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Selection Criteria for Higher Marketable Tuber Yield of Orange Fleshed Sweet Potato

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The experiment conducted at Muzaffarpur research farm during 2007-08 and 2008-09 with seven orange fleshed sweet potato genotypes using six quantitative characters *viz*., vine length, number of tuber per plant, weight of tuber per plant, dry matter, harvest index and marketable tuber yield showed that there were significant differences among genotypes. In general phenotypic coefficient of variability was higher than genotypic coefficient of variability. High heritability coupled with high genetic advance was observed for marketable tuber yield indicating the importance of this trait during selection. Number of tuber/plant had exhibited significant and positive correlation with yield having their high direct effect suggesting that during the course of selection to have the higher marketable tuber yield the number of tuber/ plant may be considered as prime trait. Based on the selection index the genotypes, 440038, SV-98 and 440127 were identified as the best for cultivation.

Key words : Orange Fleshed Sweet Potato, Heritability, Correlation, Path analysis.

Sweet potato (*Ipomoea batatas* L.) is an important source of carbohydrate. In India, sweet potato is grown in 0.14million hectares with an annual production of 1.17 million tonnes at productivity of 8.3 t/ha. But in Bihar it is growth in 300 hectares, with a annual production of 6000 tonnes and productivity is 20 t/ha respectively. Orange-fleshed sweet potato (OFSP) is regarded as beta-carotene-rich and an excellent source of pro-vitamin A. In India or many other developing countries OFSP is a secondary staple food and may play a role in controlling vitamin A deficiency. Besides this it is a future crop for sustainable agriculture after millets and pulses due to global warming and environmental change.

Materials and Methods

The present experiment was carried out at the research farm of Tirhut College of Agriculture, Dholi, Muzaffarpur during 2007-08 and 2008-09. The experimental material comprised of seven genotypes of OFSP including the check Kamala Sundari. The experiments were conducted in RBD with three replications. Data of the five randomly selected plants were recorded for the characters viz., vine length (cm), number of tuber per plant, weight of tuber per plant, dry matter (%), harvest index (%) and marketable tuber yield (t/ha). The data was analyzed as per the method given by Panse and Sukhatme (1985) for ANOVA and correlation coefficient as well as path were analyzed by following the methods given by Wright (1921), Dewey and Lu (1959).

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Results and Discussion

Mean sum of squares due to genotypes were found to be highly significant for all the characters in both years except harvest index (%) and number of tuber per plant during 2007-08 and 2008-09 respectively as evident from Table 1. Wide rage was observed for the characters viz., dry matter (%), harvest index (%) and marketable tuber yield (%), suggesting the presence of ample amount of genetic variability among the experimental materials.

For all the characters, PCV was higher than GCV during 2007-08 and 2008- 09 (Table 3). The characters having the GCV up to 15 per cent have been grouped in low genotypic variation; those having16.00 to 25.00 per cent in moderate genotypic variability and ones having GCV of more than 25.00 per cent are kept in high genotypic variability class.

Low GCV was observed for harvest index. Moderate GCV were observed for vine length and dry matter per cent, while high genotypic variability was observed for number of tuber/plant, weight of tuber/plant and marketable tuber yield (t/ha) during 2007-08. Similar results were also observed by Kumar *et al*. (1996), Hossain *et al*. (2000) and Tsegaye *et al*. (2007).

In 2008-09 three genotypes exhibited low GCV for the characters number of tuber/plant, weight of tuber/plant (kg) and dry matter per cent. Moderate GCV was observed for single character i.e. vine length. While high GCV was observed for marketable tuber yield. Similar findings were observed by Shashikanth *et al*. (2008).

Table 1. ANOVA for six, quantitative traits of September planted orange fleshed sweet potato during 2007-08 and 2008-09

Source of variation/ Character	Mean sum of square due to		
	Replication (df =2)	Treatment (df = 6)	Error (df = 12)
2007-08			
Vine length (cm)	93.5938	4927.8130**	476.5365
No. of Tuber/plant	0.0135	3.8499**	0.2642
Weight of Tuber/plant (kg)	0.0001	0.0225**	0.0005
Dry matter (%)	33.3691	64.3452**	6.6607
Harvest Index (%)	60.5117	424.6576	160.0716
Marketable tuber yield (t/ha)	0.3755	69.7938**	1.5216
2008-09			
Vine length (cm)	91.3281	3715.5160**	93.3646
No. of Tuber/plant	0.3837	1.0083	0.3390
Weight of Tuber/plant (kg)	0.0002	0.0038**	0.0003
Dry matter (%)	3.5684	21.1270**	3.9053
Harvest Index (%)	3.2969	438.7800**	19.8307
Marketable tuber yield (t/ha)	0.2465	31.8642**	1.8837

Only three characters have exhibited high heritability viz., number of tuber/plant, weight of tuber/ plant (kg) and marketable tuber yield (t/ha) as given in Table 3. Similar results were earlier recorded by Kumar *et al*. (1996). Two characters exhibited moderate heritability i.e. vine length (cm) and dryable matter (%), marketable tuber yield (t/ha) exhibited high heritability during 2007-08. Similar findings were also reported by Hossain *et al*. (2000) and Tsegaye *et al*. (2007).

In the year 2007-08 the number of tuber/plant, weight of tuber/plant, dry matter per cent and marketable tuber yield exhibited high heritability coupled with high genetic advance indicating the preponderance of additive gene action. To have the higher genetic gain these characters selection may be taken into consideration. Similar findings were also reported by Hossain *et al*. (2000) and Shashikanth *et al*. (2008).

In 2008-09 number of tuber/plant and dry matter per cent have exhibited low heritability. Moderate heritability was observed for weight of tuber/plant while high heritability was recorded for vine length (cm), harvest index (%) and marketable tuber yield (t/ha) coupled with high genetic advance, similar findings were observed by Choudhary *et al*. (1999), Tsegaye *et al*. (2007).

Table 2. Variability for six traits in orange flashed sweet potato during 2007-08 and 2008-09

Character	Range		Mean		SEm (±)		CV (%) at 0.05		CD (t/ha) at 0.05	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Vine length (cm)	127.89-235.91	115.22-208.78	163.15	144.60	12.60	5.57	13.38	6.68	38.83	17.20
No. of tuber/plant	1.89-4.99	2.35-4.00	3.04	3.21	0.29	0.33	16.90	18.13	0.91	1.04
Weight of tuber/plant (kg)	0.11-0.34	0.24-0.34	0.19	0.28	0.01	0.01	11.39	6.15	0.04	0.03
Dry matter (%)	17.17-30.33	29.09-36.36	21.02	31.91	1.49	1.14	12.27	6.19	4.59	3.51
Harvest index (%)	54.72-89.66	56.42-91.88	66.08	68.02	7.30	2.57	19.14	6.54	22.51	7.92
Marketable tuber yield (t/ha)	5.37-20.74	10.89-23.14	8.74	12.02	0.60	0.79	11.97	11.41	1.86	2.44

Table 3. Genetic parameters of six characters of Orange Fleshed sweet potato during 2007-08 & 2008-09

Character	2007-08					2008-09				
	GCV(%)	PCV(%)	h_2 (%)	GA	GA (%)	GCV(%)	PCV(%)	h_2 (%)	GA	GA (%)
Vine length (cm)	23.609	27.137	75.69	34.03	20.86	24.03	24.94	92.82	18.47	12.77
No. of tuber/plant	35.9509	39.726	81.89	0.86	28.51	14.71	23.35	39.69	0.47	14.83
Weight of tuber/plant (kg)	43.392	44.949	93.58	0.04	21.89	11.66	13.46	78.57	0.02	9.85
Dry matter (%)	20.857	24.201	74.27	3.94	18.78	7.51	9.73	59.51	2.42	7.59
Harvest index (%)	14.211	23.844	35.52	9.25	14.00	17.40	18.56	87.56	8.03	11.80
Marketable tuber yield (t/ha)	46.311	47.835	93.73	2.02	23.12	26.30	28.66	84.14	2.37	19.78

Genetic as well as phenotypic correlation were worked for all the characters combination (Table 4). Almost all the traits combinations genotypic correlation was in higher magnitude than the phenotypic correlation coefficient. During 2007-08 number of tuber/plant exhibited significant and positive correlation with weight of tuber/plant and marketable tuber yield. Similar findings were also observed by Hossain *et al*. (2000).

In 2008-09 number of tuber/plant exhibited significant and positive genotypic correlation with weight of tuber/plant and marketable tuber yield. Dry matter per cent also showed significant and positive genotypic correlation with marketable tuber yield. While vine length exhibited negative correlation with marketable tuber yield at both genotypic and phenotypic level in 2007-08 and 2008-09. Similar findings observed by Alam *et al*. (1998).

The path analysis was used to study the direct and indirect causes of association and for partitioning of correlation coefficient into direct and indirect effects. Genotypic path analysis being free from environmental influence can give a better picture of cause and effect relationship than phenotypic path analysis. The direct and indirect effect of causal variables on the resultant variable i.e. yield have been presented in the Table 5.

Number of tuber/plant had shown the significant and positive correlation with marketable tuber yield (t/ha) having the high positive direct effect in both the year (2007- 08 and 2008-09), while weight of tuber/plant and dry matter percentage had also shown significant and positive correlation with marketable tuber yield (t/ha) also having the high positive direct effect in the year 2007-08 and high positive indirect effect of number of tuber/plant in

Table 4. Phenotypic (upper value) and Genotypic (lower value) correlation coefficients between different character combination among six characters of Orange Fleshed sweet potato

Character		Ch-1	Ch-2	Ch-3	Ch-4	Ch-5	Ch-6
2007-08							
Vine length (cm)	P	1.0000	-0.1021	-0.0247	0.1408	-0.3062	-0.1164
	G	1.0000	-0.2105	-0.0625	0.3154	-0.4520	-0.1442
No. of tuber/plant	P		1.0000	0.8321	0.4554	0.3482	0.9402
	G		1.0000	0.9308**	0.5953	0.6243	1.0141**
Weight of tuber/plant (kg)	P			1.000	0.3788	0.3183	0.8411*
	G			1.0000	0.4698	0.6460	0.8766**
Dry matter (%)	P				1.0000	-0.3475	0.5119
	G				1.0000	-0.5664	0.6414
Harvest index (%)	P					1.0000	0.2786
	G					1.0000	0.5329
Marketable tuber yield (t/ha)	P						1.0000
	G						1.0000
2008-09							
Vine length (cm)	P	1.0000	0.3097	-0.4978	-0.2681	-0.3833	-0.0400
	G	1.0000	-0.2741	-0.6164	-0.4217	-0.3932	-0.0849
No. of tuber/plant	P		1.0000	0.2355	0.3588	-0.1206	0.6311
	G		1.0000	0.7977*	0.7477	0.0098	0.8672*
Weight of tuber/plant (kg)	P			1.000	0.3421	-0.6701	0.3736
	G			1.0000	0.4714	-0.9619**	0.5249
Dry matter (%)	P				1.0000	-0.2385	0.6262
	G				1.0000	-0.2641	0.9612**
Harvest index (%)	P					1.0000	-0.1492
	G					1.0000	-0.1481
Marketable tuber yield (t/ha)	P						1.0000
	G						1.0000

2008-09. This results suggest that at the time of selection for higher marketable tuber yield, number of tuber/plant and weight of tuber/plant may be considered. Similar findings were also observed by Hossain *et al*. (2000), Kumar *et al*. (1996).

Table 5. Phenotypic (upper value) and Genotypic (lower value) direct and indirect effect of six characters on marketable tuber yield of Orange Fleshed sweet potato during 2007-08 and 2008-09

Character		Ch-1		Ch-2		Ch-3		Ch-4		Ch-5		Ch-6 (Corr)	
		2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Vine length (cm)	P	-0.0584	-0.2920	-0.0737	0.1726	-0.0050	0.1925	0.0152	-0.0657	0.0055	-0.0474	-0.1164	-0.0400
	G	0.0533	-1.6368	-0.1438	0.3153	-0.0256	0.7996	-0.0206	0.4910	0.0992	-0.0540	-0.1442	-0.0849
No. of tuber/plant	P	0.0060	-0.0904	0.7214	0.5574	0.1699	0.0911	0.0492	0.0879	-0.0062	-0.0149	0.9402**	0.6311
	G	0.0112	-0.4486	0.6833	1.1503	0.3813	1.0348	-0.0389	-0.8705	-0.1370	0.0013	0.9000**	0.8672*
Weight of tuber/plant (kg)	P	0.0014	-0.1454	0.6003	0.1313	0.2042	0.3867	0.0409	0.0838	-0.0057	-0.0829	0.8411**	0.3736
	G	0.0033	-1.0089	0.6360	0.9176	0.4097	1.2972	-0.0307	-0.5489	-0.1417	-0.1321	0.8766**	0.5249
Dry matter (%)	P	-0.0082	0.0783	0.3285	0.2000	0.0773	0.1323	0.1080	0.2451	0.0062	-0.0295	0.5119	0.6262
	G	-0.0168	0.6902	0.4068	0.8600	0.1925	0.6115	-0.0653	-1.1643	0.1243	-0.0363	0.6414	0.9612**
Harvest index (%)	P	0.0179	0.1119	0.2512	-0.0672	0.0650	-0.2592	-0.0375	-0.0585	-0.0179	0.1237	0.2786	-0.1492
	G	0.0241	0.6436	0.4266	0.0113	0.2646	-1.2478	0.0370	0.3075	-0.2194	0.1373	0.5329	-0.1481

Residual effect (2007-08) (Phenotypic) = 0.305 (Genotypic) = 0.421

Residual effect (2008-09) (Phenotypic) = 0.508 (Genotypic) = 0.507

Based on the basis of mean marketable tuber yield and selection index three genotypes namely 440038, SV-98 and 440127 were identified as the best genotypes for cultivation (Table 6).

For all the characters significant differences were observed among the genotypes. In general, phenotypic coefficient of variability was higher than genotypic coefficient. High heritability coupled with high genetic advance was observed for marketable tuber yield indicating the importance of this trait during selection. Number of tuber/plant had exhibited significant and positive correlation with yield having their high direct effect suggesting that during the course of selection to have the higher marketable

Table 6. Relative pooled ranking of genotypes for marketable tuber yield

Genotype	Marketable tuber yield (t/ha)	Rank as per marketable tuber yield	Selection score on the basis of selection index	Rank as per selection index
440038	21.10	1	211.16	2
440127	15.50	3	170.77	5
362-7	9.33	6	160.87	7
SV-98	20.26	2	190.60	4
S-594	12.59	5	242.75	1
CIPSWA-2	13.07	4	164.59	6
Kamala Sundari	9.07	7	206.29	3

Rank correlation coefficient = 0.821**

tuber yield number of tuber/plant may be considered as prime trait.

Based on the basis of mean marketable tuber yield and selection index, three genotypes namely 440038, SV-98 and 440127 were identified as the best genotypes for cultivation.

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