates or not, However, many workers have realized that in identifying flowering sweet potato genotypes, which set seed after hybridization, a breeding programme could be set up with a definite purpose like breeding for disease resistance, yield, keeping quality, or for high sugar or starch content (Eguchi and Gonzaleez 1989, Thomas and Vincepruce 1997). This will serve to develop improved varieties for sustainable food security, bond on these thus the select cultivars for breeding purposes, information on growth and yield as well as flowering characteristics are severe from optimum performance of the crop. The objectives then were to;

1) Identify some orange fleshed sweet potato genotypes, with profuse flowering, and to estimate the level of agronomic and yield variability among the genotypes.

MATERIALS AND METHODS

2.1 Experimental Site and Design

The study was conducted during 2018 planting seasons of the teaching and research farm of the faculty of agriculture and veterinary medicine, Imo State University, Owerri. Owerri lies within latitude 5°29'N and 7°2'E and longitude 5.483°N and 7.003°E at an altitude of 9/m above sea level within the south-east rain forest agro ecological zone of Nigeria. The area has an annual rainfall of 1500mm to 2200mm (60 to 80 inches) and an average annual temperature of 27°C which creates an annual relative humidity of 75% (meteorological unit, ministry of land and survey – Owerri).

Experimental design was of the randomized complete block design (RCBD) with three replications.

2.2 Land Preparation and Vine Planting

The land was manually cleared by slashing using a cutlass. The field was then leveled and plots were laid out using a metre rule and pegs. The plots were prepared into beds using spades and garden lines at a dimension of 3m by 1m planting was carried out on April, 2018 vines measuring 20-30cm was planted or beds at a plant spacing of 03x1m within and between rows respectively (33333 plants/ha). Ten vines of different genotypes of orange fleshed sweet potato (OFSP) were obtained from the National root crops, research institute, Umudike.

The vines were cut about 30cm with 5-6 nodes. The vines were planted on beds by inserting half of the length of the cuttings into the soil at an angle of about 45° at a spacing of 1m by 0.3m. NPK 20:10:10 fertilizer was applied by side band placement at 3 weeks after planting (WAP). Hand weeding was one every 3 weeks until harvesting. The plants were harvested at 120 days after planting when the tubers maturity by scattering the beds and collecting tubes from the soil using hoe.

2.3 Data Collection and Analysis

Growth parameters (vine length petisle length, Number of branches, number of days to flowering and number of flowers per genotypes) were recorded.

Vine length (cm) was measured on the longest vine of each of the three tagged plants from ground level to the apical bud of the plant using a metre rule. Number of branches were determined by counting branches from each of the three tagged plants. Number of days to flowering was determined by counting number of days when 50% of the plants must have flowered and number of flowers recorded according to number produced per genotype.

Yield components (root length, root girth, number of roots per plant, root weight per plant and root yield per hectare) were determined at harvest. Root length (cm) was determine by pulling matured roots from three tagged plants and their lengths measure with a ruler (cm). Root girth this was obtained using a rope round the tubes and reading off the value of a ruler (cm).While number of roots per plant was determined by counting the number of roots produced per plant for the three tagged plants.

Root weight (root yield) per plant was determined at harvest by weighing (kg) the harvested roots of three tagged plants per plot using a weighing scales. Root yield per hectare (t/ha) was obtained by weighing the fresh root yield per plot and converting it to per hectare basis.

Data were subjected to analysis of variance (ANOVA) based on RCBD using Genstat statistical package and treatments differences determined using the least significant differences (LSD) method at 5% level of probability.

Results

3.1 Soil Physic-Chemical Properties:

The soil physic-chemical properties of the experimental size (Table 1) show that the texture of the soil was sandy loam soil with 86.80% sand, 9.20% clay and 4.00% silt. Available phosphorus (2.75ppm) was low, and total nitrogen (0.12%) was equally low. Exchangeable potassium (0.12 cmol/100g soil) was fairly moderate and soil organic carbon (1.47%) was low (<2%).

Table 1: Soil physic-chemical properties of the experimental site

Soil Properties	Values
pH (H_2O)	5.78
Sand (%)	86.00
Clay (%)	9.20
Silt (%)	4.00
Organic Carbon (%)	1.47
Organic malter (%)	2.56
Total exchangeable and (cmol/100g soil)	0.60
Aluminium (cmol/100g soil)	0.20
Calcium (cmol/100g soil)	2.40
Magnesium (cmol/100g soil)	1.00
Hydrogen (cmol/100g soil)	0.40
Total Nitrogen (%)	0.12
Potassium (cmol/100g soil)	0.12
Catian exchange capacity (cmol/100g soil)	4.25
Base saturation (%)	86.2
Sodium (cmol/100g soil)	0.23
Available phosphorus (ppm)	2.75

3.2 Mean growth parameters of different genotypes of OFSP evaluated at 18 weeks after planting is as presented in table 2 below;

Table 2: Mean growth rate characteristics of FSP genotypes at 18 WAP

Genotype	Vine length (cm)	Petiole length (cm)	Number of branches per plant
Delvia	141.92	3.64	9.2
Kwara	159.51	4.09	8.5
[illegible]	161.72	4.15	8.0
Naspot 71	213.51	5.47	4.9
Naspot 8	207.62	5.32	7.8
TIS 8164	221.32	5.67	3.9
TIS 8710087	114.67	2.94	8.3
Umuspo/1	202.47	5.19	7.5
Umuspo/2	125.82	3.23	9.9
Umuspo/3	137.62	3.53	7.9
MEAN	168.62	4.32	7.6
L.S.D (0.05)	6.35	1.701	2.0

Mean vine length of (cm) of different genotypes of OFSP had significant effect of 18 WAP. Significantly higher vine length was recorded in TIS 8164 (221.32 cm),Naspot 71 (213.51cm) and Naspot 8 genotype (207.62 cm) respectively the shortest vine length was obtained from TIS 8710087 (114.67 cm) and umasp0/2 (125.82 cm) genotype.

ANOVA results revealed significant differences among the genotypes with respect to petiole length. At 18 WAP, TIS 8164 genotype produced the longest petiole (5.67 cm) followed by Naspot – 71 (5.47 cm) and Naspot – 8 (5.32 cm). The first two genotypes differedsignificantly from the rest while Naspot apart from Delvia, also significantly differed from the rest LSD (1.701) table 2. The shortest petiole length was recorded from TIS 8710087 and Umusp0/2 with the value of 2.94 and 3.23 cm respectively.

The last column on genotypic effect of number of branches produced by the OFSP at 18 WAP indicated significant differences (L.S.D 2.0). the highest number of branches was recorded from Umusp0/2 with the value of 9.9 branches followed by Delvia that had 9.2 branches and Kwara 8.5 branches. The least number of branches was recorded from NAspot – 71 (4.9 branches) and TIS 8164 (3.9).

The yield characteristics of potato varieties is as shown in table 3.

Table 3: Mean yield characteristics of potato varieties.

Genotype	Number of days to flowering	Number of flowers at 18WAP per plant	Root length (cm)	Root girth (cm)	Number of roots per plant	Root weight per plant (kg)	Root yield per hectare (t/ha)
Delvia	33.6	8.1	14.9	15.7	4.5	1.2	16.8
Kwara	52.2	13.1	15.5	15.7	4.6	1.1	15.8
Masot – 12	50.8	12.7	10.3	18.4	4.5	1.4	19.4
Naspot 71	48.9	12.5	15.6	16.4	4.4	1.1	15.1
Naspot 8	56.8	14.2	14.6	19.6	4.3	1.2	17.7
TIS 8164	37.0	9.3	18.1	16.7	6.1	2.2	31.7
TIS 8710087	51.2	12.8	17.8	14.6	3.3	0.9	12.8
Umuspo/1	57.2	14.3	15.1	16.0	3.3	1.3	19.3
Umuspo/2	49.7	12.4	17.0	18.5	3.3	1.3	17.5
Umuspo/3	58.3	14.6	13.7	16.4	6.1	1.4	20.5
MEAN	49.5	12.4	15.3	16.8	4.4	1.3	18.7
L.S.D (0.05)	9.5	2.4	2.7	3.6	4.5	0.4	16.8

Genotypic effect on number of days to flowering and number of flowers of different genotypes revealed very high ($P<0.05$) to high significant ($P\leq0.01$) effect on number of days to flowering and number of flowers at 18 WAP (L.SD 9.5 and 2.4 respectively), Delvia was the earliest to flower (32.6 day) followed by TIS 8164 that flowered on the 37.0 days and Naspot-71 that flowered on the 48.9 days. The last to flower was umuspo/3 on the 58.3 days interestingly, umuspo/3 produced the highest number of flowers (14.6) at 18 WAP followed by umuspo/1 (14.3) while least number came from Delvia (8.1).

Analysis of variance on root length and root girth equally revealed significant differences. TIS 8164 with the value of 18.1 cm had the highest root length followed by TIS 8710087 that had 17.8 cm then umuspo/2-17.0 cm. These did not differ significantly differed from each other but they significantly differed fromthe rest. With respect to root girth, highest value came from Naspot 8 with the value of 19.6cm then umuspo/2 (18.5cm) and masot 12 (18.4cm). smallest root girth was from TIS 8710087 and Delvia (14.6 and 15.7 cm respectively).

Other yield parameters; mean number of root per plant, root weight per plant and root yield per hectare showed that these characters were significantly different from each other with respect to genotype evaluated. TIS 8164 and umuspo/3 having same mean number of roots per plant (6.1) gave highest mean root number. Those two significantly differed from TIS 8710087, umuspo/1 and umuspo/2 that had same least mean root number of 1.3.

Interms of root weight per plant highest mean root weight per plant was recorded from TIS 8164 with the value of 2.2kg and it differed significantly from the rest. This was followed by umuspo/3 and masbot 12 that had 1.4kg each, these and others significantly differed from the least mean root weight per plant which is 0.9 for TIS 8710087.

Finally, for mean root yield per hectare the highest value was from TIS 8164 (31.7) and this revealed the only significance observed with the least performer being Naspot-71; values of 16.8 though it did not reveal any significance with others as shown in table 3 above.

DISCUSSION

In vine length, significant differences were observed especially with TIS 8164 this is attributable to its genetic constitution Harriman et al (2016) opined that variation in vine length is attributable to genotypic differences among genotypes.

Similarly, results of ANOVA on petiole length and number of branches which differed significantly with respect to genotype could be as a result of varietal differences among genotypes. This finding is in line with the reports of Onyishi et al (2013) who stated that such significant differences recorded in growth parameters was due to non-uniformity and variation among genotypes.

The variation observed in number of days to flowering with Delvia and TIS 8164 consistently flowering earlier than other genotype and in umuspo/3 and TIS 8164 which produced highest number of flowers than others may be due to the genetic make up of each genotype. According to Thomas and Vince-Pruce (1997), many plants flower in response to seasonal changes in day length and that this response often varies between accessions of a single species based on their genetic constitution. This is also in harmony with the reports of Akinfoesoye et al (1997) in addition to Ray and Sinclair (1997) who attributed the flowering characteristics of crop species not only to genetic constitution of the crop but also to suitable agroecological zone where they can express their full genetic resources for flowering enhancement. They opined that early flower initiation and more flowers are desirable and not just an indication of productive potential, but also provide sufficient flowers for conventional hybridization in crop improvement.

Results further revealed that genotype had significant effect on yield parameters; (root length, root girth, number of roots per plant, root weight per plant and root yield per hectare) with TIS 8164, Kwara and Umuspo/3 producing superior number of roots per plant, and root weight per plant.

Harriman et al (2017) reported that this genotype; umuspo/3 always had a higher average root than other genotypes used in this experiment. Clark et al (1997)further asserted similar results and attributed the differences in yield and it's components between crop genotypes to variation in genetic structure, mineral concentration and potentials to transport photosynthetic materials within plants.

Number of roots per plant and root weight per plant have been known to play vital role in root yield and the overall root yield per hectare. TIS 8164 and umuspo/3 produced the maximum number of roots per plant and maximum root weight per plant which ideally resulted to max root yield per hectare. TIS 8164 and umuspo/3 appeared to be the best genotype in producing the superior yield over other genotypes, but with respect to flowering ability umuspo/3, umuspo/1 and Naspot-8 are the best flowering genotypes.

In conclusion, the genotypes showed wide variability for agronomic and yield parameters and that TIS 8164 and umuspo/3 significantly performed better than other genotypes with respect to root yield, and so showed great adaptability to the area in terms of yield production. So the above two varieties could be recommended to farmers for improved OFSP production, but in terms of flowering potentials, umuspo/3, umuspo/1 and Naspot -8 were the best flowering genotypes and could be recommended to breeders for conventional hybridization in crop improvement programme.

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