Indian J. Genet., **52** (1): 63–67 (1992)

STABILITY ANALYSIS OF KERNEL YIELD AND ITS COMPONENTS IN MAIZE (*ZEA MAYS* L.) IN WINTER AND MONSOON SEASONS

V. MAHAJAN* AND A. S. KHEHRA

Department of Plant Breeding, Punjab Agricultural University, Ludhiana 141004

(Received: May 8, 1990; accepted: July 27, 1991)

ABSTRACT

Twenty eight single cross hybrids of maize were evaluated over eight environments for grain yield and its components and harvest index. Significant genotype x environment interaction was observed for all the traits during winter and monsoon seasons, except for ear girth (both the seasons) and No. of ears/plant (monsoon season). These hybrids performed well for grain yield in both winter and monsoon seasons and were also stable for ear length, but in general, were unstable for 1000- kernel weight in both the seasons. The inbred line J-617-61-1-1- 1-1 in hybrid combination performed well in both seasons. The deviation from regression ($\overline{S}^2_d$) appeared to be a more important parameter than regression (bi) for measuring stability.

Key words: Maize, yield, stability.

The potentials of genotypes and stability of their performance can be judged by multienvironment testing. A precise knowledge of genotype x environment interaction is very important to evaluate the stability of yields and its components. In the present investigation, hybrid x environment interaction and stability of maize (*Zea mays* L.) hybrids developed from eight inbred lines of indigenous as well as exotic origin have been studied.

MATERIALS AND METHODS

Eight inbred lines, namely, Vijay 444-2-4f (Vijay), PTR, J 54 (FS) 76-3-1-2-6-2 (J 54), CM 202 (CM 202), J 617-61-1-1-1-1 (J 617), B 57-3-2 (B 57), J 663 (FS) 158-1-1-1 (J 663), and H 104-21-4-2-1-2-3 (H 104), of maize with variable reaction to cold, were crossed in a diallel combination, excluding reciprocals, during monsoon season. The resulting 28 F_1 hybrids

*Present address: Division of Plant Breeding, ICAR Research Complex N.E.H. Region, Umroi Road, Barapani Meghalaya 793103.

were evaluated under eight diverse environments represented by two sowing dates (normal and late), two locations (Ludhiana and Gurdaspur), and diverse seasons (winter and monsoon). The trials were planted in a randomized block design with two replications in each environment. During winter season, each plot consisted of two rows of 2.8 m length with a spacing of 0.6 x 0.2 m. In the monsoon season, each plot consisted of two rows of 5.06 m length with the spacing of 0.75 x 0.22 m. Data were recorded for kernel yield per plant, number of ears per plant, ear length, ear girth, 1000-kernel weight and harvest index (based on plant weight excluding roots). Stability analysis was carried out after testing the homogeneity of variances, separately for winter and monsoon seasons, and over the two seasons following Eberhart and Russell [1]. The stability parameters, regression and deviation from regression, were used for identifying the ideal hybrid for various traits [1].

RESULTS AND DISCUSSION

Significant differences were observed among hybrids when tested in the four environments during winter and monsoon seasons as well as when tested across the eight environments (Table 1). Mean squares due to G x E interaction (linear) during winter season were significant for number of ear/plant and 1000- kernel weight only during winter. The nonlinear G x E interaction was significant for grain yield/plant, ear length, 1000-kernel weight and harvest index in both seasons. Thus, to measure stability the deviation from regression ($\bar{s}^2_d$) appeared to be a more important criterion than regression (b_i). Similar results were reported by other workers [2–5]. It has been advocated that the linear regression ($\bar{b}$) could simply be regarded as a measure of response of a particular genotype and deviation from regression ($\bar{s}^2_d$) should be considered as a better measure of stability [3, 6–8].

When the analysis was pooled over the seasons, both linear and non-linear components of G x E interaction were significant for all the traits, except harvest index (nonsignificant linear component), ears/plant, and ear girth (nonsignificant nonlinear component). Thus, over the diverse seasons, linear component mainly accounted for G x E interaction for ears/plant and ear girth, whereas for harvest index only the nonlinear component was significant. Thus, a prediction of performance over diverse seasons is possible for number of ears per plant and ear girth but not for harvest index. In comparison to winter and monsoon seasons taken individually, the G x E (linear) interactions were of greater importance in the analysis pooled over both seasons.

An ideal hybrid may be characterized as having the highest mean, unit regression (b=1.0), and the lowest deviation from the regression (ideally $\bar{s}^2_d = 0$) [1]. Ten hybrids in winter season, 17 in monsoon season, and 4 in the pooled analysis showed numerically higher mean for kernel yield per plant over the average of all the hybrids, but only 4 hybrids

Table 1. Analysis of variance for stability in maize hybrids grown in winter and monsoon seasons

Source	d.f.	Mean squares					
		kernel yield per plant	No. of ears/plant	ear length	ear girth	1000-kernel weight	harvest index
A. Winter (four environments)							
Hybrids x env.	81	17.2^{2**}	0.0046**	0.91**	0.18	260.0**	8.75**
Hybrids x env. (linear)	27	83.5	0.0067**	0.89	0.16	356.9*	4.93
Pooled deviation	56	129.2**	0.0034	0.90**	0.18	204.0*	10.28**
B. Monsoon (four environments)							
Hybrids x env.	81	113.7**	0.0016	0.71**	0.30	329.6**	8.32**
Hybrids x env. (linear)	27	70.4	0.0016	0.58	0.27	254.6	9.82
Pooled deviation	56	130.6*	0.0015	0.74*	0.30	354.0	7.31**
C. Over seasons (eight environments)							
Hybrids x env.	189	159.5**	0.0036**	1.11**	0.29**	353.4**	9.79**
Hybrids x env. (linear)	27	326.0**	0.0118**	1.84**	0.59**	530.8**	11.43
Pooled deviation	168	127.1**	0.0022	0.96**	0.24	312.3**	9.18**

*,**P ≤ 0.05 and 0.01, respectively.

in winter, 8 in monsoon, and only 1 across the seasons possessed significantly high yield, nonsignificant unit regression and the lowest deviation from regression (Table 2). In winter season, four hybrids, i.e. Vijay x J 617, PTR x J 54, PTR x J 617 and PTR x CM 202, exhibited high mean and low deviation from linear regression for kernel yield per plant. In general, these hybrids were also high performing for ears/plant, ear length and harvest index, but had low 1000-kernel weight. In winter, the lines PTR and J 617-61-1-1-1-1 produced desirable hybrids more frequently than others.

During monsoon season eight hybrids had desirable stability parameters for grain yield per plant. These hybrids were J 617 x H 104, CM 202 x H 104, PTR x J 617, Vijay x 617, J 54 x J 617, PTR x CM 202, Vijay x PTR, and J 54 x H 104. In general, the hybrids with high yield performance were also high performing for ear length, 1000-kernel weight and harvest index. The hybrids which perform better than others in monsoon season had the parents PTR, J617-61-1-1-1-1 and H104-21-4-2-1-2-3 more frequently than the other inbreds. The hybrids Vijay x J617 and PTR x J 617 and PTR x CM202 performed well for kernel yield in both winter and monsoon seasons and were also stable for ear length but were generally, unstable for 1000-kernel weight in both seasons.

In pooled analysis over seasons, the cross PTR x J 617 showed stable performance (unit regression and the lowest deviation from regression) for grain yield per plant. This hybrid showed higher prolificacy, greater ear length and higher harvest index, but had lower ear

Table 2. Mean performance and estimates of stability parameters in selected hybrids of maize

Hybrid	Winter		Monsoon		Pooled		
	$\bar{X}_i$	$\bar{S}^2_d$	$\bar{X}_i$	$\bar{S}^2_d$	$\bar{X}_i$	b_i	$\bar{S}^2_d$
Vijay x PTR	83.2	15.9	82.0	31.3	82.6	0.22	29.4*
Vijay x J 617	110.9	60.3	86.9	45.2	98.9	0.98	56.3*
PTR x J 54	105.1	24.5	72.5	59.1	88.8	1.57*	39.7*
PTR x CM 202	103.9	12.1	83.1	5.8	93.5	1.29*	12.5
PTR x J 617	105.1	12.9	88.8	-21.2	96.9	0.92*	-5.1
J 54 H 104	94.8	62.2*	84.4	-3.3	89.6	0.74	73.0
CM 202 x H 104	102.0	257.4*	80.0	9.7	91.0	1.10	93.4*
J 617 x H 104	102.6	507.2*	93.1	18.4	97.9	0.73	248.7*
Mean	97.8	—	78.9	—	83.3	1.00	—
SE (±)	2.3	—	2.3	—	1.5	0.34	—
CD at 5%	6.4	—	6.4	—	4.2	0.67	—

*$P \leq 0.05$.

girth and 1000-kernel weight in comparison to the mean values over all the hybrids. Thus, the line J 617-61-1-1-1-1 performed well in the hybrid combinations in both the seasons, and will be useful for breeding varieties suitable for these diverse seasons.

ACKNOWLEDGEMENTS

The first author is grateful to CSIR, New Delhi, for financial help as SRF. The guidance and constructive criticism of Dr. V. V. Malhotra, Ludhiana, and Dr. S. S. Pal, Gurdaspur, is acknowledged.

REFERENCES

1. S. A. Eberhart and W. A. Russell. 1966. Stability parameters for comparing varieties. Crop Sci., **6**: 36–40.

2. S. A. Eberhart and W. A. Russell. 1969. Yield and stability for a 10-line diallel of single cross and double cross maize hybrids. Crop Sci., **9**: 357–361.

3. R. S. Paroda and J. D. Hayes. 1971. Investigation of genotype–environment interactions for rate of ear emergence in spring barley. Heredity, **26**: 157–176.

4. A. V. B. Sayoji Rao. 1982. Combining Ability and Stability Analysis of Diallel Cross in Maize. M. Sc. Thesis. Punjab Agricultural University, Ludhiana.

5. P. B. Jha. 1983. Combining Ability and Yield Stability in Crosses of Maize (*Zea mays* L.) Involving Inbreds from Indigenous and Exotic Populations. Ph. D. Dissertation. Punjab Agricultural University, Ludhiana.

6. D. S. Jatasra and R. S. Paroda. 1979. Genotype–environment interactions and environmental sampling in wheat. Crop Improv., **6**: 86–93.

7. S. Langer, K. J. Frey and T. Bailey. 1979. Associations among productivity, production response and stability indexes in oat varieties. Euphytica, **28**: 17–24.

8. H. C. Becker. 1981. Correlations among some statistical measures of phenotypic stability. Euphytica, 30: 835–840.