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Genetic Variability Study in Sweet Potato (Ipomoea batatas L.) genotypes

Madawal, S. I., Alloli, T. B. Siddappa Madarakhandi and Anand Narasannavar

ABATRACT: *The investigation on genetic variability study in sweet potato was undertaken during the year 2010-11 at Horticulture Research Station RHREC Kumbapur farm ,Dharwad, Karnataka. All 52 genotypes showed significant differences for all the characters studied. GCV and PCV were low to high for all characters. High heritability with high GAM was recorded for vine length, leaf area index, number of tubers per vine, total soluble solids, tuber length, tuber yield per plot and tuber yield per hectare which indicates the presence of additive gene effects for these traits. Hence improvement can be done through phenotypic selection. High heritability with low to moderate GAM was observed for inter nodal length, number of auxiliary branches and tuber girth which indicates the role of non additive gene effects. Hence, improvement in these traits would be more effective by selecting specific combinations followed by intense matting of lines.*

Key words: *sweet potato, genetic variability, genetic advance, heritability*

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Poir) is a dicotyledonous plant belonging to the family Convolvulaceae is one important starchy root tuber food crop of tropical and subtropical countries. In southern part of United States, it is popularly known as 'white potato' or 'Irish potato'. It is popularly called as 'Sakarkand' in India. Sweet potato is grown as food crop in practically all countries of the world and extensively cultivated in tropical and sub tropical countries including India, Bangladesh, Pakistan, China (Bose and Som, 1986). The nutrition of Sweet potato in human diet is quite appreciable since, it provides high quantity of starch, substantial amount of vitamins (A, B and C) (Hung 1999), minerals and trace elements compared to cereals.). Recent studies associated with the consumption of carotenoid rich food showed the decrease of the incidence of certain cancers in human beings (Gester, 1993). Considering the potentiality of the crop in alleviating hunger and malnutrition, there is a prime need for developing/ identifying varieties suited to specific agro-ecological conditions. Before taking up any breeding programme in any crop species, a thorough knowledge regarding the amount of genetic variability existing in that particular crop for various characters is essential. If the crop has the wide range of variability, then scope of breeding will also be very wide and *vice-versa.*

Breeding varieties suited to specific agro-ecological conditions for vegetable purpose is urgently needed for northern parts of Karnataka. Though, sweet potato has been under civilization in small patches its potentiality is not fully exploited. Therefore, there is a need for identification or development of sweet potato genotypes suited for northern dry zone of Karnataka. This calls for an evaluation of local or related genotypes to know the variability. Sweetpotato is one of the most under exploited of the developing world's major crops (Rees *et al*., 2003), as evidenced by its breeding initiatives that are at relatively early stages compared to other crops. The need to identify local germplasm with desirable traits has long been recognised by breeders (Rees *et al*., 2003).

MATERIAL AND METHODS

The study was conducted at Horticulture Research Station, Dharwad (Kumbapur farm). The experiment was conducted on sandy loam soil which was located in the agro climatic zone-8 (Northern Transition zone) of Karnataka state. Geographically, Dharwad is located at 15°26′ North latitude, 76°27′ East longitude and at an altitude of 678m above mean sea level. 52

KRCCH, Arabhavi. University of Horticultural Sciences, Bagalkot-587103

sweet potato genotypes through various regions of Karnataka including three varities from TNAU (Co-1, Co2 and Co-34) were used.

The experiment was arranged in a randomized block design with three replications. Each genotype was planted on 3 m long and 2.4 m wide plot consisting of four rows, which accommodated ten plants per row and thus forty plants per plot. A distance of 1m was maintained between the plots. Vine cuttings from the top portion of 3-4 months old mother plants were taken for planting. The vine cuttings were then cut into 30 cm length and thereafter planting was done on 11th July 2011 with a spacing of 60 cm between rows and 30 cm between plants. Earthing up was done twice, 45 and 75 days after planting. Fertilizers were not applied during the course of the experiment. During the course of this experiment, no serious disease or insect pest infestations were noticed and thus crop protection measures were not employed.

The observations were recorded for various characters viz. vine length, number of auxiliary branches, inter nodal length and leaf area index at 40, 80 and 120 days after planting and yield parameters like number of tubers per vine, tuber length, tuber girth, total soluble solids tuber yield per vine, tuber yield per plot and hectare. The mean performance of individual treatments were pooled and employed for statistical analysis (Table 1). Analysis of variance to test the significance for each character was carried out as per methodology given by Gomez and Gomez (1984).Phenotypic coefficient of variability (PCV) and genotypic coefficient of variability (GCV) and heritability in broad sense (h2) were calculated by the formula given by Burton and De Vane (1953), and genetic advance that is the expected genetic gain was calculated by using the procedure given by johnson et al. (1955).

RESULT AND DISCUSSION

The analysis of variance (Table 1) revealed highly significant variation among all the accessions at one per cent level and also at five per cent probability for 17 growth and yield parameters in sweet potato. This result was confirmatory with Engida *et al.* (2007). It indicates that sufficient variability existed for the characters studied and considerable improvement could be achieved in most of the characters by selection.

In the present study, wide range of variability was observed for all the characters except inter-nodal length. Similar results, *i.e.*, wide range of variability for different characters were observed by Jansirani and Thanburaj (1987), Srivastava and Goutam (1987), Rao *et al.* (1993), Devi *et al.* (2008) and Engida *et al.* (2007).

The phenotypic and genotypic coefficient of variation recorded were moderate to high (10%-25%) for characters like vine length, leaf area index, number of tubers per vine, tuber length, total soluble solids, tuber yield per vine, tuber yield per plot and tuber yield per ha.

These results were in confirmatory with the findings of various workers like Jansirani and Thanburaj (1987), Gunjanjaha (2008) and Engida *et al.* (2007) for number of tubers per plant; Teshome *et al.* (2004), Gunjanjaha (2008), Engida *et al.* (2007) and Evoor *et al.* (2008) for vine length; Engida *et al.* (2007) and Gunjanjaha (2008) for tuber length. Teshome *et al.* (2004), Gunjanjaha (2008) and Engida *et al.* (2007) for tuber yield per plant (kg); Engida *et al.* (2007) for tuber yield per plot and tuber yield per ha.

In the present study, high heritability values were estimated in the characters like vine length (85.6), leaf area index (94.57), number of tubers per vine (85.00), tuber length (70.92), tuber girth (90.17), tuber yield per vine (96.68), total soluble solid (92), tuber yield per plot (94.90) and tuber yield per ha (94.50) (Table-3). Similar results were observed by Gunjanjaha (2008), Evoor *et al.* (2008) and Engida *et al.* (2007) for vine length; Jansirani and Thanburaj (1987), Teshome *et al*. (2004), Engida *et al.* (2007) and Evoor *et al.* (2008).

Jansirani and Thanburaj (1987) and Teshome *et al.* (2004) for tuber length; Jansirani and Thanburaj (1987), Gunjanjaha (2003) and Teshome *et al.* (2004) for tuber girth; Engida *et al.* (2007) , Gunjanjaha (2008) and Evoor *et al.* (2008); Engida *et al.* (2007) for tuber yield per plot and tuber yield per ha.

Low heritability was observed in the present investigation for the characters like inter nodal length (6.67) and number of auxiliary branches (38.08) (Table-2) in contradiction with the findings of Devi *et al.* (2008) for inter nodal length; Singh and Mishra (1975) and Rao *et al.* (1993) for number of auxiliary branches.

According to Panse (1967), if heritability is mainly due to non additive effects, the genetic advance will be low and if heritability was due to additive gene effects, it would be associated with high genetic advance.

In the present investigation high heritability (> 60%) with high genetic advance over mean (> 20%) were exhibited by the traits like vine length, leaf area index, number of tubers per vine, total soluble solids, tuber length, tuber yield per vine, tuber yield per plot

Table 1
Analysis of variance (mean squares) for different growth, yield and quality parameters in sweet potato

Sl. No.	*Sources of variation/ characters*	*Replication*	*Treatments (genotypes)*	*Error*	*S.Em±*	*CD (5%)*
	Degrees of freedom	*2*	*51*	*102*		
A	**Growth parameters**					
1	Vine length (cm) (40 DAP)	2685.598	2914.9**	329.57	10.48	29.40
2	Vine length (cm) (80 DAP)	2244.518	2944.6**	389.64	11.39	31.96
3	Vine length (cm) (120 DAP)	2195.112	3201.0**	436.53	12.06	33.83
4	Number of axillary branches (40 DAP)	0.684062	0.965**	0.2924	0.31	0.87
5	Number of axillary branches (80 DAP)	10.39518	1.155**	0.4565	0.39	1.09
6	Number of axillary branches (120 DAP)	7.130502	2.256**	0.6609	0.46	1.31
7	Internodal length (cm) (40 DAP)	1.608695	0.4071**	0.1983	0.25	0.72
8	Internodal length (cm) (80 DAP	19.27131	1.210**	0.4000	0.36	1.02
9	Internodal length (cm) (120 DAP)	28.4791	2.676**	0.7935	0.51	1.44
10	Leaf area of index (cm^2)	10.07203	47.64**	0.3916	0.36	1.01
B.	**Tuber Parameters**					
1	No of tubers per plant	0.677949	2.631**	0.346053	0.33	0.952702
2	Tuber length (cm)	11.03564	17.81**	3.411523	1.06	2.991298
3	Tuber girth (cm)	1.695993	5.696**	0.378015	0.35	0.995727
4	Tuber yield per vine (kg)	0.043372	2.669**	0.030164	0.10	0.281275
5	Tuber yield per plot (kg)	3.878269	75.92**	3.582027	1.09	3.065138
6	Tuber yield per ha	7.481229	146.4**	6.909775	1.51	4.257136
C.	**Quality Parameters**					
1	Total soluble solids (^{o} brix)	0.03533	0.5713**	0.132	0.20	0.588618

** Significant @ 1%

Table 2
Variability for various growth characters in sweet potato

Sl. No.	*Characters*	*Mean*	*Range*	*GV*	*PV*	*PCV*	*GCV*	*h^2 (%)*	*GA*	*GA % of mean*
1	Vine length at 40 DAP (cm)	118.04 ± 10.4	65.67- 177.78	861.77	1191.35	29.24	24.87	72.33	4244.12	35.95
2	Vine length at 80 DAP (cm)	133.48 ± 11.3	78.33- 194.67	851.68	1241.32	26.39	21.86	68.61	4109.41	30.79
3	Vine length at 120 DAP (cm)	155.13 ± 12	101-220.23	1103.47	1274.81	22.96	21.36	86.56	5253.98	33.87
4	No. of axillary branches at 40 DAP (cm)	3.60 ± 0.31	2.51-4.76	0.02	0.65	22.79	4.45	38.08	52.17	14.49
5	No. of axillary branches at 80 DAP (cm)	5.45 ± 0.39	4.09- 6.60	0.15	0.91	17.09	6.91	16.34	26.43	4.85
6	No. of axillary branches at 120 DAP (cm)	8.21± 0.4	5.77- 10.27	0.50	1.16	12.92	8.54	43.10	78.85	9.60
7	Internodal length at 40 DAP (cm)	2.90 ± 0.25	1.85- 3.85	0.021	0.324	21.54	5.49	6.67	6.46	2.23
8	Internodal length at 80 DAP (cm)	4.14 ± 0.36	2.53- 5.57	0.02	0.69	21.29	3.44	2.61	3.69	0.89
9	Internodal length at 120 DAP (cm)	6.37 ± 0.51	4.22-8.5	0.33	0.61	14.35	10.54	5.32	7.08	1.11
10	Leaf area index	6.32 ± 0.36	1.86-19.56	15.75	16.14	63.59	62.81	94.57	615.42	97.61

GV- Genotypic variance; h^2- Broad sense heritability; PV- Phenotypic variance
GAM- Genetic advance as per cent of mean; GCV- Genotypic co-efficient of variation; DAP- Days after planting
PCV- Phenotypic co-efficient of variation

Table 3
Variability for various tuber characters in sweet potato

Sl. No.	*Characters*	*Mean*	*Range*	*GV*	*PV*	*PCV*	*GCV*	*h^2 (%)*	*GA*	*GA % of mean*
1	No. of tubers per vine	3.91 ± 0.23	2.40- 6.97	0.86	1.01	26.18	24.14	85.00	145.39	22.14
2	Tuber length (cm)	14.96 ± 0.83	10.47- 21.33	5.02	7.07	17.78	14.97	70.92	320.67	21.44
3	Tuber girth (cm)	6.01 ±0.48	3.23- 8.40	1.81	2.01	10.70	8.04	90.17	217.29	16.07
4	Total soluble solids (^{o} brix)	14 ±0.60	7-21	0.15	0.28	20.38	19.57	92	4.45	38.44
5	Tuber yield per vine (kg)	1.56 ± 0.1	0.60- 6.00	0.88	0.91	61.16	60.14	96.68	145.79	96.60
6	Tuber yield per plot (kg)	13.32 ±1.09	6.00- 26.08	25.73	27.10	38.88	37.88	94.90	839.86	62.72
7	Tuber yield per ha (t)	18.42 ±0.97	8.33-36.23	48.61	51.43	38.94	37.86	94.50	1152.09	62.27

GV- Genotypic variance; h^2- Broad sense heritability; PV- Phenotypic variance
GAM- Genetic advance as per cent of mean; GCV- Genotypic co-efficient of variation; DAP- Days after planting
PCV- Phenotypic co-efficient of variation

and tuber yield per ha. Accordingly, selection for these characters for further improvement would be gainful as they indicated predominance of additive genetic variance. Although some of the characters like vine length and leaf area index are of no importance from consumer point of view, it may be of much importance for a breeder, as they serve as good source of production and supply of sufficient carbohydrates for growth of tubers. Similar findings of high heritability with genetic advance over mean were reported by Teshome *et al.* (2004) , Engida *et al.* (2007) for vine length**;** Kamalam *et al.* (1977), Choudhary *et al.* (1999), Gunjanjaha (2008) , Teshome *et al.* (2004), Engida *et al.* (2007) , Hossain *et al.* (2000) and Evoor *et al.* (2008) for number of tubers per plant; Gunjanjaha (2008) for total soluble solids; Choudhary *et al.* (1999) for tuber length; Engida *et al.* (2007) , Teshome *et al.* (2004), Choudhary *et al.* (1999) and Hossain *et al.* (2000) for tuber yield per ha.

In the present study, high heritability (> 60%) with moderate genetic advance over mean (10-20%) was observed for tuber girth. Similar findings were reported by Rao *et al.* (1993), Gunjanjaha (2008) and Engida *et al.* (2007).

A low heritability with low genetic advance was observed in number of auxiliary branches and inter nodal length (Table-2). The results are in confirmatory with findings of Choudhary *et al.* (1999) for inter nodal length; Afaupe *et al.* (2011) and Gunjanjaha (2008) were also observed low heritability with low genetic advance for number of auxiliary branches.

The high heritability with high genetic advance over mean observed in present study for vine length, leaf area index (Table 2), number of tubers per vine, total soluble solids, tuber length, tuber yield per vine, tuber yield per plot and tuber yield per ha (Table-3) and these characters like can be improved through direct selection.

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