https://doi.org/10.29321/MAJ.10.A02990

Madras agric. J. 66 (9): 561—564. Sep., 1979.

Analysis of Yield Components in Early Maize Germplasm Complexes

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Genetic variability, correlation and path coefficients were studied in a set of 23 early maize germplasm. There was a wide range of variability among all the characters studied. The characters *viz.*, 1000-grain weight and grain yield had high heritability estimate and genetic advance. High positive associations were observed between grain yield on the one hand, and ear length, ear diameter, number of rows per cob and 1000-grain weight on the other. Path coefficient analysis revealed that ear diameter, ear length, 1000-grain weight and number of rows per cob were important yield contributing components.

Crop improvement depends upon the magnitude of genetic variability present in a base population. The heritable component of variation can be measured and expressed with the help of suitable genetic parameters such as coefficient of genetic variation, heritability estimates and genetic advance. Grain yield in maize as in other crop is a complex character influenced by several components. For an effective breeding programme it is essential to have some informations on the association between the different yield components and their relative contributions to the yield. The interrelations among the yield components can be analysed with the help of path coefficient analysis which permits the separations of the correlation coefficient into direct and indirect effect.

The objective of the present investigation was to find out the genetic variability present in a set of early maize germplasm and to study relationship between yield and other quantitative traits. An attempt was also made to estimate the direct and indirect effects of the component characters on grain yield.

MATERIAL AND METHODS

A set of 23 early maize varieties of diverse origin was selected and were grown in a randomised block design with four replications. Each variety in a replication had a two-row plot of 10m length, with a spacing of 75 x 25 cm. Observations were recorded on days to silk, ear length, ear diameter, number of rows per cob, 1000-grain weight and grain yield.

The mean value of 10 plants selected at random from each plot were used. Heritability in broad sense and genetic advance expressed in percentage of mean were computed (Allard, 1960).

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TABLE I. Phenotypic variability for six characters in early maize germplasm complexes

Character	Range	Mean	Entry M.S.*	C.V.***
Days to silk (No.)	48 — 70	55.84 ± 1.95	70.27**	7.00
Ear length (cm)	9.1 — 17.3	13 30 ± 0.56	7.19**	8.35
Ear diameter (cm)	2.52 — 4.28	3.48 ± 0.90	0.32**	5.17
Number of rows per cob (No.)	9 — 17	13.09 ± 0.49	10.55**	7.49
1000-grain weight (gm)	108.4 —257.8	159.47 ± 9.05	3297.31**	11.35
Grain yield (gm)	24.70 — 82.44	48.89 ± 3.80	268.77**	15.55

* Entry mean sum of squares ** Significant at 1% level *** Coefficient of variation

Phenotypic and genotypic correlations were calculated from the variance and covariance component following the method of Miller *et al.* (1958). Path coefficient analysis was computed to estimate effects of one character on the other characters (Dewey and Lu, 1959).

RESULTS AND DISCUSSION

All the characters showed a wide range of phenotypic variation Table I. Varietal differences were highly significant for all the characters under study. Coefficient of genetic variation ranged from 6.64 for days to silk to 17.08 for 1000-grain weight Table II. The heritable portion of the variation was determined with the help of heritability estimate. Heritability estimates were higher for all the characters under study. Genetic advance expressed as percentage of mean was highest (33.40) for 1000-grain weight and lowest (12.10) for days to silk. Johnson *et al.* (1955) while studing heritability in soybean pointed out that heritability estimate

TABLE II. Estimates of phenotypic, genotypic and environmental variance: coefficient of genetic variation, hertibility estimates and genetic advance

Characters	Phenotypic variance	Genotypic variance	Environmental variance	Coefficient of genetic variation	Heritability in broad sense	Genetic advance as per cent of mean
Day to silk (No.)	17.56	13.75	3.81	6.64	78.30	12.10
Ear length (cm)	1.79	1.48	0.31	9.14	82.68	17.13
Ear diameter (cm)	0.08	0.072	0.008	7.71	90.00	15.06
≥umber of rows per cob (No.)	2.64	2.40	0.24	11.83	90.91	23.23
1000-grain weight(cm)	824.33	742.39	81.94	17.08	90.06	33.40
Grain yield (gm)	67.19	52.73	14.46	14.85	78.47	27.10

Percentage of mean of six characters

along with genetic advance is more reliable than the heritability value alone in predicting the effect of selection. High heritability associated with high genetic advance may be attributed to the action of additive genes (Panse, 1957). A high genotypic variance and heritability estimates combined with comparatively greater genetic advance for 1000-grain weight and grain yield indicate that selection for these traits would prove effective in these materials.

The phenotypic and genotypic correlation coefficients among the characters indicated that highly significant positive correlations were observed between grain yield on the one hand and ear length, ear diameter, number of rows per cob and 1000-grain weight on the other Table III. Grain yield was also found significantly associated with days to silk. Significant correlations among grain yield. ear length and ear diameter have been observed earlier (Jenkins, 1929), Robinson, *et al*. (1951) and Singh (1970). Such correlations indicate that in the present germplasm complexes selection for late maturity, larger ear length and ear diameter, higher number of rows per cob and large sized grain can be expected to result in higher yielding strains. Other phenotypic correlations of interest are among days to silk, ear diameter and number of rows per cob which were highly significant and positive. Ear diameter was highly associated with number of rows per cob and 1000-grain weight. Number of rows per cob had highly negative correlation with 1000-grain weight. Other correlations were non-significant.

There was a close agreement between genotypic and phenotypic correlation coefficients and in most of the cases genotypic correlation coefficients were higher in magnitude (Table III).

TABLE III. Correlation coefficients computed among six character of early maize germplasm complexes (only phenotypic correlation coefficients have been tested)

	Ear length	Ear diameter	Numcer of rows/scob	1000-grain wt.	Grain yield
Days to silk (No.)	—.1067 —.0620	.5293** .6257	.6471** .7985	—.0762 —.0707	.2612* .3401
Ear length (cm)		—.2890** —.3633	—.0723 —.1086	—.1061 —.1740	.3103** .2234
Ear diameter (cm)			.4760** .4728	.4574** .4147	.6287** .9115
Number of rows per cob (No.)				—.3657** —.3923	.2834** .2785
1000-grain weight (gm)					.5682** .5714

* Significant at 5% level. ** Significant at 1% level

N.B. Upper value phonotypic and lower value genotypic correlation coefficients

TABLE IV. Path coefficient analysis of genotypic correlation coefficients (r) to determine direct effects of four variables on grain yield

Variables correlated and method of effect		
Grain yield *vs* ear length		
Direct effect	.6524	
Indirect via ear diameter		—.4147
Indirect via number of rows per cob		.0138
Indirect via 1000-grain weight		—.0281
Grain yield *vs* ear diameter		.2234
Direct effect	1.1415	
Indirect via ear length		—.2370
Indirect via number of rows per cob		—.0600
Indirect via 1000-grain weight		.0670
		.9115
Grain yield *vs* number of rows per cob		
Direct effect	—.1270	
Indirect via ear length		—.0708
Indirect via ear diameter		.5397
Indirect via 1000-grain weight		—.0634
		.2785
Grain yield *vs* 1000-grain weight		
Direct effect	.1617	
Indirect via ear length		—.1135
Indirect via ear diameter		.4734
Indirect via number of rows per cob		.0498
		.5714

Residual effect —.4932

Path coefficient analysis was computed to determine the direct and indirect effect of ear length, ear diameter, number of rows per cob and 1000-grain weight on grain (Table Iv). The main effect of ear diameter on grain yield was direct which is in agreement with the finding of Singh (1970). Similarly ear length had direct effect on grain yield. Its indirect effect *via* ear diameter was negative. Its indirect effects on grain yield *via* other traits were very low. Number of rows per cob and 1000-grain weight had little direct effect on grain yield, while their indirect effects *via* ear diameter on grain yield were considerably high and positive

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