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Evaluation of genotype x environment interaction in maize

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Abstract

Twelve maize hybrids along with one check, Girija Composite, were evaluated in randomized block design with three replications at five locations spread over different agro-climatic zones of Himachal Pradesh. Pooled analysis of variance for stability revealed significant differences among hybrids for days to 50 per cent tasseling, 50 per cent silking, 75 per cent maturity, plant height and seed yield. The hybrid x environment (H x E) interaction was found to be significant for days to 50 per cent tasseling, 50 per cent silking, 75 per cent maturity, plant height and seed yield indicating the differential response of hybrids over environments for these characters. The hybrids X-640, HM-105, Kaveri-2020 and S-621 having higher seed yield and average stability could be considered as ideal hybrids. Besides these, the hybrids X-453 and Girija Composite exhibited average stability for days to 50 per cent tasseling and 50 per cent silking. The hybrids HM-105 and Girija Composite were found to be stable for days to 50 per cent silking and 75 per cent maturity, respectively. It is suggested that while selecting for stability in yield, the various component characters should also be taken into account.

Key words: Maize, yield, regression, stability.

Introduction

Maize (*Zea mays* L.) is the third most important cereal in India after rice and wheat that provides food, feed, fodder, fuel and serves as a source of basic raw material for a number of industrial products. In Himachal Pradesh, maize is the staple crop for food and feed and is grown under varied agro climatic conditions ranging from tropical to temperate situations. With the development of high yielding varieties and hybrids that are competitive with rice and wheat with respect to farm profitability and are resource use efficient (Anonymous, 2008), it is essential to understand the effects of diverse soil and climatic conditions on the performance of hybrids and identify hybrids with the least genotype x environment interactions. Selection of stable hybrids in maize is of great importance as the environmental conditions vary from season to season over the years. Therefore, in the present investigation, an attempt has been made to evaluate maize hybrids over locations and select the superior hybrids on the basis of stability parameters for seed yield and related components for general cultivation in this hill state.

Materials and Methods

Twelve maize hybrids along with one check (Girija Composite) were evaluated in randomized block design with three replications during *kharif* 2006 at five locations spread over different agro-climatic zones of Himachal Pradesh *viz.*, Bajaura, Dhaulakuan, Kangra, Sundernagar 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 per cent tasseling, days to 50 per cent silking, days to 75 per cent 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 per cent 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 for stability revealed significant differences among hybrids for days to 50 per cent tasseling, 50 per cent silking, 75 per cent maturity, plant height and seed yield (Table 1). The hybrid x environment (H x E) interaction was found to be significant for days to 50 per cent tasseling, 50 per cent silking, 75 per cent maturity, plant height and seed yield

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indicating the differential response of hybrids over the environments for all characters studied, except cob placement height. The significant differences among genotypes and H x E interaction for days to 75 per cent maturity in maize have also been reported by Agarwal *et al.* (2000) and Dodiya and Joshi (2003). A high and significant variance due to environments (linear) indicated the presence of linear variation among different environments for all the characters under study. However, the linear component of H x E interaction was non-significant revealing thereby that the linear sensitivity of different genotypes is not variable, hence the expression of hybrids for all the characters under different environmental conditions is unpredictable. Significant pooled deviations observed for days to 50 per cent tasseling, 50 per cent silking, 75 per cent maturity, cob placement height, plant height and seed yield indicated that the hybrids showed significant fluctuations from their linear path of response to environments and the deviation from linear regression only contributed towards the differences in stability of hybrids. Thus, the non-linear components contributed significantly to the H x E interactions observed for these characters.

Table 1. Pooled analysis of variance (mean squares) for different characters over five environments

Source	d. f.	Days to 50% tasseling	Days to 50% silking	Days to 75% maturity	Cob placement height (cm)	Plant height (cm)	Seed yield (q/ha)
Hybrid (H)	12	50.63*	54.05*	51.46*	1076.49	217.92*	144.41*
Environment (E)	4	121.39*	151.69*	570.64*	3267.37	8207.36*	8882.54*
Hybrid x Environment (H x E)	48	6.63*	7.28*	18.03*	4400.53	289.71	151.89*
Environment + (H x E)	52	11.38*	13.92*	49.44*	1605.30	720.45*	729.98*
Environments (linear)	1	485.58*	606.73*	2282.55*	13069.55*	32829.48*	35530.13*
H x E (linear)	12	2.20	1.06	7.16	729.35	34.54	20.16
Pooled deviation	39	2.05*	2.67*	5.19*	1580.09*	108.19*	56.07*
Pooled error	120	0.28	0.48	0.44	833.71	32.44	8.74

*Significant at P≤0.05

According to the Eberhart and Russel (1966) model, the stable genotype would be the one which has high mean, regression coefficient equal to unity (bi=1) and non-significant deviation from regression ($s^2di= 0$). Based on this, the stability parameters were worked out for days to 50 per cent tasseling, 50 per cent silking, days to 75 per cent maturity and seed yield. Although, eight hybrids, *viz.,* X-640, X-453, Bisco-855, S-621, HM-105, Kaveri-2020, Kaveri-218 and Kaveri-225 exhibited seed yields higher than the population mean, however, only four hybrids, X-640, HM-105, Kaveri- 2020 and S-621 were considered to be stable as these exhibited unit regressions, non-significant deviations from regression and higher seed yields. The hybrid Bisco-855 responded well to the poor environment for days to 50 per cent tasseling, whereas the hybrid X-453 and Girija Composite were found to be stable for this character across the environments. Likewise, two hybrids, *viz.*, HM-105 and X-453 along with Girija Composite were found to be stable for days to 50 per cent silking over the locations. On the other hand, hybrid X-453 was specifically adapted to poor environments for days to 75 per cent maturity (Table 2). 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; Dev *et al.*, 2009; 2010; Lata *et al.*, 2010).

Table 2. Stability parameters for yield and other component characters in maize hybrids

S. N.	Hybrids	Days to 50% tasseling			Days to 50% silking			Days to 75% maturity			Seed yield (q/ha)		
		Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
1.	Bisco-844	63	1.16	2.63*	67	0.95	3.32*	103	1.07	8.21*	55.09	0.95	24.41*
2.	Bisco-855	58	0.72*	0.41	61	0.78	1.40*	98	0.68*	3.04*	61.68	0.92	51.15*
3.	X-640	62	1.35	6.17*	65	1.05	9.20*	101	1.26	3.37*	57.99	1.08	22.88
4.	HM-105	55	0.76	1.90*	60	0.82	0.61	95	0.93	6.93*	57.50	0.95	10.03
5.	Kaveri-2020	57	0.70	1.48*	61	1.08	3.98*	96	0.84	6.01*	57.02	0.98	9.16
6.	Kaveri-218	61	1.20	1.80*	64	1.08	1.80*	101	1.23	4.42*	55.66	1.05	71.99*
7.	Kaveri-224	64	1.30	4.27*	69	1.15	2.48*	103	1.33	2.29*	49.34	1.18	53.08*
8.	Kaveri-225	60	0.94	1.30*	64	0.94	1.87*	101	1.02	6.58*	55.62	1.10	24.22*
9.	X-404	67	1.31	0.97*	71	1.20	1.75*	105	1.17	5.35*	50.10	0.90	60.45*
10.	X-453	61	0.98	0.53	64	0.85	0.85	99	0.92*	0.09	63.59	0.88	199.92*
11.	S-621	59	0.95	2.71*	62	1.18	3.57*	97	0.84	16.41*	57.93	0.96	5.94
12.	Swati	57	0.68*	0.62	62	0.81	1.63*	96	0.93	3.42*	49.70	1.05	148.73*
13.	Girija	60	0.96	1.78	64	1.10	1.78	99	0.77	1.40	44.26	0.99	47.05*
	Composite (check) Mean	**60**	-	-	**64**	-	-	**100**	-	-	**55.09**	-	-

*Significant at P≤0.05

Based on the results, it appeared that no hybrid was observed to be stable for all characters studied and each hybrid was stable for one or the other character. Thus, it is suggested that while selecting for stability in yield, the various component characters should also be taken into account. In the present study, hybrids X-640, HM-105, Kaveri-2020 and S-621 having higher seed yield and average stability could be considered as ideal hybrids. Besides these, the hybrid X-453 and Girija Composite exhibited average stability for days to 50 per cent tasseling and 50 per cent silking. The hybrid HM-105 and Girija Composite were found to be stable for days to 50 per cent silking and 75 per cent maturity, respectively. The hybrids Bisco-855 and X-453, with high mean, unity or near unity value of b and high value of S^2d are very useful for cultivation under intensive farming because these are very sensitive to improved cultivation practices.

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References

Abdulai MS, Sallah PYK and Safo Kantanka O 2007. Maize grain yield stability analysis in full season lowland maize in Ghana. Intl. J. Agri. Bio. **9** (1): 41-45.

Agarwal P, Verma SS and Mishra SN 2000. Phenotypic stability for different quantitative traits in maize hybrids. Indian J. Agric. Res. **34**: 107-11.

Anonymous 2008. Annual Report 2007-08. Directorate of Maize Research. ICAR, New Delhi.

Dev J, Chahota RK, Guleria SK, Lata S, Kalia V, Singh A, Kumari V, Jenjiha JK and Sood BC 2009. Phenotypic stability analysis of maize hybrids – 2005. Intl. J. Agric. Sci. **5** (1): 239-42.

Dev J, Guleria SK, Lata S, Kalia V, Singh A, Bhardwaj CL, Kumari V and Sood BC 2010. Influence of G x E interaction on seed yield and related traits in maize. Intl. J. Agric. Sci. **6** (1): 54-57.

Dodiya NS and Joshi VN 2003. Genotypic x environment interaction and stability analysis for yield and maturity in maize (*Zea mays* L.). Crop Res. **26** (1): 110-13.

Eberhart SA and Russell WA 1966. Stability parameters for comparing varieties. Crop Sci. **6**: 36-40.

Javed HI, Masood MA, Chughtai SR, Malik HN, Hussain M and Saleem A 2006. Performance of maize genotypes on the basis of stability analysis in Pakistan. Asian J. Pl. Sci. **5** (2): 204-10.

Kaundal R and Sharma BK 2006. Genotype x environment interaction and stability analysis for yield and other quantitative traits in maize (*Zea mays* L.) under rainfed and high rainfall valley areas of the submontane. Res. Crops **7** (1): 171-80.

Lata S, Guleria SK, Jai Dev, Katna G, Sood BC, Kalia V and Anand Singh 2010. Stability analysis in maize (*Zea mays* L.) hybrids across locations. Electronic J. Pl. Breed. **1** (3): 239-43.