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Genetic variability and correlation studies in sweet potato (*Ipomoea batatas* Lam. L.)

TESHOME ANSHEBO, D. VEERARAGAVATHATHAM AND M. KANNAN
Dept. of Vegetable Crops, Hort. College and Res. Instt., Tamil Nadu Agrl. Univ., Coimbatore - 3

Abstract : Genetic variability and correlation coefficients were worked out for eight parameters in 86 genotypes of sweetpotato (*Ipomoea batatas* Lam) of diverse origin. For all the characters studied, phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) indicating the influence of environment on the expression of these traits. The characters *viz.* number of branches per plant, weight of single tuber, girth of tuber and length of tuber showed higher estimates of PCV and GCV. High heritability estimates were noticed for vine traits *viz.* length of vine, number of branches per plant and weight of foliage per plant. The least estimate of heritability was observed for number of tubers per plant. The characters such as number of branches per plant, weight of single tuber, girth of tuber and length of tuber showed high heritability estimates associated with high genetic advance indicating the presence of additive gene effect. Characters like weight of single tuber, girth of tuber, length of tuber and number of branches per plant showed a strong positive correlation with tuber yield. However, length of vine expressed a strong negative correlation with it. Selection based on weight of single tuber, length of tuber and number of branches per plant can be effective for genetic improvement of sweet potato.

Key words: Correlation, Sweet potato genotypes, Tuber yield, Variability.

Introduction

The amount of variability present in the germplasm collection of any crop determines the limit of progress that can be achieved through selection. An assessment of variability in the germplasm for the important economic characters is required for the genetic improvement of the crop. The wide range of genetic variability available opens immense scope to design the selection procedures leading to the identification of superior genotypes. So, consideration of quantitative genetic approaches for exploitation of the extensive genetic variability in sweetpotato (*Ipomoea batatas* Lam. L.) is dependent on good estimates of the genetic parameters involved. Although a number of inheritance studies have suggested quantitative inheritance pattern (Jones *et al.* 1985; Li, 1992), genetic information about many traits of economic importance is meagre. The narrow sense heritability estimate has a great impact on breeding programmes since it facilitates evaluation of hereditary and environmental effects on phenotypic variation. The variability available in a population could be portioned into heritable and non-heritable components with the aid of genetic parameters such as genotypic coefficient of variation, heritability and genetic advance which also serves as a basis for selection. The degree of success in a selection programme depends on the magnitude of heritable variation. Hence, the present study was taken up to assess the variability in sweetpotato with the help of genetic parameters like phenotypic and genotypic coefficient of variation, heritability and genetic advance and to estimate the extent of interrelationship among yield contributing traits through correlation analysis.

Materials and methods

Eighty six genotypes of sweetpotato collected from different parts of the country were utilized for the present study during 2001-2002 at the Department of Vegetable Crops, Horticultural College and Research Institute,

Table 1. Estimates of genetic variability in sweet potato

Character	Mean	Variance		PCV (%)	GCV (%)	h^2	GA (% of mean)
		σ^2p	σ^2g				
Vine length (cm)	206.20	3687.23	3651.06	29.45	29.31	0.96	60.08
No. of branches /plant	10.70	24.64	24.25	46.18	45.81	0.94	93.63
Weight of single tuber (g)	108.80	2217.28	2214.18	43.26	43.23	0.90	89.00
Weight of foliage/plant (g)	702.80	25278.53	25154.55	22.62	22.57	0.91	46.37
No. of tubers/plant	4.50	0.66	0.64	18.22	17.95	0.61	36.43
Tuber length (cm)	11.50	21.76	21.38	40.59	40.23	0.80	82.14
Tuber girth (cm)	3.70	2.33	2.31	41.07	40.88	0.85	83.84
Tuber yield/plant (g)	450.70	11240.72	11008.86	23.52	23.28	0.86	47.46

Tamil Nadu Agricultural University, Coimbatore, India. The genotypes were evaluated in RBD with three replications having a plot size of 3.6 m x 2.4m. Vines were planted at a spacing of 60cm x 20cm. The observations were recorded on ten randomly selected plants per plot for eight characters *viz.* vine length, number of branches per plant, weight of foliage per plant, number of tubers per plant, length of tuber, girth of tuber, weight of single tuber and tuber yield. Data of all the plants were recorded on plot basis after removing the border rows. Statistical analysis was made after Johnson *et al.* (1955) for variability and Panse and Sukhatme (1987) for correlations. Heritability and genetic advance were calculated according to the methods suggested by Allard (1960).

Results and discussion

The mean, phenotypic (σ^2p) and genotypic (σ^2g) variances, the coefficients of phenotypic (PCV) and genotypic (GCV) variation, heritability estimates (h^2) and expected genetic advances (GA) are given in Table. 1. The analysis of variance revealed significant differences among the genotypes of sweetpotato for all traits under the study. Weight of foliage per plant, tuber yield per plant, length of vine and weight of individual tuber showed high phenotypic as well as genotypic variances.

In general the genotypic coefficient of variation was lower than the phenotypic coefficient of variation for all the characters studied, indicating the influence of environment on the expression of these characters. The data further indicated that characters like number of branches per plant, weight of single tuber, girth of tuber and length of tuber showed high values for phenotypic and genotypic coefficient of variation. High values of GCV for these characters suggest better scope of improvement by selection. The number of tubers per plant showed the lowest coefficient of variation at phenotypic and genotypic levels. Similar results were reported for these traits with respect to PCV and GCV (Thamburaj and Muthukrishnan, 1978).

However, it is not possible to determine the amount of heritable variation with the help of genotypic coefficient of variation alone. Burton (1952) suggested that the study of genotypic coefficient of variation along with heritability estimates is needed to obtain the best results on the extent of heritable variation. In general, in the present studies, vine characters showed high heritability compared to tuber chracters. Jones *et al.* (1985) and Singh and Mishra (1987) reported high heritability estimates for the vine traits compared to root traits. In the present study high heritability estimates were observed for length of vine followed by number of branches per plant and weight of foliage per plant indicating importance of additive genetic variance for these characters. In case of number

Table 2. Phenotypic (P) and genotypic (G) correlation, coefficeints among various characters in sweet potato

Characters		No.of branches/ plant	Wt. of single tuber	Wt. of foliage/ plant	No.of tubers/ plant	Tuber length	Tuber girth	Tuber yield/ plant (g)
Vine length (cm)	P	-0.272	-0.454**	0.141	0.180	-0.290	-0.326*	-0.595**
	G	-0.282	-0.459**	0.147	0.199	-0.304*	-0.330*	-0.508**
No. of branches /plant	P		0.317*	0.215	-0.114	0.228	0.213	0.301*
	G		0.328*	0.228	-0.126	0.241	0.227	0.316*
Wt. of single tuber (g)	P			0.155	-0.112	0.271	0.309*	0.410**
	G			0.157	-0.126	0.282	0.314*	0.420**
Wt. of foliage /plant (g)	P				-0.116	0.258	0.137	0.225
	G				-0.133	0.271	0.142	0.235
No. of tubers /plant	P					-0.243	-0.212	-0.225
	G					-0.264	-0.229	-0.241
Tuber length (cm)	P						o0.246	0.336*
	G						0.262	0.360*
Tuber girth (cm)	P							0.406**
	G							0.422**

** Significant at 1 per cent level; * Significant at 5 per cent level

of tubers per plant, non-additive genetic variance played major role since the heritability estimate was the lowest. Similar result was reported by Jong (1984), who suggested that the additive genetic variance was more important than the non-additive type. In the present study relatively moderate heritability was observed for tuber yield which suggests the importance of non-additive genetic variance. Similarly, Li (1992) reported low heritability for tuber yield in sweet potato.

The character, number of tubers per plant gave the lowest heritability estimate. It has also shown lower values for genotypic coefficient of variation indicating larger influence of environmental conditions on this character. The estimate of heritability of a character provides a measure of the effectiveness of selection for that particular character. As shown in the table, the heritability estimates were high for almost all the characters except for number of tubers per plant. The length of vine, number of branches per plant, weight of single tuber and weight of foliage per plant showed very high heritability while it was moderate with respect to tuber yield per plant, tuber girth and tuber length. The number of tubers per plant registered low heritability value combined with low genotypic coefficient of variation indicating the larger influence of environment for the expression of this trait.

Swarup and Chaugle (1982) and Jones *et al.* (1985) reported that heritability estimates along with genetic gain are usually more efficient than heritability values alone in predicting the final outcome of selection. The expected genetic advance as percentage of mean showed wide range from 36.43 for number of tubers per plant to 93.63 for number of branches per plant. The characters such as number of branches per plant, weight of single tuber, girth of tuber and length of tuber showed high heritability estimates associated with high genetic advance indicating the presence of additive gene effect. Hence individual plant selection for these traits would be satisfactorily effective in sweet potato. Thamburaj and Muthukrishnan (1978) reported high genetic advance and high heritability estimates for girth of tubers and number of tubers. However, Singh and Mishra (1987) obtained high heritability and high genetic gain for length of vine whereas Kamalam *et al.* (1977) reported the same for vine length and number of tubers. In the present investigation, high heritability values with moderately low genetic advance were observed for length of vine, weight of foliage per plant and tuber yield per plant, which may be due to the non-additive gene effects.

The present study indicated that high heritability coupled with high genetic advance make the component traits *viz.* number of branches per plant, weight of single tuber, girth of tuber and length of tuber as the most reliable in the selection programme. Jones *et al.* (1985) regarded consideration of both heritability and genetic advance together as the most appropriate for selection of characters for breeding. High heritability accompanied by high genetic gain is an indication of the presence of additive genetic effects (Panse and Sukhatme, 1987). Hence in the present study, the traits number of branches per plant, weight of single tuber, girth of tuber and length of tuber offered scope for further improvement in breeding programme.

Correlation among tuber yield and other yield components computed at both phenotypic and genotypic levels are presented in Table 2. In general the genotypic correlations were higher than phenotypic ones. This was probably due to modifying or masking effect of environment in the expression of the character under the study. This also indicated an inherent association between the characters. A highly significant and positive correlation was observed between tuber yield and component traits *viz.* weight of single tuber and girth of tuber. Tuber yield was also correlated significantly and positively with length of tuber and number of branches per plant. Thamburaj and Muthukrishnan (1978) observed a similar high degree of positive associations between tuber yield and growth of tuber, number of branches and length of tuber both at phenotypic and genotypic levels. Positive correlations of tuber yield with weight of single tuber, weight of foliage per plant and number of tubers per plant were also reported by Li (1992). In the present study the relationship of length of vine was significantly negative with tuber yield. In contrast to the report by Li (1992) in the present study a negative but non-significant correlation was observed between tuber yield and number of tubers per plant. Similar Kamalam *et al.* (1977) reported that the number of tubers per plant and length of vine exerted negative influence on tuber yield.

Hence if maximum tuber yield are to be obtained in sweet potato, a compromise between number of tubers and length of vine is suggested in the selection programme. The present study also suggests the importance of weight of single tuber, girth of tuber, length of tuber and number of branches per plant as the major components of tuber yield and in sweet potato. If a selection procedure is designed to improve these characters, the tuber yield could be increased considerably in sweet potato. Simultaneously the length of vine is to be reduced to the optimum level.

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