Indian J. Genet., **65**(3): 211-212 (2005)

Short communication

Genetic analysis of maize (*Zea mays* L.) composite under stress and non-stress conditions

S. Marker and V. N. Joshi

Department of Plant Breeding and Genetics, RCA, Maharana Pratap Univ. of Agril. & Tech., Udaipur 313 001

(Received: September 2004; Revised: July 2005; Accepted: August 2005)

Hybrids and composites of maize developed in India, at the research station under much better agronomic conditions did not show the expected superiority on the farmer's field, where conditions are commonly sub optimal due to erratic monsoon and low fertility in majority of the fields. Therefore, the choice of environment for selection has gained importance in maize breeding [1]. An improved population Mahikanchan was used as experimental material for the development of 256 full-sibs progenies following NCD-I. Mahikanchan is an early maturing yellow grained composite derived from CD-Yellow gene pool, developed at Centre of All India Coordinated Maize Improvement Project. These 256 full families (64 half-sib families) were developed during rabi 2001-02 at Rajasthan College of Agriculture, Udaipur. To develop full-sib and half-sib families, each sixty four randomly chosen male plants were crossed with 6 random female plants. After harvest out of six female plants, four successfully pollinated female plants that had sufficient seed for field evaluation were retained to constitute a male group (a group of four families involving the same male parent). The sixty-four male groups were assigned to sixteen sets with each set comprising 4 male groups. Each set of 4 male groups thus has sixteen families (full-sibs) in it. Various male groups were assigned to the sets at random. In each replication sets were randomized and in each set the sixteen full sib families were also randomized. These 256 full sib families were evaluated in incomplete block design (simple lattice design) with two replications in rainfed farming situations of Udaipur under two fertility levels of NPK *viz.*, 120:60:00 kg per hectare (E_1) and 60:60:00 kg per hectare (E_2). Each family was sown in a single row plot of 3 meter length maintaining a crop geometry of 60 × 25 cm. Observations were recorded on eleven traits (Table 1) out of which, ASI was recorded on plot basis while rest of characters were recorded on 5 random plants. Data for individual characters were subjected to analysis as proposed by Comstock and Robinson [2, 3] NCD-I.

The mean values for all the families were larger in the non-stress conditions than in the stress conditions except that the stress conditions delayed the flowering (Table 1). The difference in the mean performance between two operational environments were more pronounced for grain yield, than 100-grain weight, ear length, ear diameter, plant height and ear height showing that the effect of stress varied with the characters, Thus a particular environment may be stress for one attribute and non stress for another.

Table 1. Mean and range of different characters in stress and stress and non-stress conditions

Characters	Mean		Range	
	Stress	Non-stress	Stress	Non-stress
Grain yield per plant (g)	58.36	73.20	33.33-96.71	38.25-113.15
100-grain weight (g)	17.91	19.41	14.05-23.56	15.50-24.19
Kernel rows per ear	12.88	13.24	10.00-16.00	10.00-16.00
Ear length (cm)	12.31	13.99	8.25-16.50	9.85-17.38
Ear diameter (cm)	11.48	12.75	8.00-15.25	9.38-15.70
Number of cobs per plant	1.11	1.13	1.00-2.00	1.00-2.00
Plant height (cm)	164.98	181.64	125.0-207.50	141.20-227.50
Ear height (cm)	75.98	86.32	51.20-105.45	60.25-119.00
Anthesis silking interval	2.38	2.26	1.00-4.00	1.00-4.00
Stover yield per plant (g)	84.72	100.74	54.00-121.30	63.25-125.25
Harvest index (%)	37.90	37.74	28.30-42.33	29.37-41.36

The component of genetic variance revealed that additive genetic variance was more important than dominance variance for all the traits in both fertility levels except for plant height and ear height in stress conditions and for number of cobs per plant in stress and non-stress conditions, where dominance variance was of greater significance (Table 2). Dominance ratio ($\sigma^2{}_D/\sigma^2{}_A$) showed no dominance to partial dominance for expression of majority of the traits including grain yield, indicating that $\sigma^2{}_A$ was the main contributor for total variability. Presence of high additive genetic variance for most of the traits suggests that a recurrent selection scheme within population in advisable. These findings are in conformity with the earlier reports [4,5].

Table 2. Estimates of additive genetic variance (σ^2_A), dominance variance (σ^2_D) and dominance ratio (σ^2_D/σ^2_A) in stress and n on stress condition

Characters	σ^2_A		σ^2_D		σ^2_D/σ^2_A	
	Stress	Non-stress	Stress	Non-stress	Stress	Non-stress
Grain yield per plant	462.14**	1088.63**	433.05**	864.08**	0.93	0.79
100-grain weight	6.83**	12.52**	-	5.37	-	0.42
Kernel rows per ear	4.94**	6.41**	3.05	3.18	0.61	0.49
Ear length	4.17**	9.17**	1.48	1.02	0.35	0.11
Ear diameter	4.27*	4.51*	1.82	0.64	0.42	0.14
Number of cobs per plant	3.43**	3.29**	4.65**	4.95**	1.35	1.50
Plant height	544.22**	740.13**	826.28**	665.79**	1.51	0.89
Ear height	221.55**	546.17**	281.46**	365.96**	1.27	0.67
Anthesis silking interval	0.25**	0.23**	0.21	-	0.84	-
Stover yield per plant	310.374**	766.14**	91.57**	491.12**	0.29	0.64
Harvest index	18.41	13.69	1.20	–3.16	0.06	–0.23

**,*Significant at 1% and 5% level respectively

The estimates of expected genetic gain (as per cent of mean) indicated that the present population can be considerably improved through selection, since expected genetic gain through full-sib family selection was higher than mass selection for all the traits in both the operational environments. For grain yield per plant the genetic gain through full-sib family selection method under stress and non-stress conditions varied from 42 to 52 per cent, which was 1.3 to 1.5 times higher than mass selection (Table 3). This suggests the superiority of full-sib family selection over mass selection.

The genetic gain for grain yield per plant, 100-grain weight, kernel rows per ear, ear length, plant and ear height was higher under non-stress conditions than for stress conditions with both the selection procedures. However, the stress conditions seemed better for conducting selection for ear diameter and number of cobs per plant, which are very important yield components. Expected genetic gain was also higher for anthesis silking interval and harvest index under stress conditions than that under non-stress conditions. Thus better performing family under stress condition will provide a better-improved version of this composite for wide area of adaptation.

Table 3. Expected genetic gain as per cent of mean at 5 per cent selection intensity in stress and non-stress conditions

Characters	Full-sib selection		Mass selection	
	Stress	Non-stress	Stress	Non-stress
Grain yield per plant	42.03	52.678	30.57	38.14
100-grain weight	17.64	23.67	12.00	20.66
Kernel rows per ear	21.40	24.34	17.636	20.37
Ear length	21.28	30.34	16.00	27.61
Ear diameter	22.99	22.53	18.17	17.40
Number of cobs per plant	186.30	175.92	175.58	168.84
Plant height	15.22	17.96	13.10	16.75
Ear height	21.34	34.00	19.21	32.96
Anthesis silking interval	19.16	19.15	8.48	7.21
Stover yield per plant	26.07	32.83	17.02	23.00
Harvest index	12.28	9.21	5.46	3.56

Though a slight decrease in genetic advance was noted for grain yield in stress conditions, yet it may be worthwhile to make selections in such an environment as these conditions are more close to the one prevailing on the farmer's fields in India. Thus selection under stress conditions may also prove useful for early maturity via anthesis silking interval and selection for number of cobs per plant where the expected genetic gain is distinctly higher under stress than non-stress conditions.

References

1. **Batta R. K., Khehra A. S., Gupta M. L. and Dhillon B. S.** 1981. Genetic analysis of random mating population of maize under stress and non-stress environments. Crop Improv., **8**: 90-94.
2. **Comstock R. E. and Robinson H. F.** 1948. The components of genetic variance in population of biparental progenies and their use in estimating the average degree of dominance. Biometrics, **4**: 254-266.
3. **Comstock R. E. and Robinson H. F.** 1952. Estimation of average degree of dominance of genes. *In*: J.W. Gowen (ed.) Heterosis : Iowa State College Press, Ames, Iowa. P. 494-516.
4. **Arha M. D., Sarda R. P. and Agarwal K. N.** 1990. Studies on maize gene pools I. Genetic architecture of grain yield and other agronomic traits. Acta Agronomica Hungarica, **39**: 115-120.
5. **Shanti K., Rao V. P., Reddy M. R., Reddy M. S. and Sarma P. S.** 1997. Response of maize (*Zea mays* L.) hybrid and composite to different levels of nitrogen. Indian J. Agric. Sci., **67**: 424-5.