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Association of Metric Traits and Path Analysis in Sweet potato (*Ipomoea batatas* Lam.)*

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ABSTRACT

Investigations with 65 clones of sweet potato (*Ipomoea batatas* Lam.) indicated that (i) in general the genotypic coefficient of variation was lower than the phenotypic one indicating the larger measure of influence of environment; (ii) the weight of tubers per vine, number of leaves per vine and the weight of foliage exhibited a high degree of both phenotypic and genotypic coefficients of variations while girth of stem had the least coefficient of variation; (iii) high heritability estimates were obtained for length of petiole and number of leaves per vine; (iv) high heritability and low genetic advance were observed for all the characters except girth of tuber and number of tubers per vine in which the genetic advance was very high; (v) except length of vine and girth of stem, all the characters had positive association with tuber yield; (vi) the path analysis indicated that the weight of foliage, girth of tuber and number of tubers per vine contributed maximum direct effects on tuber yield indicating the importance of these three characters as selection indices for sweet potato and (vii) the number of leaves, length of petiole and length of tuber had negative direct effects on tuber yield.

INTRODUCTION

Biometrics provides basis for an interpretation of not only analysis of variation shown by individual characters but analysis of covariance describing the way in which a number of characters vary conjointly in a population. Genetical studies on the association of yield components enable for a programme in manipulating or accentuating the expression of characters towards higher yields. The variability available in a population could be partitioned into heritable and non-heritable components with the aid of genetic parameters as genotypic coefficient of variation, heritability and genetic advance whice serve as a basis for selection. Path coefficient analysis is a standardized partial regression coefficient and as such measures the direct influence of one variable upon another and permits the separation of correlation coefficient into components of direct and indirect effects (Dewey and Lu, 1959). Studies were taken up at the Department of Horticulture, Tamil Nadu Agricultural University on the genetic association of characters and path

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coefficient analysis in sweet potato (*Ipomoea batatas* Lam) and the results are presented.

MATERIALS AND METHODS

Sixty five clones of sweet potato (*Ipomoea batatas* Lam) available in the germplasm reserve of the Department of Horticulture were utilized for the study. The clones had widely different origins with a high magnitude of variation in the morphological characters. These clones were raised in the field No. 52a of Orchard during 1974-75 (October to Febuary) in a randomised block design with two replications. The plot size was 2.40x4.50 m accommodating a total of 80 plants. Five plants were selected at random from each plot and totally 650 plants were utilized for recording observations. Data were gathered on length of vine, girth of stem, weight of foliage, number of branches per vine, number of leaves per vine, length of petiole, length of tuber, girth of tuber, number of tubers per vine and weight of tubers per vine and subjected to statistical analysis. The analysis of variance was worked out as per Panse and Sukhatme (1957). The genotypic and phenotypic coefficients of variations were computed as per Burton (1952). Heritability and genetic advance were computed as per the method suggested by Hanson *et al.* (1955). Phenotypic and genotypic correlation coefficients were estimated as per Al-Jibouri *et al.* (1958). With the genotypic correlation coefficients, path-coefficient analysis was done following the Wright's (1921) procedure adapted by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The results of the invesiigations are presented in Tables 1 and 2 and Figs. 1, 2 and 3.

Table 1. Estimates of genetic parameters for ten characters

Characters	Range	Mean	Genotypic C. V.	Phenotypic C. V.	Heritability (Per cent)	Genetic advance as per cent of mean
Length of vine (cm)	55.336	147.50	41.05	44.58	84.77	7.90
Girth of stem (cm)	0.4-0.9	0.57	15.14	17·21	77.44	27.45
Weight of foliage(g)	150-2750	547.46	65.44	75.82	74.50	2.44
Number of branches per vine	8.0-48.0	18.20	30.07	44.09	46.51	34.93
Number of leaves per vine	65-1078	213.49	71.61	74.75	91.79	7.66
Length of petiole(cm)	7.0-27.5	15.37	34.25	35.46	93.24	12.50
Girth of tuber (cm)	1.8-6.5	3.59	25.62	29.29	76.47	237.58
Length of tuber (cm)	6.0-26.4	14.27	18.83	24.03	61.24	43.37
Number of tubers per vine	1.0-6.5	2.34	43.08	51.85	69.05	437.98
Weight of tubers per vine (g)	25-1600	400.92	72.79	77.88	87.35	3.96

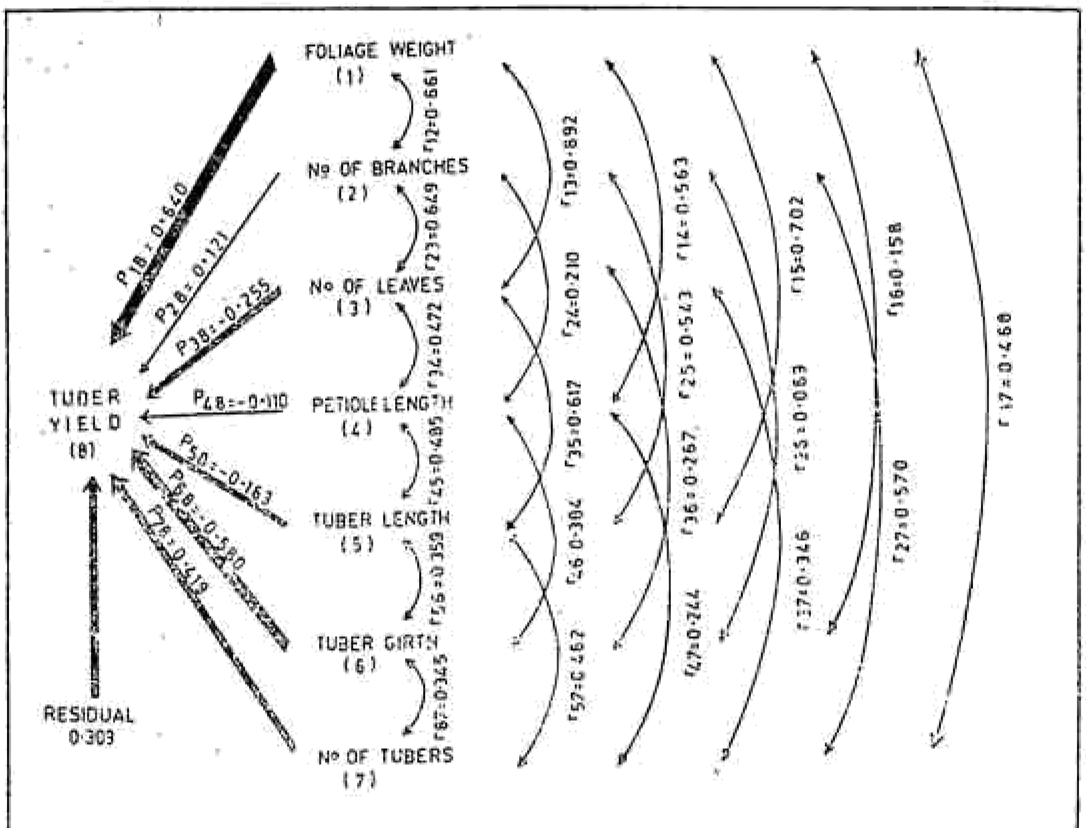

FIG.1 PATH DIAGRAM

The extent of variability in various morphological characters has been well brought out by phenotypic and genotypic coefficient of variation (Table 1). In general, the genotypic coefficient of variation was lower than the phenotypic one thus indicating the larger of influence of environment. Among the various characters studied, the weight of tubers per vine, number of leaves per vine and the weight of foliage exhibited a high degree of both phenotypic and genotypic coeffcients of variations indicating a high degree of variability. These three characters thus offer scope for selection in crop improvement programmes. Wide variation of such characters have also been reported in sweet potato by Steinbauer *et al.* (1943), Massey *et al.* (1957), McLean (1955), Mac Donald (1965), Jones *et al.* (1969), Haynes and Wholey (1971) and Lowe and wilson (1975 b). The girth of stem had the least coefficient of variation of 17.21 and 15.24 at phenotypic and genotypic levels respectively and hence these traits provide practically little chance for plant selection.

It is needless to say that the genetic coefficient of variation does not offer full scope to estimate the variation that is heritable and therefore estimates of heritability become necessary. In the present study (vide Table 1) high heritability estimates were recorded for length of petiole (93.24 per cent)

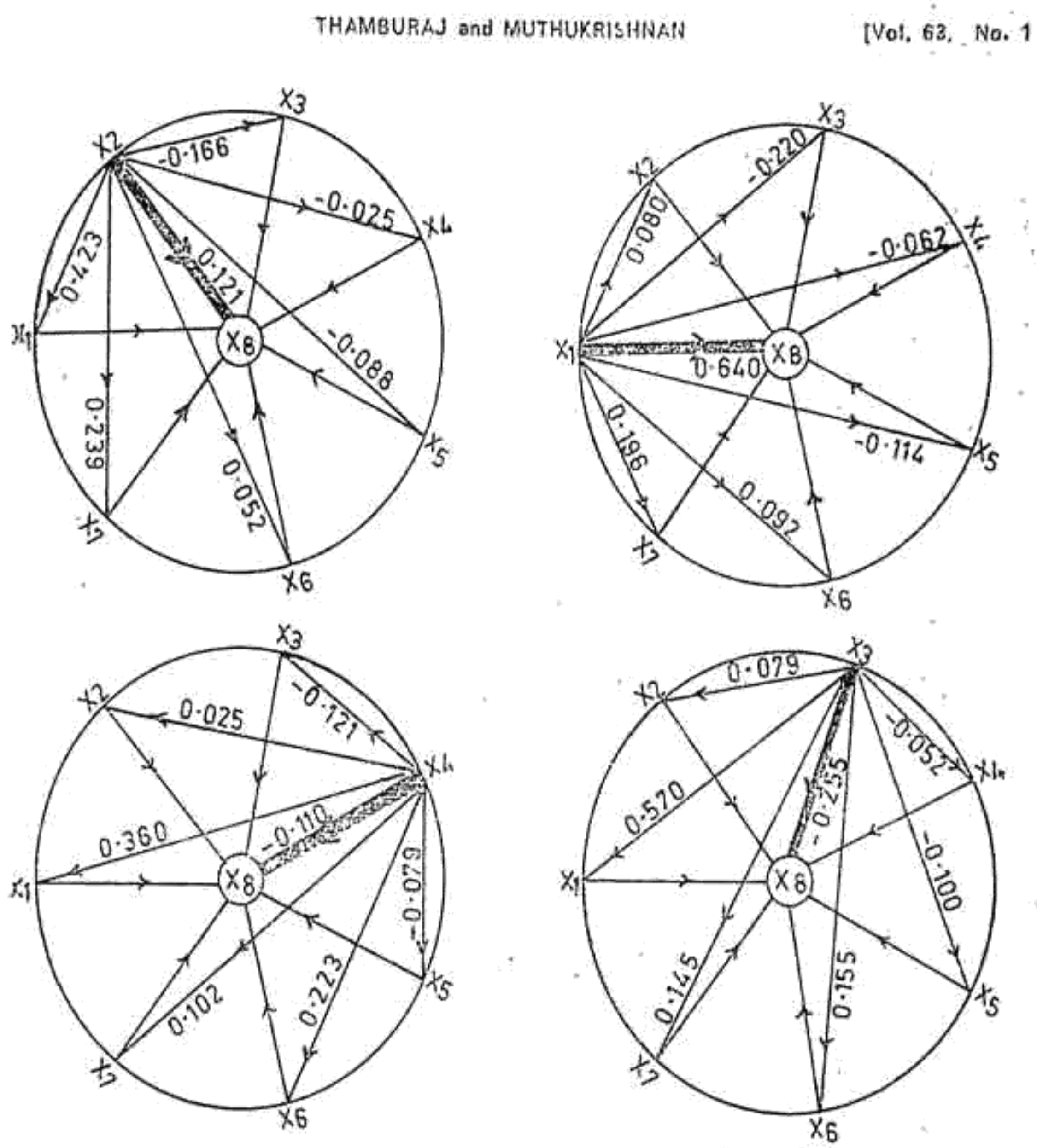

FIG. 2. DIRECT AND INDIRECT EFFECTS OF YIELD COMPONENTS

and number of leaves per vine (91.79 per cent). Invariably the heritability estimates were comparatively higher for all the ten traits ranging from 41.51 to 93.24 per cent. Jones (1969), Jones *et al.* (1969) and Singh and Mishra (1975) have reported higher estimates of heritability for vine traits than for the root traits. But such distinctions could not be made in the present study.

Heritability indicates the effectiveness with which selection of genotype could be based on the phenotypic performance (Johnson *et al.*, 1955) and therefore high heritability does not indicate a greater genetic gain. The results of the percent study have clearly brought out that despite high heritability, genetic advance was low for all the characters except girth of tuber and number of tubers per vine

(Table 1). Such a high heritability and low genetic advance are possibly attributable to the non-additive gene effects (Panse and Sukhatme, 1957). The genetic advance was more than heritability for girth of tuber and number of tubers per vine which may be due to additive gene effect. These two traits are considered to be less influenced by environment and hence offer scope for an efficient plant selection.

With regard to the association of plant characters, the number of tubers per vine, girth of tuber, weight of foliage, number of branches per vine, number of leaves per vine, length of tuber and length of petiole had a high degree of positive association with the tuber yield both at phenotypic and genotypic levels (Table 2). The inter-relationships of these characters were also positive and significant thereby

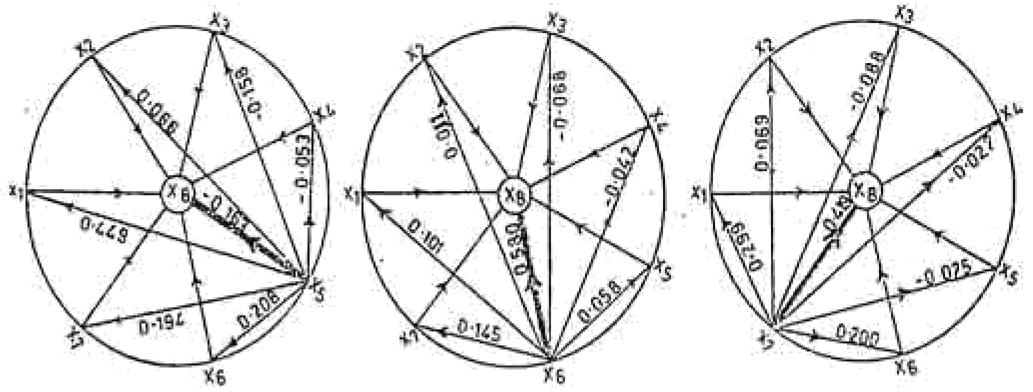

FIG. 3 DIRECT AND INDIRECT EFFECTS OF YIELD COMPONENTS

indicanting the usefulness of these traits for formulating selection indices. Jones (1970) observed improved genotypic correlations between leaf vein purpling and root weight and number of edible roots. Higher root weight was also associated with the increased diameter of roots. In general the genotypic correlations were higher than the phenotypic correlations possibly due to modifying or masking effect of environment in the expression of the character under study (Nandpuri *et al.*, 1973). Since the length of vine and girth of stem had no relationship with tuber yield, they were not considered for computing path analysis.

The contribution of yield components to tuber yield could be partitioned into direct and indirect effect by path analysis and it also helps to rank the order of importance given to the different characters on a sound basis. The results of the path analysis (Figs. 1, 2 and 3) have indicated that the weight of foliage contributed the maximum direct effect to the tuber yield in sweet potato. However its influence was reduced to some extent by the negative indirect effect through mumber of leaves, length of petiole and length of tuber. The girth of tuber had also a direct association with tuber yield and

Table 2. Phenotypic (r_{ph}) and Genotypic (r_g) correlation coefficients between ten characters

		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	r_{ph}	—	0.110	0.024	-0.075	0.039	0.394**	0.130	0.185	0.054*	0.074
(Length of vine)		—	0.156	-0.019	-0.198	0.021	0.44**	0.107	0.193*	0.257**	0.090
X_2	r_{ph}	—	—	0.551**	0.129	0.372**	0.265**	0.239**	0.173	.0.137	0.055
(Girth of stem)	r_g	—	—	0.666**	0.213*	0.448**	0.309**	0.369**	0.258**	.0.171	0.014
X_3	r_{ph}	—	—	—	0.579**	0.848**	0.466**	0.569**	0.258**	0.367**	0.575**
(Weight of foliage)	r_g	—	—	—	0.661**	0.892**	0.563**	0.702**	0.158	0.468**	0.604**
X_4	r_{ph}	—	—	—	—	0.523**	0.143	0.371**	0.093	0.321**	0.420**
(No. of branches)	r_g	—	—	—	—	0.649**	0.210*	0.543**	0.089	0.570**	0.558**
X_5	r_{ph}	—	—	—	—	—	0'437**	0.529**	0.263**	0.295**	0.528**
(No. of leaves)	r_g	—	—	—	—	—	0.472**	0.617**	0.267**	0.346**	0.542**
X_6	r_{ph}	—	—	—	—	—	—	0.384**	0.305**	0.209*	0.376**
(Length of petiole)	r_g	—	—	—	—	—	—	0.485**	0.384**	0.244**	0.402**
X_7	r_{ph}	—	—	—	—	—	—	—	0.368**	0.242**	0.494**
(Length of tuber)	r_g	—	—	—	—	—	—	—	0.359**	0.462**	0.543**
X_8	r_{ph}	—	—	—	—	—	—	—	—	0.132	0.605**
(Girth of tuber)	r_g	—	—	—	—	—	—	—	—	0.345**	0.668**
X_9	r_{ph}	—	—	—	—	—	—	—	—	—	0.663**
(No. of tubers)	r0	—	—	—	—	—	—	—	—	—	0.798**
X_{10}	r_{ph}	—	—	—	—	—	—	—	—	—	—
(Weight of tubers)	r_g	—	—	—	—	—	—	—	—	—	—

* Significant at 5 per cent level

** Significant at 1 per cent level

the expression was slighlty increased by the indirect effect through weight of foliage and number of tubers per vine. The greater magnitude of association obtained for number of tubers per vine on tuber yield was primarily due to its direct effect and also due to the boosting up through the weight of foliage and the girth of tuber. Its effect was minimised by negative indirect effects through number of leaves, length of petiole and length of tuber.

Inspite of the direct negative effects in some cases, moderate and positive correlations were obtained chiefly due to compensatory effects through other characters. Since these characters also showed indirect effect for other paths, it would be profitable to exercise selection for decreasing values for these characters.

The path analysis has thus indicated that if a selection procedure is designed to improve the weight of foliage, girth of tuber and number of tubers per vine, the tuber yield could be considerably increased. Simultaneously the number of leaves, length of petiole and length of tuber are to be reduced to the optimum level. In other words the photosynthetic efficiency of the plant is to be increased primarily by increasing the weight of foliage followed by providing a strong physiological sink for the assimilates through increased number of tubers per vine and girth of tuber.

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