PLANT BREEDERS ASSOCIATION OF NIGERIA
HYBRID ANNUAL CONFERENCE, MAKURDI 2023
(ISSN: 3027-088X)

YIELD PERFORMANCE AND FLOWER PRODUCTION OF SOME OFSP GENOTYPES IN UMUDIKE

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Abstract
Field screening of ten genotypes of OFSP was conducted during 2015 and 2016 planting seasons at the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Nigeria. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and the data collected were subjected to analysis of variance (ANOVA). Analyses were done by pooling together two years data due to insignificant genotype x year interactions. The results of the experiment showed that growth characters, yield and yield components significantly varied ($p < 0.05$) with genotypes. Pearson's Correlation was carried out to examine the inter-relationships among traits using SPSS. The results from sweet potato growth parameters revealed that the vine length, number of branches and yield characters varied with genotypes. The vine length was highest in TIS 8164 (221.32cm) and Naspot-71 (213.51cm) at 18WAP, while the least was recorded for TIS 8710087 (114.67cm). Early flowering was recorded from Delvia (32.6 days) and TIS 8164 (37.0 days), while late flowering was recorded from Umuspo/3 (58.3 days). However, highest number of flowers was obtained from Umuspo/3 (14.6) and Umuspo/1 (14.3). The highest root weight per plant was recorded from TIS 8164 (2.2kg) and Umuspo/3(1.4kg). However, highest root yield per hectare was recorded from TIS 8164 (31.7t/ha). This was followed by Umuspo/3(20.5t/ha). The results obtained from correlation showed that root yield per ha was significantly and positively correlated with number of seeds per plant ($r = 0.189$), root weight per plant ($r = 0.987^{**}$), root girth ($r = 0.475^{**}$), number of roots per plant($r = 0.424^{*}$) and number of flowers per plant ($r = 0.848^{**}$). Negative correlation was recorded between root yield per ha and days to flowering ($r = -0.198$).

Keywords: Genotypes, OFSP, correlation, Flowering ability, seed-set

Introduction
Orange fleshed-sweetpotato is important in alleviating Vitamin A deficiency (VAD). Over the past few years, there has been a significant amount of interest in the cultivation of this crop by local farmers throughout the country (Ozturk *et al*., 2012; Degras, 2003; IVACG, 2009). Propagation is through unrooted sprouts called the 'slip' and vine cuttings. Vegetative propagation maintains the selected characteristics of the individual plant and enables multiplication of the best stock possible. One of the major constraints to sweet potato production, however, is the availability of good quality planting material. Lack of sustainable seed systems (including virus management, seed quality and supply) is one of the key constraints to sweet potato productivity in sub-Saharan Africa (Low *et al*, 2009; WHO, 1995). Reports of shortages of planting materials caused by prolonged dry seasons are common in the literature (Nsibande and McGeoch, 1999). Lack of planting materials is often particularly acute at the onset of the rains after the long dry season has desiccated the foliage. Traditional vine sources often fail to provide adequate planting materials, resulting in delayed planting or loss of a particular desirable genotype to dryness.

Similarly, repeated use of vines as planting material has been shown to promote increased weevil infestation in sweetpotato roots (Ray *et al*, 1983). This situation can be salvaged by using seeds generated by some genotypes as it is not susceptible to dryness. This is because sweetpotato seeds can maintain their viability for many years. However, within a sweetpotato collection, a wide variation is generally observed in the flowering habits of different accessions. Under normal sowing conditions, some cultivars do not flower, or have scanty flowers and others flower profusely. Flowering is indispensable in order to obtain sexual seed from the accessions maintained in a collection, both for long term gene conservation and for use in breeding. Several techniques have been developed to promote not only sweetpotato flowering but also fruit and seed production (Eguchi and Gonzalez, 1989). Sweetpotato Seeds are used in breeding programmes to obtain genetic variation for the development of new varieties (Thankanmap and. Easwarai mma, 1987). The fact that sweetpotato rarely produces flowers and true seed has placed the various investigators, in a rather helpless position in regard to any improvement program other than the selection of new types which arise as mutations and which must be propagated asexually (Klass, 1998). Many workers have realized that in identifying flowering sweetpotato genotypes which set seed after hybridization, a breeding program could be set up, with a definite purpose such as breeding for disease resistance, yield, cooking quality, shape, high sugar or starch content. This will serve to develop improved varieties for sustainable food security. In order to select cultivar for breeding purposes, information on the growth and flowering characteristics are necessary to make optimum decision. The objectives of this research work therefore were; to investigate the flowering variability among the orangefleshed sweetpotato genotypes, to study the correlation between yield and yield related traits and to establish the nature of variability for agronomic characters among the genotypes.

Materials and Methods

Experimental site

The experiment was conducted during the 2015 and 2016 planting seasons at the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Nigeria. The location is typically rain forest vegetation and its soil is classified as sandy loam (reference). It has an average annual rainfall of about 2177mm per annum and average annual temperature of about 26^0 C (reference).

Collection of OFSP

Vines of different genotypes of orange fleshed sweetpotato (OFSP) obtained from the National Root Crops Research Institute, Umudike were used for this experiment.

Experimental design and planting

The experiment was laid out in a randomized complete block design (RCBD) with three replications. Field beds measuring 3m x 1m were used. Vines measuring 20-30cm were planted on beds at a plant spacing of 0.3 x 1m within and between rows respectively, giving 33,333 plants/ ha. Weeding was done manually using hoe at 3weeks after planting, just before fertilizer application. Fertilizer type NPK 15:15:15 was applied to the plants 3 weeks after planting at the rate of 400kg per hectare.

Data collection and analysis

Data were collected on growth, flowering and yield characters. The data collected were subjected to analysis of variance (ANOVA) using Genstat Discovery Edition 12 (Genstat, 2012). Separation of treatment means with significant effect was done using Fishers Least Significant Difference (F-LSD) as described by Wahua (1999).

Results

The means for growth and yield traits of ten genotypes of OFSP evaluated are presented in Table 1. From the results, genotype had significant effect on vine length of OFSP.At

18WAP, the same trend was observed with the genotype TIS 8164 having the longest vine (221.32cm). This was followed by Naspot-71 that had the vine length of 213.51cm, and Naspot-8 genotype (207.62cm). However, the shortest vine length was obtained from TIS 8710087 (114.67 cm) and Umuspo/2 (125.82cm) genotypes. Analysis of variance results showed that number of branches was significantly different from each other with respect to the genotypes evaluated (P<005). Results from number of branches showed that At 18WAP, the highest number of branches was recorded from Umuspo/2 (9.9 branches). This was followed by Delvia (9.2 branches) and Kwara (8.5 branches). However, the least number of branches was recorded from TIS 8164 (3.9) and Naspot-71 (4.9) branches. The mean results recorded for number of days to flowering showed that the genotype, Delvia was the earliest to flower (32.6 day), followed by TIS 8164 that flowered on the 37.0 day and Naspot-71 that flowered on the 48.9 day. The last to flower was Umuspo/3 in 58.3 days. With respect to number of flowers at 12 and 18WAP, highest number of flower was produced by Umuspo/3 with the values of 7.8 and 14.6 flowers at 12 and 18WAP respectively. This was followed by Umuspo/1 with the values of 7.6 and 14.3 flowers at 12 and 18WAP respectively. With respect to number of seeds per plant, the highest number of seeds per plant was recorded from TIS 8164 with the value of 20.1. This was followed by TIS 8710087 that had 19.7 and Umuspo/2 that had 18.9. The smallest number of seeds per plant was recorded from Masot-12 and Umuspo/3 with the values of 11.4 and 15.2 respectively. However, the least number of flowers was recorded from Delvia that had 4.3 and 8.1 flowers at 12 and 18WAP, respectively. With respect to root length, the highest root length was recorded from TIS 8164 with the value of 18.1cm. This was followed by TIS 8710087 with 17.8cm and Umuspo/2 with 17.0cm. The shortest root length was produced by Masot-12 and Umuspo/3 with the value of 10.3 and 13.7cm respectively. However, highest root girth was recorded from Naspot-8with the value of 19.6cm. This was followed by Umuspo/2 with 18.5cm and Masot-12 with 18.4cm. Analysis of variance results showed that all the yield characters were significantly different from each other. The highest number of root was recorded from TIS 8164 and Umuspo/3 with each having 6.1 roots. This was followed by Kwara with 4.6 roots. The highest root weight per plant was recorded from TIS 8164 with the value 2.2kg. This was followed by Umuspo/3 and Masot12 with 1.4kg each. However, the highest root yield per hectare was recorded from TIS 8164 with the value 31.7t/ha. This was followed by Umuspo/3 with 20.5t/ha and Masot-12 with 19.4t/ha. The smallest root yield per hectare was recorded from TIS 8710087 and Naspot-71 with the value of 15.1t/ha each.

Table 1: Growth and yield traits variations of 10 OFSP genotypes evaluated in Umudike.

Genotype	VL@18	NB@	NDF NFPP	NFPP	NSPP RL	RG	NRPP RWPP RYH				
						(cm)	(cm) WAP(cm)	18WAP	12WAP	18WAP	(kg)	(t/ha)
Delvia	141.92	9.2	32.6	4.3	8.1	16.6	4.5	1.2	16.8	14.9	15.7
Kwara	159.51	8.5	52.2	6.9	13.1	17.2	15.5	15.7	4.6	1.1	15.8
Masot-12	161.72	8.0	50.8	6.8	12.7	11.4	10.3	18.4	4.5	1.4	19.4
Naspot-71	213.51	4.9	48.9	6.7	12.5	17.3	15.6	16.4	4.4	1.1	15.1
Naspot-8	207.62	7.8	56.8	7.6	14.2	16.2	14.6	19.6	4.3	1.2	17.7
TIS 8164	221.32	3.9	37.0	4.9	9.3	20.1	18.1	16.7	6.1	2.2	31.7
TIS 8710087	114.67	8.3	51.2	6.8	12.8	19.7	17.8	14.6	3.3	0.9	12.8
Umuspo/1	202.47	7.5	57.2	7.6	14.3	16.7	15.1	16.0	3.3	1.3	19.3
Umuspo/2	125.82	9.9	49.7	6.6	12.4	18.9	17.0	18.5	3.3	1.3	17.5
Umuspo/3	137.62	7.9	58.3	7.8	14.6	15.2	13.7	16.4	6.1	1.4	20.5
MEAN	168.62	7.6	49.5	6.6	12.4	16.9	15.3	16.8	4.4	1.3	18.7
LSD (0.05)	66.355	2.0	9.5	1.3	2.4	3.0	2.7	3.6	4.5	0.4	16.8

WAP = weeks after planting, VL = vine length, NB = number of branches, NDF = number of days to flowering, NFPP = Number of flowers per plant, RL = root length, RG = root girth, NSPP = number of seeds per plant

Table 2. Correlation matrix for some OFSP characters evaluated in Umudike.

Characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1). Number of seeds per plant	1									
2). Root weight /plant	0.205	1								
3). Root length	0.248	0.166	1							
4). Root girth	0.045	0.481**	0.036	1						
5). Number of root/plant	0.134	0.422*	-0.164	0.414*	1					
6) . Day to flowering	-0.459*	-0.206	-0.225	-0.106	-0.025	1				
7). No. of branches@18WAP	-0.107	-0.427*	-0.175	-0.233	-0.258	0.243	1			
8). Vine length@18WAP	-0.280	0.332	0.054	0.337	0.296	0.132	-0.429*	1		
9). Number of flower per plant	0.138	0.833**	0.193	0.467**	0.244	-0.285	-0.576**	0.532**	1	
10). Root yield per ha	0.189*	0.987**	0.143	0.475**	0.424*	-0.198	-0.442*	0.337	0.848**	1

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).

The results obtained from correlation analysis among growth characters, yield and yield related traits of OFSP genotypes revealed positive and negative associations among the studied traits (Table 2).Root yield per ha was significantly and positively correlated with number of seeds per plant (r = 0.189*), root weight per plant (r = 0.987**), root girth (r = 0.475**), number of root per plant(r = 0.424*) and number of flower per plant (r = 0.848**). However, significant and negative correlation was recorded between root yield per ha and number of branches at 18WAP(r = -0.442*). Negative correlation was recorded also between root yield per ha and days to flowering (r = -0.198). Root girth was significantly and positively correlated with root weight per plant (r = 0.481**). Days to flowering was significantly and negatively correlated with number of seeds per plant (r = -0.459*) and negatively correlated with root weight per plant (r = -0.206), root length (r = -0.225) and root girth (r = -0.106).

Discussion

The significant differences observed in the vine length, with TIS 8164 consistently producing higher vine length might be due to the genetic constitution of each Genotype. These findings were supported by Onyishi *et al.* (2013) who reported that the significant differences recorded in growth parameters was due to the non- uniformity and variation among the genotypes. The variation observed in number of days to flowering with Delvia and TIS 8164 consistently flowering earlier than other genotypes and in Umuspo/3 and TIS 8164 which consistently produced highest number of flowers than others may be due to the genetic make-up of each genotype. According to Thomas and Vince-Prue (1997), many plants flower in response to seasonal changes in day length and that this response often varies between accessions of a single species base on their genetic constitution. This is also in harmony with the reports of Akinfoesoye *et al*. (1997) and Ray and Sinclair (1997) who attributed the flowering characteristics of crop species not only to genetic constitution of the crop but also to the suitable agro-ecological zone where they can express their full genetic resources for flowering enhancement. According to their reports, 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. The results also showed that genotypes had significant effect on yield parameters with TIS 8164, Kwara and Umuspo/3 producing superior number of roots per plant and root weight per plant. The results could be compared with those of Harriman *et al.* (2017), who reported that the genotype Umuspo/3 had higher average number of roots than other genotypes used in the experiment. Clark *et al.* (1997) reported similar results and attributed the differences in yield and its components between crop genotypes to variations in genetic structure, mineral concentration and potentials to transport photosynthetic materials within plants. Number of roots per plant and root weight per plant 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 maximum root yield per hectare. TIS 8164 and Umuspo/3 appeared to have the best genotype in producing superior yield over other genotypes. However, with respect to flowering ability, Umuspo/3, Umuspo/1 and Naspot-8 were best flowering genotypes, while TIS 8164, TIS 8710087 and Umuspo/2 had best seed-set ability. Pearson correlation showed that root yield per ha was significantly and positively correlated with number of seeds per plant (r = 0.189*), root weight per plant (r = 0.987**), root girth (r = 0.475**), number of root per plant(r = 0.424*) and number of flower per plant (r = 0.848**).This indicated that root yield per ha increased as these characters increased. Our current finding is in line with the findings of Nedunchezhiyan *et al*.(2007). However, negative correlation recorded between root yield per ha and day to flowering (r = -0.198) indicated that root yield per ha increased as the OFSP flowered earlier. According to Antiaobong and Bassey (2008), the earlier a plant flowers, the better the yield. Yield is an agronomic index that measures adaptability of a genotype to its growing environment, hence genotype TIS 8164 and Umuspo/3 can be identified as the highest producers of root yield per ha and adaptable to the study area and local growing conditions (Nwankwo *et al*., 2012). Results from correlation showed that selection of OFSP with increased root weight per plant, root girth, number of roots per plant and early flowering genotypes is possible and can be used as an important index for selection of OFSP to growers aimed at producing high root yield. In conclusion, the results obtained from this experiment showed that TIS 8164 and Umuspo/3 significantly performed better than other genotypes with respect to root yield.

Conclusion

Based on the findings, TIS 8164 and Umuspo/3 could be recommended for release to farmers for improved OFSP production in Umudike. Based on the flowering potentials of the genotypes evaluated, Umuspo/3, Umuspo/1 and Naspot-8 were the best flowering genotypes and could be recommended to breeders for incorporation into hybridization in crop improvement programme.

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