I J T A
© Serials Publications

National Academy of Agricultural Science (NAAS) Rating : 3. 03

Genotypic and Phenotypic Correlations of tuber Yield and other Traits of Orange-Fleshed Sweet Potatoes [*Ipomoea batatas* (L.) Lam.]

Madawal, S. I., Alloli, T. B. Siddappa Madarakhandi and Ambresh

ABSTRACT: *Understanding the interrelationships among various agronomic triats is vital to plan an effective breeding program in sweet potato. This study was undertaken to determine associations among yield and yield related triats in the crop plant so as to identify the major triats of importance that could be used as a basis for clonal selection. A replicated field experiment was carried out using fifty two sweet potato genotypes selected at random from throught the regions of india. Observations were made on ten characters. In the present investigation, genotypic correlation is higher than phenotypic correlation for all the characters, indicating little influence and masking effect of environment and the presence of inherent association between various characters. Phenotypic as well as genotypic correlation coefficients analysis reveled tuber yield per ha was positively and significantly correlated with number of tubers per vine , tuber girth , total soluble solids, tuber yield per vine and tuber yield per plot at both phenotypic and genotypic levels. Tuber length was negatively and highly significant with tuber girth indicating the compensatory relationship between tuber length and tuber girth. In the present study vine length was negatively and significantly correlated with tuber length and tuber yield per ha, leaf area index and total soluble solids. Vine length was also negatively significant with tuber length and tuber girth. Therefore by this study it is known that as the vine length increases there is reduction in tuber length, tuber girth and tuber yield. Hence, during breeding programme if maximum tuber yield are to be obtained in sweet potato compromise with vine length is suggested.*

Key word*: Genotypic correlaltion, Phenotypic correlation, Correlation coefficients, Sweet potato.*

INTRODUCTION

Sweet potato (*Ipomea batatas* L.) is adaptable to a broad range of agro-ecological conditions and fits into low-input agriculture. It is highly productive even under adverse farming conditions (Prakash, 1994). Sweet potato and other root crops are considered by many to be inferior or "poverty food" (Purcell *et al.*, 1989); however, being cultivated in more than 100 countries (Woolfe, 1992), with over 135 million metric tones produced annually (Purcell *et al.*, 1989), sweet potato is an extremely important, versatile, and underutilized food crop in many parts of the world including. One of the major contributions, which sweet potatoes could make to the health and welfare of humankind is that of supplying carotenoid vitamin A precursors. Vitamin A deficiency is one of the major health problems, which some developing countries face at the present time. Correlations of characteristics among yield, its components, and other economical traits is important for making selection in breeding program. Correlation coefficient analysis measures the mutual relationship between various plant characteristics and determines the component characters on which selection can be based for improvement in yield. Knowledge of interrelationships between different traits is important in breeding for direct and indirect selection of characters that are not easily measured and those with low heritability (Patil *et al.*, 1981). Selection for tuber yield, which is a polygenic trait, often leads to changes in other characters. Hence knowledge of the relation that exists between tuber yield and other characters and also interrelationships among various characters is necessary to be able to design appropriate selection criteria in sweet potato breeding (Engida *et al.*, 2006). Therefore, the objective of this paper was to estimate the phenotypic and genotypic correlations among different traits.

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

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 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 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 (cm) , number of auxiliary branches, inter nodal length (cm) and leaf area index (cm2) at 40, 80 and 120 days after planting and yield parameters like number of tubers per vine, tuber length (cm), tuber girth (cm), total soluble solids tuber yield per vine (kg), tuber yield per plot (kg) and tuber yield per hectare (t). The mean performance of individual treatments were pooled and employed for statistical analysis (Table 1). The phenotypic and genotypic correlations between all possible characters were calculated according to formula given by Al-Jibouri *et al.*, 1958.

RESULTS 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

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**	0.4	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	0.1	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 (° brix)	0.03533	0.5713**	0.132	0.2	0.588618

** Significant @ 1%

Table 2
Genotypic correlation for growth, tuber yield and its components in sweet potato

Characters	*Vine length (cm)*	*No. of auxillary branches*	*Internodal length (cm)*	*Leaf area index (cm2)*	*No. of tubers per vine*	*Tuber length (cm)*	*Tuber girth (cm)*	*Total soluble solids*	*Tuber yield per vine (kg)*	*Tuber yield plot (kg)*	*Tuber yield per ha (t)*
Vine length (cm)	**1.000**	0.016	-0.05	-0.185*	-0.165*	-0.327**	-0.148	-0.138	-0.156	-0.068	-0.103
No. of axillary branches		**1.000**	0.181*	-0.097	-0.194*	-0.019	-0.208*	0.043	0.161*	0.237**	0.229**
Internodal length (cm)			**1.000**	0.019	-0.127	-0.448**	0.239**	0.043	0.433**	0.27**	0.265**
Leaf area index (cm2)				**1.000**	0.164*	-0.233**	0.159*	0.484**	-0.068	-0.05	-0.034
No. of tubers per vine					**1.000**	0.034	0.029	0.431**	0.296**	0.371**	0.398**
Tuber length (cm)						**1.000**	-0.217**	-0.079	-0.11	-0.07	-0.051
Tuber girth (cm)							**1.000**	0.42**	0.407**	0.171*	0.174*
Total soluble solids								**1.000**	0.38**	0.248**	0.277**
Tuber yield per vine (kg)									**1.000**	0.755**	0.772**
Tuber yield plot (t)										**1.000**	0.998**

Critical r @ 1% = 0.210 Critical r @ 5%= 0.159 *Significant at 5% ** Significant at 1%

Table 3
Phenotypic correlation for growth, tuber yield and its component characters in sweet potato

Characters	*Vine length (cm)*	*No. of axillary branches*	*Internodal length (cm)*	*Leaf area index (cm 2)*	*No. of tubers per vine*	*Tuber length (cm)*	*Tuber girth (cm)*	*Total soluble solids*	*Tuber yield per vine (kg)*	*Tuber yield plot (kg)*	*Tuber yield per ha (t)*
Vine length (cm)	**1.000**	-0.008	-0.054	- 0.172*	- 0.167*	- 0.188*	- 0.126	- 0.122	- 0.141	- 0.071	- 0.099
No. of axillary branches		**1.000**	0.148	- 0.052	- 0.145	0.091	- 0.152	0.035	0.08	0.162*	0.143
Inter nodal length(cm)			**1.000**	0.01	- 0.056	- 0.258**	0.132	0.072	0.325**	0.22**	0.215**
Leaf area index				**1.000**	0.153	- 0.195*	0.152	0.346**	-0.066	-0.046	- 0.029
No. of tubers per vine					**1.000**	0.013	0.031	0.33**	0.273**	0.331**	0.361**
Tuber length(cm)						**1.000**	- 0.206**	- 0.03	-0.098	-0.075	-0.064
Tuber girth(cm)							**1.000**	0.246**	0.39**	0.154	0.155
Total soluble solid								**1.000**	0.258**	0.168*	0.192*
Tuber yield per vine (kg)									**1.000**	0.723**	0.739**
Tuber yield plot(kg)										**1.000**	0.99**

Critical r @ 1% = 0.210 Critical r @ 5%= 0.159 *Significant at 5% ** Significant at 1%

result was confirmatory with Engida *et al.* (2007). It is indicated that sufficient variability existed for the characters studied and considerable improvement could be achieved in most of the characters by selection. However, the analysis of variance by itself is not enough and conclusive to explain all the inherent genotypic variances in the genotypes.

In the present investigation, genotypic correlation is higher than phenotypic correlation for all the characters, indicating little influence and masking effect of environment and the presence of inherent association between various characters.

In all the instances however more reliance may be placed on genotypic correlation tuber yield per ha was positively and significantly correlated with number of tubers per vine , tuber girth , total soluble solids, tuber yield per vine and tuber yield per plot at both phenotypic and genotypic levels. Similar findings were observed by Thanburaj *et al.* (1976), Li *et al.* (1992), Hossain *et al.* (2000) Teshome *et al.* (2004), Islam *et al.* (2002), Engida *et al.* (2007) and Burhan *et al.* (2007) for number of auxiliary branches, inter nodal length, number of tubers per vine and tuber girth and Gunjanjaha (2008) for tuber yield and total soluble solids.

In the present study vine length was negatively and significantly correlated with tuber length and tuber yield per ha, leaf area index and total soluble solids. This results were similar with Li *et al.* (1992) for tuber yield; Kamalam *et al.* (1977), Teshome *et al.* (2004) and Engida *et al.* (2006) for tuber length and tuber yield per ha and Gunjanjaha (2008) for leaf area index and total soluble solids. Vine length was also negatively significant with tuber length and tuber girth. These results were in confirmatory with Teshome *et al.* (2004). Therefore by this study it is known that as the vine length increases there is reduction in tuber length, tuber girth and tuber yield. Hence, during breeding programme if maximum tuber yield are to be obtained in sweet potato compromise with vine length is suggested.

Numbers of auxillary branches were negatively significant with number of tubers per vine, tuber girth and positively highly significant with tuber yield. Similar results were observed by Teshome *et al.* (2004). Therefore by this study it is known that as the number of auxiliary branches increases there is increase in tuber yield but reduction in number of tuber per vine and tuber girth.

Leaf area index was positively and significant to total soluble solid. This might be due to photosynthetic activity in leaves as the food production takes in leaves and it is distributed to other parts of plant. This result was in confirmatory with Gunjanjaha (2008).

Number of tubers per vine was positively and highly significant with total soluble solids, tuber yield per vine, tuber yield per plot and tuber yield per ha at both phenotypic and genotypic levels. Similar results were observed by Engida *et al.* (2006) for tuber yield per vine and tuber yield per ha; Islam *et al.* (2002) for tuber yield per ha and Gunjanjaha (2008) for total soluble solids.

In the present study tuber girth was positively significant with total soluble solids and tuber yield per vine. This was in confirmatory with Pushkaran *et al.* (1976), Thanburaj and Muthukrishnan (1976), Kamalam *et al.* (1977), Thankamai and Easwari (1990), Nanda (1994), Kumar *et al.* (1996), Alam *et al.* (1998), Pareda *et al.* (1999), Hossain *et al.* (2000), Choudhary *et al.* (2000), Islam *et al.* (2002), Hossain *et al.* (2000), Ravindran (2000), Teshome *et al.* (2004) for tuber yield; Gunjanjaha (2008) for tuber yield and total soluble solids. So this study indicates that as there is increase in tuber girth there is increase in tuber yield and total soluble solids.

Total soluble solids were positively significant with tuber yield. Similar results were observed by Gunjanjaha (2008).

Tuber yield per vine and tuber yield per plot was positively and significantly correlated with tuber yield per ha.This indicates that as the tuber yield per vine and per plot increases also there is an increase in tuber yield per ha. This result was in confirmatory with Engida *et al.* (2007).

CONCLUSION

Correlation studies revealed that highly significant and positive association of Tuber yield per ha with number of tubers per vine, total soluble solids, tuber yield per vine and tuber yield per plot indicating the possibility of simultaneous selection for these traits to improve the tuber yield in sweet potato.

REFERENCES

Al-Jibouri, H. A., Miller, P. A. and Robinson, H. V., (1958), Genotypic and environmental variance and co-variances in an upland cotton cross of interspecific origin. *Agron. J.*, **50**: 633-636.

Alam, S., Narzary, B. and Deka, B., (1998), Variability character association and path analysis in sweet potato. *J. Agric. Sci. Soci., N. E India*, **11**: 77-78.

Burhan, A, (2007), Relationship among yield and some yield characters in potato (*Solannum tuberusum*). *J. Biol. Sci.*, **7**(6)**:** 973-976.

Chaudary, S. C., Harash, K., Kumar, M., Verma, V. S. and Naskar, S. K. T., (2000), Correlation and path analysis in sweet potato (*Ipomea batatas* lam.). *J. Research*, **12**(2): 239-242.

Engida, T., Devakara, E. V. and Nigussie, D., (2006), Correlation and path analysis in sweet potato. *J. Agron.*, **5** (3): 391-395.

Engida, T., Devakara, E. V. and Nigussie, D., (2007), Genetic variability for yield and other agronomic triats in sweet potato. *J. Agron.*, **6** (1): 94-99.

Gunjanjaha, (2008), Estimation of genetic variability in sweet potato. *The Ecoscan.*, **41**: 180-185.

Hossain, M., Rabbani, M. and Mallah, M., (2000), Genetic variability, correlation and path analysis of yield contributing characters in sweet potato. *Pak. J. Sci. Int. Res.*, **43**: 314-318.

Islam, M. Z., Haque, M. M. and Husian, M. F., (2002), Growth and yield potential of nine selected genotypes of sweet potato. *Pakistan J. Biol. Sci.*, **5** (5): 537-538.

Kamalam, P., Biradar, R, S. and Rajendran, P. G., (1977), Path analysis and correlation studies in sweet potato (*Ipomea batatas* lam.). *J. Root crops.*, **3**(1): 5-11.

Kumar, R., Jain, B. P., Ganduli, D. K., Patty, V. P. and Pillai, S. V., (1996), Variability, character association and path analysis in sweet potato (*Ipomea batatas* lam.). *Tropical Tuber Crops: Prospects, Problems and Future Strategies*, **4**: 140-145.

Li li., (1992), Studies on association among yield components and their relationship to tuber yield in sweet potato. *J. Agric. Assoc. China.*, **49**: 1-14.

Nanda, H. C., (1994), Correlation and path studies for yield and its components in rainfed sweet potato. *J. Root Crops*, **20** (2): 135-137.

Pareda, A. K., Bera, M. K. and Nandi, (1999), Identification of parameters influencing of sweet potato tuber yield under late planted rainfed condition. *Environment and Ecology*, **17**(4): 971-974.

Patil, V.D., V.G. Makane and P.R. Chopde. (1981), Genetic variability and character association in intervarietal crosses of linseed. *Indian Journal of Agricultural Science* **51:** 631- 633.

Prakash, C.S. (1994), Sweet potato biotechnology: progress and potential. *Biotech. And Dev. Monitor*, 18, 1919-1822.

Purcell, A.E., W.M. Walter, Jr., and L.G. Wilson, (1989), Sweet potatoes. pp. 285-304.In: N.A. Michael Eskin (ed.). Quality and Preservation of Vegetables. CRC Press, Inc., Boca Raton, Florida.

Pushkaran, K., Nair, S. P. and Gopkumar, K., (1976), Analysis of yield and its components in sweet potato (*Ipomea batatas* lam.). *Agric. Res. J. Kerala.*, **14 *(2)***: 153-159.

Ravindran, C, S., (2000), Breeding and selection approach for sweet potato in South west Asia. *Hort. Sci.*, **21**: 41-43.

Teshome, A., Veeraragavathatham, D. and Kanan, M., (2004), Genetic variability and correlation studies in sweet potato. *Madras Agric. J.*, **91** (7-12): 420-424.

Thanburaj, S. and Muthukrishnan, C. R, (1976), Association of metric triats and path analysis in sweet potato (*Ipomea batatas* lam.). *Madras Agric. J.*, **63**: 1-8.

Thankamai, P. and Easwari, A. C., S, (1990), Variability in the hybrid progenies of sweet potato. *J. Root Crops.*, **16**: 8-12.

Woolfe, J.A., (1992), Sweet Potato: An Untapped Food Resource. Cambridge, UK,(In collaboration with the international Potato Center, Lima, Peru). 643 p.