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Genetic Variability and Heterosis in Maize

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Collection and evaluation of varieties is very essential in any crop improvement work. The studies were conducted (i) to evaluate 86 indigenous and 23 inbread lines of maize introduced from U. S. A. for yield and other economic characters and (ii) to estimate the extent of heterosis exhibited by these introduced inbred lines in cross combination with the local standard variety of maize and the results are presented in this paper.

Meterials and Methods: Three experiments were conducted during kharif 1969-70 at the Regional Research Station, Dharwar. Twenty three inbred lines and 86 varieties of maize including Arabhavi local as check were grown in randomised block lay-out with four and two replications respectively. The cross hybrids of 23 inbred lines with Arabhavi local as the male parent were also grown in randomised block lay-out with four replications. The spacing adopted in all the three experiments were 70 x 30 cm. between the rows and within the plants respectively with a row length of 8 m. Five plants were selected at random and the observations were recorded on important quantitative characters influencing yield and yield contributing characters. The mean values of these selected plants were used for statistical analysis. The formulaes suggested by Burton (1952), Johnson *et. al.* (1955) and Turnar (1953) were used to estimate the various genetic parameters.

Results and discussion: *Initial evalution of indigenous maize varieties:* The varietal differences were highly significant for all the characters. All the characters except cob diameter showed wide range of phenotypic variation (Table 1). The range was maximum in cob yield per plant and minimum in cob diameter. Cob yield per plant, plant height and rows per cob were seen to have high genetic coefficient of variation. The genetic coefficient of variation alone is however not helpful in determining the heritable portion of variation for which estimation of heritability is needed. Days to 75% silking, plant height and rows per cob had quite high heritability, while heritability estimates were moderate for the remaining three characters. Such high estimates of heritability for the above characters were also recorded by Patil *et al.* (1970) and Ramamurthy *et al.* (1970) using different varieties of maize. As stated by Johnson *et al.* (1955) that heritability along with genetic advance is more useful for selection work, in the present study, cob yield per plant plant and plant height showed high genetic advance along with high heritability. Thus, selections for these two characters may also profitably made on phenotypic performance.

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TABLE 1. *Range, mean, genetic coefficient of variation, heritability (%), genetic advance and genetic advance in per cent of mean for six characters in maize*

Character	Range	Mean	Genetic co-efficient of variation	Heritability %	Genetic advance	Genetic advance as % of mean
Days to 75% silking	56.00– 72.00	62.38 ± 1.05	5.08	69.96	6.16	9.67
Plant height (cm)	138.00–245.00	180.30 ± 7.99	12.64	89.07	44.44	24.59
Cob length (cm)	10.00– 20.00	15.81 ± 0.97	10.84	75.90	3.08	19.48
Cob diameter (cm)	3.05– 4.60	3.74 ± 0.19	8.02	78.26	0.35	9.46
No. of rows per cob	8.00– 17.00	12.96 ± 0.71	11.27	80.87	1.85	14.27
Single plant cob yield (gm)	52.00–167.00	107.31 ± 14.67	23.66	74.98	45.31	42.22

Initial evaluation of exotic lines of maize: The difference between inbreds were highly significant for all the characters except for 1000-grain weight. Most of the characters showed wide range of phenotypic variation (Table 2). The range was maximum in 1000-grain weight and minimum in cob diameter. Single plant cob yield, cob length and number of rows per cob were seen to have high genetic coefficient of variation. Days to 75% silking, number of rows per cob, cob diameter, cob length and single plant cob yield had quite high heritability estimate was moderate for plant height. The same for 1000-grain weight was rather very low, thus indicating that the character is subjected to a great amount of environmental variability. Such high estimate for cob yield was also recorded by Patil *et al.* (1970). In the present study single plant cob yield, cob length, number of rows per cob and cob diameter showed high genetic advance along with high heritability. Hence selections for these four characters may be profitably made on phenotypic performance.

TABLE 2. *Range, mean, genetic coefficient of variation, heritability (%), genetic advance and genetic advance in per cent of mean for seven characters in maize*

Character	Range	Mean	Genetic coefficient of variation	Heritability (%)	Genetic advance	Genetic advance as % of mean
Days to 75% silking	53.00– 63.00	58.26 ± 0.20	3.93	92.92	4.55	7.81
Plant height (cm)	59.70–110.70	79.44 ± 10.41	16.06	60.02	20.36	25.62
Cob length (cm)	5.00– 15.00	8.76 ± 1.11	25.78	80.60	4.17	47.60
Cob diameter (cm)	2.24– 4.44	3.02 ± 0.77	16.80	81.10	0.94	31.17
No. of rows per cob	6.20– 14.00	9.97 ± 0.80	19.15	85.31	3.64	36.50
1000-grain weight (gm)	132.88–282.86	200.42 ± 35.74	3.35	2.92	2.36	1.17
Single plant cob yield (gm)	9.00– 57.00	29.68 ± 8.79	55.49	77.85	29.93	100.84

Performance of top cross hybrids: The F_1, mid and better parental values are also per cent increase or decrease of F_1 over the mid and better parents for days to 50% silking and cob yield per plant are given in Table 3. It is seen that in most of the cases, the hybrids silked much earlier than their

TABLE 3. *The performance of parents, hybrids and heterosis for two characters in maize*

Inbreds crossed with Arbhavi local	Days to 75% silking						Single plant cob yield in (gms)					
	Mean values				Heterosis in % over		Mean values				Heterosis in % over	
	PI	PII	F1	MP	MP	BP	PI	PII	F1	MP	MP	BP
KN 11	63.0	61.0	59.5	62.0	− 4.20*	− 5.88*	50.2	44.0	76.0	47.1	+38.02*	+33.94*
VE		60.0	61.0	61.5	− 0.81*	− 3.27*		27.2	72.0	38.7	+46.25*	+30.27*
WD		56.0	59.5	59.5	0	− 5.88*		34.0	84.5	42.1	+50.17*	+40.59*
K 261		60.0	54.5	61.5	−12.84*	−15.59*		30.0	105.5	40.1	+61.59*	+52.41*
K 275		60.0	57.5	61.5	− 6.95*	− 9.56*		38.0	78.7	44.1	+43.96*	+36.21*
W 617		57.0	55.0	60.0	− 9.09*	−14.54*		13.5	79.5	31.8	+60.06*	+39.86*
K 126		60.0	59.5	61.5	− 3.36*	− 5.88*		80.0	57.2	65.1	+13.81	−39.86*
K 98		54.0	57.5	58.5	− 1.73*	− 9.56*		10.0	82.5	30.1	+63.51*	+39.15*
RS		57.0	56.5	60.0	− 6.19*	−11.50*		44.0	98.0	47.1	+51.93*	+48.77*
KN 1		59.5	61.2	61.2	0	− 2.94*		40.0	46.0	45.1	+ 1.95	− 9.13
6 e		57.2	57.0	60.1	− 5.43*	−10.52*		10.0	91.2	30.1	+66.99*	+44.95*
A 495		59.7	60.0	61.3	− 2.16*	− 5.00*		17.2	93.5	33.7	+63.95*	+46.31*
61.73		56.0	58.0	59.5	− 2.58*	− 8.62*		13.0	55.5	31.6	+43.06*	+ 9.54
61.70		60.0	59.0	61.5	− 4.23*	− 6.77*		32.2	61.5	41.2	+33.00*	+18.37
61.66		53.0	56.0	58.0	− 3.57*	−12.50*		12.7	84.0	31.4	+62.61*	+40.23*
61.67		57.0	57.5	60.0	− 4.34*	− 9.56*		9.0	48.5	29.6	+38.96*	− 3.50
61.69		58.0	57.2	60.5	− 5.76*	−10.13*		23.5	55.5	36.8	+33.69*	+ 9.54
61.80		56.2	54.0	59.6	−10.37*	−16.66*		25.7	87.0	37.9	+56.43*	+42.29*
61.77		58.2	57.5	60.6	− 5.39*	− 9.56*		12.0	85.5	31.2	+63.62*	+41.28*
61.76		58.0	57.0	60.5	− 6.14*	−10.52*		56.2	62.2	53.2	+14.46	+ 9.64
67.65		58.0	59.5	60.5	− 1.68*	− 5.88*		23.0	68.0	36.6	+46.17*	+26.17*
67.64		57.2	59.0	60.1	− 1.86*	− 6.77*		9.7	76.0	29.9	+60.65*	+33.94*
KD 54		62.0	57.0	62.5	− 9.64*	−10.52*		57.0	94.0	53.6	+42.97*	+39.36*

* Significant at 5% level

parents, thus indicating that the earliness is dominant over lateness. The range is between 0% to 12.84% and 2 94% to 16.66% over the mid and better parents respectively. These serve as sources for incorporating earliness into our leading maize varieties which are late maturing at present. Cob yield per plant of the hybrids varied from 1.95% to 66 99% and - 3.50% to 52.41% over the mid and better parents respectively. Four crosses showed inferior which is indicative of their poor specific combining ability, when both mid and better parents were taken into consideration. The yield of the remaining hybrid not only exceeded the mid parental value over a wide margin but the better parent as well. When the overall performance of the hybrids was examined K. D. 54, 60, 61-66, 61-80, K 261, R5 and W 617 were found superior to others. These data lend support to our earlier findings (Aradhya *et al.* 1970; and Swamy Rao *et al.*, 1970) regarding superiority for yield and earliness. The observed increase for yield an earliness is high enough to justify further studies on the exploitation of heterosis in the introduced material.

Summary: Experiments were laid out during Kharif 1969-70 at the Regional Research Station, Dharwar using 86 indigenous and 23 exotic varieties in maize with a view to evaluate the varietal collections separately and also to estimate the extent of heterosis exhibited by these introduced inbread lines in cross combination with the local standard variety. The results have shown that:

i) Phenotypic selections for cob yield per plant, and plant height are useful in the indigenous material. ii) New introductions possess rich genetic potentialities for single plant cob yield, cob length. number of rows per cob and cob diameter. iii) The top cross bybrids have shown that the yield can be increased as high as 52% and they were earlier in maturity by 16% over the better parent, thus, justifying the need for commercial exploitation of hybrid vigour in the exotic material.

REFERENCES

Aradhya, R. S., M. Mahadevappa, T. Swamy Rao, A. Ramamurthy, S. J. Patil and N. B. Kaljjari. 1970 A note on the evaluation of maize crosses between Arabhavi local and new introductions in Mysore state. *Mys. J. Agric. Sci.*, 41 : 217-19.

Burton, G. W. 1952. Quantitative inheritance in grasses. *Proc. 6th Intl. Grassland Cong.*, 1 : 277.

Johnson, H. W., H. F. Robinson and R. E. Comestock. 1955. Estimates of genetic and environmental variability in soyabeans. *Agron. J.*, 48 : 268.

Patil, S. J., T. Swamy Rao and A. Ramamurthy. 1970. Genetic variation, heritability and genetic advance of quantitative characters in maize. *Genet. Polon.* (in press).

Ramamurthy, A., T. Swamy Rao, S. J. Patil, R. S. Aradhya and N. B. Kajjari. 1970. Evaluation of new maize introductions in Mysore state. 1. Adaptation and phenotypic and genotypic variability in four environments. *Genetica Agraria* (in press).

Tumar, J. H. 1953. A study of heterosis in upland cotton. I. Yield of hybrids compared with varieties. *Agron. J.*, 45 : 484-86.