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Influence of G x E interaction on seed yield and related traits in maize

JAI DEV*, S.K. GULERIA[1], S. LATA, V. KALIA[2], AMAR SINGH[3], C.L.BHARDWAJ[4], VEDNA KUMARI AND B.C. SOOD

Department of Plant Breeding and Genetics, C.S.K., H.P. Agricultaural University, PALAMPUR (H.P.) INDIA

ABSTRACT

Thirteen maize hybrids along with two checks were evaluated under six locations spreading over different agro-climatic zones of Himachal Pradesh during *Kharif* 2007 for stability parameters with respect to seed yield and other traits. Pooled analysis of variance indicated the presence of considerable variability among the genotypes as well as environments with respect to the characters studied. Significant mean squares for hybrid x environment (H x E) interaction revealed the differential response of hybrids over environments for all tha characters. The partitioning of environment + (hybrid x environment) mean squares further confirmed the existence of significant variation among the environments with regard to their effect on the performance of hybrids for all the traits. The hybrid X-717, having high mean yield and average stability exhibited general adaptability for seed yield whereas, three hybrids DMH-829, X-789 and NMH-51 showed general adaptability for early silking and maturity across the environments in the state. It was concluded that plasticity of different components be taken into consideration while selecting for stability in yield and related traits.

Key words : Maize, Hybrid x environment interaction, Regression, Stability

INTRODUCTION

Maize (*zea mays* L.) considered as the queen of cereals, is the third most important cereal crop in the world. In India, it is cultivated over 8.0 million hectare area with a production of 16.78 million tones having a productivity of more than 2 tones / hectare thereby contributing 7 % in the food basket of the country (Annonymous, 2008). In Himachal Pradesh, it is the staple crop for food and fodder. Although, maize productivity in this hill state is higher than the national average, yet there is still a lot of scope to increase it further. The major constraint for realization of full yield potential in the state is the lack of availability of high yielding varieties suitable for cultivation under varied agro-climatic conditions. Genotype x environment interaction is of major importance to a plant breeder in developing high yielding and stable maize genotypes which can withstand fluctuating environmental conditions prevailing in the state during *Kharif* season and produce commercially satisfactory harvest. High and stable yield of hybrids is highly desirable in maize breeding programme. Stable yield of a hybrid would mean that its rank, relative to other hybrids, remains unchanged in a given set of environments (Abera *et al.,* 2006). Therefore, an attempt has been made in the present investigation to evaluate different maize hybrids for their stability performance under varied agro-climatic conditions in Himachal Pradesh where maize is traditionally grown under rainfed situations.

MATERIALS AND METHODS

Thirteen maize hybrids along with two checks were evaluated in randomized block design with three replications during *Kharif* 2007 under six locations spreading over different agro-climatic zones of Himachal Pradesh *viz.,* Bajaura, Dhaulakuan, Berthin, Kangra, Sunder Nagar and Palampur. The sowing was completed during the first fortnight of June at all the locations and recommended package of practices was followed to raise the crop. Data were recorded on plot basis for days to 50 % tesseling, days to 50 % silking, days to 75 % maturity and seed yield and on ten randomly taken plants for cob placement height (cm) and plant height (cm). Seed yield of each hybrid was calculated at 15 % moisture and converted into q/ha. Stability parameters for different characters were computed using the regression approach of Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Pooled analysis of variance over environments showed significant differences among hybrids and environments (Table 1) indicating the presence of considerable variability among the genotypes as well as environments with respect to the characters studied. Significant mean squares for hybrid x environment (H x E) interaction revealed the differential response of hybrids over environments for all the characters. The partitioning of environment + (hybrid x environment) means squares

*** Author for correspondence.** [1] Regional Research Station, Bajaura, KULLU (H.P.) INDIA
[2]Regional Research Station, Dhaulakuan, SIRMOUR (H.P.) INDIA
[3]Krishi Vigyan Kendra, Sundernagar, MANDI (H.P.) INDIA
[4]Research Sub Station, Berthin, BILASPUR (H.P.) INDIA

Table 1 : Joint regression analysis of varience (mean squares) for different traits over six environments

Source of variation	d.f.	Days to 50% tasseling	Days to 50 % silking	Days to 75 % maturity	Cob placement (cm)	Plant height (cm)	Seed yield (q/ha)
Hybrid (H)	14	53.22*	52.60*	37.44*	858.83*	734.09*	713.18*
Environments (E)	5	412.98-	430.15*	696.68*	4328.34*	10587.85*	4446.00*
Hybrid x environment (HxE)	70	5.51*	7.02*	10.90*	238.08*	347.45*	274.54*
Environment + (H xE)	75	29.24*	30.86*	49.84*	362.63*	813.95*	381.81*
Environment (linear)	1	2064.91 +	2150.78+	3483.42 +	21641.80 +	52940.00 +	22230.00+
H x E (linear)	14	1.147	2.33	6.63 +	78.36	150.24	60.50
Pooled deviation (non linear)	60	1.79*	2.19*	2.70*	74.31*	100.05*	92.64*
Pooled error	168	0.11	0.17	0.54	9.33	12.79	6.36

* Significant against pooled error at 5 % level; +significant against pooled deviation at 5 % level

further confirmed the existence of significant vatriation among the environments with regard to their effect on the performance of hybrids for all tha traits. Both linear and non linear components of H x E interactions were highly unpredictable and thus, required to be confirmed in more environments for their stability performance. The significant differences among genotypes, environments and H x E interaction for seed yield and maturity traits have also been reported by earlier workers (Mani and Singh, 1999; Agarwal *et al.*,2000; Dodiya and Joshi, 2003; Kumar and Singh, 2004).

An ideal hybrid would be the one which has high mean, regression coefficient equal to unity (bi =1) and the lowest deviation from regression ($s^2di=0$) (Eberhart and Russel, 1966). Based on the stability parameters, none of the hybrids was observed to be stable for days to tasseling as their deviations from regression were significant. Two hybrids *viz.*, DMH-829 and X-789 were considered to be stable and most desirable for early silking (Table 2). On the other hand, the hybrid NMH-51 responded well to only poor environments for this character. Two hybrids *viz.*, EMH-1003 and VMH-2009 were also found to be stable over the environments but were slightly late for days to silking. For maturity, three hybrids Viz., DMH-829, X-789 and NMH-51 with unit regression and non significant deviations from regression were found to be stable and slightly early in maturity over different environments (Table 2 and Fig. 1). For cob placement, only one hybrid PMZ-4 (check) was stable having unit regression and non significant deviations for regression but exhibited slightly higher cob placement height (128.4 cm) than the population mean. None of the hybrids was desirable and stable for plant height as all the hybrids showed significant deviations for regression.

Seven hybrids *viz.*, X-717, PMZ-4 (Check), DKC-7074, X-121, Apoorva, X-789 and EMH-1000, in order of their merit, recorded higher seed yield than the grand mean

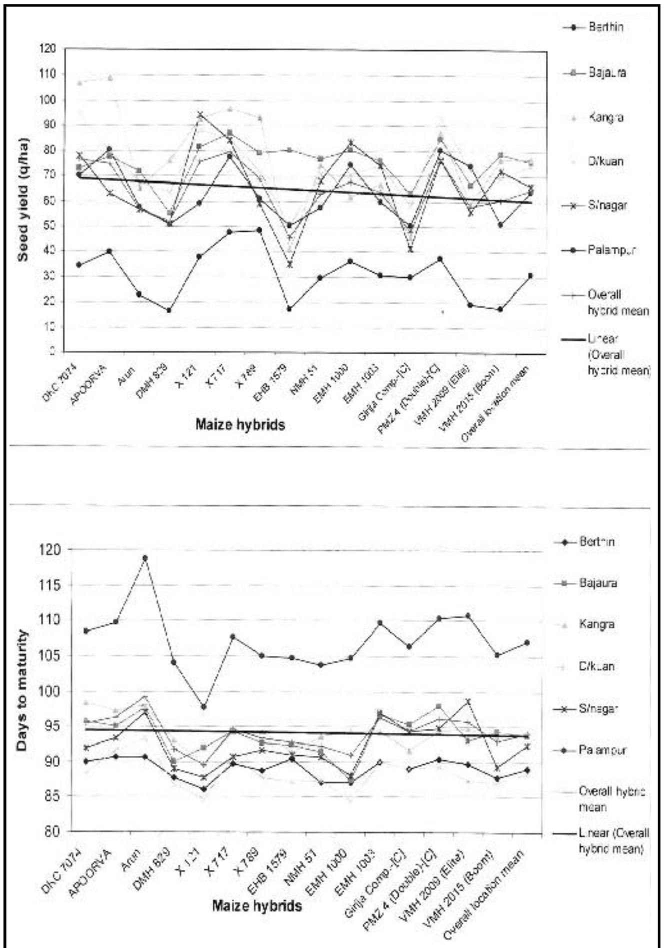

Fig. 1 : Mean performance of maize hybrids for seed yield (above) and maturity (below) at six locations in HP during 2007

(Table 2 and Fig. 1). Among these, the hybrid X-717, having higher seed yield, unit regression and non significant deviation from regression, was considered as stable and desirable for seed yield over the environments. Another hybrid, NMH-51 could also be considered stable for seed

Table 2 : Estimates of stability parameters for different maize hybrids over six environments

Sr. No.	Hybrids	Days to 50 % tasseling			Days to 50 % silking			Days to 75 % maturity			Cob placement (cm)			Plant height (cm)			Seed yield (q/ha)		
		Mean	Bi	S^2di	Mean	Bi	S^2di	Mean	Bi	S^2di	Mean	Bi	S^2di	Mean	Bi	S^2di	Mean	Bi	S^2di
1.	DKC-7074	58.67	1.03	1.12*	61.89	1.09	0.67*	95.44	1.05	3.06*	120.29	0.92	74.26*	233.42	0.90	37.18*	76.13	1.30	146.40*
2.	Apoorva	60.94	1.00	1.68*	64.11	1.01	2.58*	96.28	1.01	1.22	132.78	1.13	110.07*	260.31	0.64	139.82*	47.92	1.11	192.95*
3.	Arun	62.50	1.19	3.60*	65.22	1.07	5.57*	99.22	1.44	2.74*	128.07	0.88	43.83*	234.32	1.05	17.98*	56.85	1.01	9.40
4.	DMH-829	54.89	1.04	1.01*	57.33	0.99	0.15	91.72	0.93	1.28	107.09	1.04	88.54*	211.13	0.70	200.38*	52.13	1.09	49.88*
5.	X-121	51.17	0.94	1.56*	54.67	0.98	3.17*	89.61	0.67*	2.28*	99.70	0.78	58.17*	233.79	1.42	36.14*	75.56	1.15	147.93*
6.	X-717	57.78	1.01	0.47*	60.00	0.88	1.91*	94.56	0.97	2.05*	116.36	0.66*	27.50*	227.51	0.79	94.57*	79.59	0.96	16.22
7.	X-789	55.06	0.94	0.38*	57.28	0.89	0.38	93.33	0.91	0.27	115.82	0.61*	224.61*	240.10	0.94	321.13*	68.70	0.75	111.89*
8.	EHB-1579	55.28	0.93	2.51*	58.28	0.99	2.93*	92.78	0.88	1.85*	121.89	1.40	91.79*	231.69	1.25	78.88*	45.74	0.88	266.44*
9.	NMH-51	54.44	0.86	0.85*	57.06	0.81*	0.15	92.28	0.89	0.66	100.83	1.07	77.83*	227.08	0.95	70.42*	62.79	1.01	11.50
10.	EMH-1000	54.22	0.84	2.84*	57.61	0.83	3.42*	90.94	1.05	6.16*	108.82	1.07	34.18*	235.49	0.90	49.18*	67.72	0.78	141.31*
11.	EMH-1003	58.22	0.97	1.06*	60.39	0.97	0.44	96.28	1.03	3.09*	112.58	0.77	29.58*	228.68	1.00	62.66*	63.63	0.94	41.76*
12.	Girija composite (C)	56.61	0.99	1.51*	59.44	0.98	1.66*	94.28	0.92	3.10*	125.82	1.14	86.40*	239.64	1.00	98.58**	48.04	0.56*	63.90*
13.	PMZ-4 (C)	59.22	1.05	1.50*	62.06	1.09	13.6*	96.17	1.10	2.34*	128.39	1.32	85.34	237.04	1.18	81.79*	76.55	1.13	22.68*
14.	VMH-2009	59.11	1.23	1.62*	62.00	1.32	0.17	95.67	1.15	8.56*	142.74	1.25	46.49*	250.57	1.07	44.11*	57.80	1.02	122.09*
15.	VMH-2015	54.83	0.98	5.19*	57.17	1.08	8.26*	92.89	0.98	1.81*	114.17	0.96	35.44*	229.04	1.20	167.84*	60.78	1.31	45.26*
	Grand mean	56.90	-	-	59.63	-	-	94.10	-	-	118.40	-	-	234.70	-	-	64.46	-	-

* indicates significance of value at P=0.05

yield as it had unit regression, non significant deviations from regression but slightly lower seed yield. Earlier workers have also identified stable maize genotypes based on phenotypic stability analysis across the environments (Javed *et al.*, 2006; Kaundal and Sharma, 2006; Abdulai *et al.*, 2007; Jai Dev *et al.*, 2009).

The results of the present investigation revealed that, although, no single hybrid was found stable for all the traits studied, however, the hybrid X-717, having high mean yield and average stability exhibited general adaptability for seed yield whereas, three hybrids DMH-829, X-789 and NMH-51 showed general adaptability for early maturity across the environments in Himachal Pradesh. It may, therefore, be useful to consider plasticity of different components while selecting for stability in yield and related traits.

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