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STABILITY ANALYSIS OF INBREDS AND THEIR SINGLE CROSS MAIZE (*ZEA MAYS* L.) HYBRIDS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

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ABSTRACT

The present investigation was carried out to assess the stability and suitability of maize genotypes in different environmental stress conditions *viz*., normal nitrogen, low nitrogen, high nitrogen and water logging. The field experiment consists of 21 single cross maize hybrids along with 10 inbred lines (7 lines and 3 testers)and two check varieties namely Pant Sankar Makka-1 and Vivek hybrid-9 were evaluated in randomized block design during *kharif* 2010 at N. E. Borlaug Crop Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India. Among the genotypes studied followed by high mean, regression coefficient (*bi*) equal to unity and deviation from regression (S^2di) near to zero ($\bar{x} = >, bi = 1, S^2di = 0$)the cross L_4 x T_3 (16.15, 1.06, 0.06) for ear length, lines L_6 (3.50, 0.96, 0.05) and T_3 (3.47, 1.00, 0.21) and crosses L_1 x T_3 (4.11, 1.02, 0.09) and L_7 x T_1 (4.23, 0.89, 0.05) and two checks Pant Sankar Makka-1 (4.02, 1.09, 0.06) and Vivek hybrid-9 (4.00, 0.99, 0.01) for ear diameter and L_5 x T_2 (3.25, 1.02, 0.12) and L_7x T_3 (3.31, 0.92, -0.09) for yield character, respectively showed stable performance over the stress environmental conditions. Therefore, these lines and crosses could be used for further breeding programme and commercial cultivation in these environmental stress conditions.

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop of the world. Maize is a highly cross pollinated crop species and there is a wide scope for exploitation of hybrid vigour. The genotypes do not perform similar behavior in different environmental conditions because it depends on genotype x environment interaction. Hence, it becomes obvious for the plant breeder to select genotypes which perform consistently across all the environments which is known as stability. It is essential to study the performance of a crop in different environments to identify superior genotypes which gives high and satisfactory productivity over a wide range of environments. The study of stability analysis has been done in other cereal crops such as rice (Kulsum *et al.,* 2013), wheat (Sharma *et al.,* 2012) and sorghum (Mona *et al.,* 2012) and in pulses chick pea (Shukla *et al.,* 2014) etc. For the quantitative trait such as yield, a significant genotype x environment interaction can be limiting the efforts of selection of superior genotypes seriously for both the new crop production and development of improved variety or cultivars (Kumar *et al.* 2013 and Shukla *et al.,* 2014).

The G × E interaction in multilocation trials complicates the identification of superior genotypes for a single location, because of magnitude of genotype by year interaction (Badu *et al.,* 2003). Grain yield is quantitative in nature and routinely exhibits G × E which is necessitates genotype evaluation in multi-environments in the advanced stages of selection (Kang *et al.,* 2004 and Fan *et al.,* 2007). The cause of yield stability often are unclear but the mechanisms of stability falls into four general categories, genetic heterogeneity, stress tolerance, capacity to recover rapidly from stress and yield component compensation. Since the visible expression of the genotype is the resultant of G x E andits large interaction effect causes problem to the breeder in selecting a genotype with consistent performance across environments. The genotypes have the genetic potential of high yielding at the same time with the good stability and adaptability (Babic *et al.,* 2006). The stability concept determined in several ways and through biometrical methods, one is the regression method which iswidely usedin plant breeding for selection of stable genotypes or major importance in developing improved varieties (Reddy and Ahuja, 2004, Kaundal and Sharma, 2006). It assumes added importance in the breeding of dry land crops such as maize, which are more subjected to the vagaries of weather (Bhasker, 2010). Eberhart and Russell (1966) have provided a dynamic approach for studying and interpreting phenotypic stability from regression analysis. Therefore, the objective of present study was to find the stable and suitable genotypes and determine the influence of G × E interaction for their phenological and morphological parameters as well as yield attributing traits grown under normal, low nitrogen, high nitrogen and water logging stress environments regarding further utilization these genotypes in breeding programme. Thus, it is imperative to study the performance of a crop in more than one environment to identify stable and superior genotypes which give high productivity over a wide range of environments. Such genotypes will be very useful for utilizing their potentials forthe development of high yielding and stable varieties which can withstand such uncertain conditions.

MATERIALS AND METHODS

The present investigation was carried out at N. E. Borlaug Crop Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India. The experimental material consists of 21 single cross hybrids developed by crossing 10 inbred lines (7 lines, 3 testers) in line x tester design (Kempthorne, 1957). Geographically, Pantnagar is situated at the latitude of 29° N, longitude 79.3° E and at an altitude of 243.84 meters above the mean sea level. The university falls under the subtropical zone and situated in the *Tarai* region at the foothills of *Shivalik* range of the Himalayas. The 21 hybrids along with 10 inbred lines and two check varieties namely Pant Sankar Makka-1 and Vivek hybrid-9 were evaluated in randomized block design with two replications under four environments namely normal nitrogen 120 kg/ha (E_1), low nitrogen 40 kg/ha (E_2), high nitrogen 60 kg/ha(E_3) and water logging (E_4) conditions. All genotypes were grown in single row plots of 4m length and between row and within row spacing of 0.75m and 0.25m, respectively. Observations were recorded on the whole plot basis for plant height (cm), ear height (cm), ear length (cm), ear diameter (cm), 100-kernel weight (g) and yield (kg/plot). The data of different parameters was used to estimate stability and suitability of genotypes using STPR and OPSTAT statistical software for the model of Eberhart and Russell (1966). In the experimental materials lines YHP B V 161-1-4-1-2-2-1-2-1-V-2V 4 (L_1), Pob 446 V-12-3-2-B-B-B (L_2), YHP A V 85-4-3-2-3-3-7-1-1 V 2 (L_3), YHP B V 45-2-1-3-1-2-1-3 (L_4), Pob 445 V-54-2-2-B-B-B (L_5), POB.45 C_8 V-86-1-3-7 V 1 (L_6) and POB 45 C_8 V-72-2-1-1-2 V 2 V (L_7) and testers were Pop 31 V 18-2-1-1-4-2-2-1/1-V-2V10A (T_1), Tarun V 61-5-3-1-2-1-1-1-1 (T_2) and Pob 445 V 101-3-2-BBB-V-1V 3 (T_3).

RESULTS AND DISCUSSION

It enables selection of genotypes that may give reasonably stable performance over a wide range of environments.The stability of varieties was defined by high mean value, regression coefficient (bi = 1) and deviates from regression as small as possible (S^2di = 0) (Eberhart and Russell, 1966). The regression coefficient is greater than unity may indicate either better than the average response to high yielding environments or worse than the average response to low yielding environments. A *bi* significantly less than unity may indicate either a better than the average performance in low-yield environments or a lower than the average response to high-yield environments. The S^2di measures the predictability of cultivar reaction to environments, while the *bi* should appropriately be considered as a measure of cultivar response to varying levels of management (Nagabhushan *et al.,* 2010). In the present investigation, the stability of genotypes to various characters of maize were judged on the basis of deviation from regression (*bi*) and due consideration was also given to their mean performance and linear response. The results of stability are representing in Table 1, 2 and 3.

Pooled analysis of variance (Table 1) revealed significant difference among genotypes and environments for all the six characters except ear height. The substantial variation among all the genotypes was observed for all the characters. The significance of environments (linear) for all the characters revealed that existence of real varietal differences for regression over environmental means; environment effects were additive in nature, signifying considerable differences among the environments and their predominant effects on the characters.The pooled deviation and G x E interaction observed insignificant for all the characters showed that the G x E interactions of the genotypes was predictable and phenotypic expression under different environmental conditions respond same to specific environments for these characters. The findings of the study agree with the earlier report Arunkumar and Singh (2004), Abdulai *et al.* (2007), Rahman *et al.* (2010) and Nadagaud *et al.* (2012).

For the plant height all the lines had *bi* values non-significantly different from unity, indicating average response. The deviation from regression (S^2di) was non-significant for all lines except L_1 (184.34) and two testers, T_1 (558.09) and T_2 (336.78), exhibited the performance of the genotypes over environments is predictable. It means other lines and tester T_3 exhibit stable reaction for this character. The line L_6 with high mean value (230.28) and regression coefficient (1.08) but deviation from regression (36.32) not near to zero, indicating that the genotype exhibit stable performance for the plant height is predictable. The hybrid $L_3 \times T_2$, had mean value (223.79), *bi* (1.06) and

Table 1: Pooled Analysis of variance for stability analysis (Eberhart and Russell, 1966) for six quantitative traits in maize over four environmental conditions

Source of variation	d.f.	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	100-kernel weight (g)	Yield (kg/plot)
Genotype	32	999.656**	507.839**	7.292**	0.208*	19.007**	0.68**
Environment	3	981.446*	83.249	16.904**	2.132**	87.065**	7.277**
Genotype x Environment	96	344.355	86.909	2.507	0.125	10.026	0.276
Environment + Genotype x Environment	99	363.661	86.798	2.943	0.186	12.360	0.488
Environment (Linear)	1	2944.339**	249.747**	50.712**	6.396**	261.196**	21.832**
Environment x Genotype (Linear)	32	294.7	223.201**	3.367*	0.162	8.101	0.356
Pooled Deviation	66	357.995	18.195	2.014	0.103	10.655	0.228
Pooled Error	128	961.947	215.609	5.051	0.191	14.473	0.371
Total	131						

*, ** Significant at 5% and 1% probability levels, respectively.

Table 2: Stability (Eberhart and Russell, 1966) parameters for plant height, ear height and ear length in different genotypes pooled over environments

Genotypes	Plant height (cm)			Ear height (cm)			Ear length (cm)		
	$\bar{X}i$	bi	S2di	$\bar{X}i$	bi	S2di	$\bar{X}i$	bi	S2di
Lines									
L1	217.61	2.29	184.34**	89.00	3.06	220.15**	13.78	-1.42	1.75
L2	205.88	-0.83	28.78	92.04	-3.53	37.99	12.94	1.02	0.59
L3	205.09	-0.49	32.72	82.96	-2.38	26.78	14.34	1.42	-0.33
L4	215.08	0.64	25.24	90.62	-4.04	-9.18	15.02	1.42	-0.32
L5	208.25	1.57	13.92	94.49	6.55	309.00**	13.49	2.74	1.57
L6	230.28	1.08	36.32	105.67	-0.48	107.92**	15.06	0.50	-0.08
L7	204.04	3.92	14.15	94.39	1.33	81.45**	12.11	1.27	0.42
Testers									
T1	200.63	-0.06	558.09**	80.75	-1.03	467.90**	12.65	1.59	0.35
T2	204.80	4.60	336.78**	91.46	0.80	36.59	14.43	0.23	9.28**
T3	199.18	1.89	13.13	91.92	1.82	-9.18	14.55	1.50	-0.39
Crosses									
L1 × T1	221.74	3.11	205.55**	107.75	8.09*	221.92**	15.16	-0.52	0.97
L1 × T2	224.60	3.06	605.39**	99.37	3.60	358.69**	14.99	0.99	1.09
L1 × T3	223.68	0.35	350.72**	95.50	5.77	34.33	15.20	1.30	0.60
L2 × T1	217.54	2.58	-6.15	92.71	0.76	50.07*	15.33	0.29	-0.34
L2 × T2	220.85	0.37	92.81**	81.46	-0.98	44.78*	16.08	-0.04	3.00**
L2 × T3	220.33	1.34	348.07**	102.08	4.03	94.54**	16.56	2.33	1.64
L3 × T1	210.08	0.86	-10.07	85.29	1.34	46.82*	15.53	0.95	1.64
L3 × T2	223.79	1.06	28.61	104.08	2.60	-5.98	15.59	1.48	-0.22
L3 × T3	246.67	2.30	194.53**	107.00	1.49	83.14**	17.23	-0.62	3.28**
L4 × T1	225.95	-0.82	50.55*	104.38	0.59	-7.16	16.27	2.20	-0.05
L4 × T2	232.70	1.59	57.91*	107.92	2.55	71.67**	16.79	0.44	-0.42
L4 × T3	233.04	1.35	77.31**	114.42	0.92	-8.95	16.15	1.06	0.06
L5 × T1	230.71	-0.74	243.79**	110.12	1.01	7.86	17.65	0.38	-0.04
L5 × T2	229.41	1.30	125.62**	108.83	1.30	31.37*	16.64	0.82	-0.05
L5 × T3	214.45	-1.53	150.71**	101.92	1.47	52.96*	15.76	0.59	-0.61
L6 × T1	222.25	0.12	159.59**	97.50	-0.95	126.72**	15.39	0.05	0.50
L6 × T2	232.53	-1.07	11.20	96.92	-1.49	-19.49	15.47	0.83	0.14
L6 × T3	223.16	-0.48	12.01	101.54	-1.39	108.15**	17.23	0.51	-0.20
L7 × T1	210.08	1.64	108.28**	101.67	-1.33	123.99**	15.08	1.55	2.86*
L7 × T2	218.71	1.26	94.32**	95.83	-0.57	35.08	15.77	1.52	1.13
L7 × T3	210.74	-1.48	4.93	88.33	-1.18	98.01**	16.34	2.24	0.34
Checks									
Pant Sankar Makka-1	213.59	0.97	545.79**	87.75	-0.55	61.37	14.98	2.08	1.38
Vivek hybrid-9	226.50	1.21	398.82**	86.54	3.82	7.91	15.94	2.27	-0.38
MEAN	218.907	0.99		96.73	1.00		15.31	0.71	
SE (±)	7.48	1.42		5.99	3.35		1.00	0.91	

*, ** Significant at 5% and 1% probability levels, respectively.

S^2di (28.61) exhibits stable performance across the environments and predictable for this character. The hybrids $L_1 \times T_3$, $L_2 \times T_1$ and $L_6 \times T_1$ were better than the average response in low yielding environment or poor environment because high mean, low *bi* and S^2di not zero and insignificant, indicated stable performance and predictable for this character. Other hybrids $L_4 \times T_2$, $L_4 \times T_3$, $L_5 \times T_2$ and Vivek hybrid-9 were better than average response in high yielding or rich environment high mean, high *bi* and significant S^2di significant not near to zero indicated average performance and predictable. Similar results were observed by Arunkumar and Singh (2004), Nagabhushan *et al.* (2010), Karadavut and Akilli (2012) and Nadagaud *et al.* (2012).

The coefficient of regression values showed non-significantly different from unity for all the 10 parents, however, lines L_2, L_3, L_4 and testers T_2 and T_3 have deviation from regression non-significantly differ, indicating predictable reaction for ear height. Among the crosses, $L_1 \times T_1$ exhibited significant regression coefficient. The deviation from regression exhibit non-significant for $L_1 \times T_3$, (34.33), $L_5 \times T_1$(7.86), $L_7 \times T_2$ (35.08) and Pant Sankar Makka-1 (14.98) indicating that predictable and stable reaction over the environments. The hybrid over the environments was $L_5 \times T_1$ because of high mean (110.12), and regression coefficient (1.01) but deviation from regression (7.86) not near to zero means indicated that the performance of the genotype over environment stable and predictable for this character.The hybrids, $L_3 \times T_3$, $L_5 \times T_2$ and $L_5 \times T_3$ were suitable for rich environment indicated average performance over the environments. The result was compared to Arunkumar and Singh (2004), Nagabhushan *et al.* (2010), Karadavut and Akilli (2012) and Nadagaud *et al.*, (2012).

All the parental lines showed average response of regression coefficient for ear length. Among the parental lines except T_2(9.28) exhibited S^2di non-significantly different from zero. All the hybrids except $L_2 \times T_2$, $L_3 \times T_3$, and $L_7 \times T_1$ showed S^2di values non-significantly differ from zero indicating their predictable and stable performance over environments. The most desirable and stable hybrid was $L_4 \times T_3$ with mean (16.15),

Table 3: Stability(Eberhart and Russell, 1966) parameters for ear diameter, 100 kernel weight and yield in different genotypes pooled over environments

Genotypes	Ear diameter (cm)			100-kernel weight (cm)			Yield (cm)		
	i	bi	S2di	i	Bi	S2di	i	bi	S2di
Lines									
L1	3.50	0.76	0.09	23.24	-0.62	9.84**	18.00	1.09	0.22
L2	3.76	1.27	-0.04	22.05	1.70	0.03	2.56	2.27*	0.05
L3	3.71	0.56	0.04	21.66	1.45	18.55**	2.62	1.10	0.03
L4	3.69	0.72	-0.03	22.57	-0.25	-0.08	2.56	1.29	-0.09
L5	3.50	2.10	0.15*	19.44	-0.40	41.24**	2.50	1.36	-0.06
L6	4.01	0.96	0.05	20.14	-0.02	14.12**	2.38	0.81	-0.01
L7	3.52	1.98	0.31**	22.58	2.92*	30.70**	2.69	0.79	0.62
Testers									
T1	3.79	2.10	0.05	21.23	2.71	12.85**	1.75	0.46	0.01
T2	3.47	0.33	0.30**	19.49	1.54	17.79**	2.00	0.00	-0.10
T3	3.47	1.00	0.21**	19.56	1.38	3.88	2.56	1.29	-0.09
Crosses									
L1 × T1	4.21	-1.06	0.04	23.63	-0.35	1.44	2.75	0.78	0.29
L1 × T2	4.02	1.33	0.08	23.22	-0.40	12.11**	3.44	0.16	0.17
L1 × T3	4.11	1.02	0.09	23.31	1.05	-0.15	3.44	0.75	-0.04
L2 × T1	3.95	1.50	0.05	23.76	1.61	1.77	3.19	-0.09	0.11
L2 × T2	3.86	2.29*	0.04	21.93	2.09	0.66	2.75	1.14	0.03
L2 × T3	3.94	0.68	0.05	23.60	0.76	-0.43	3.06	0.43	0.35
L3 × T1	4.04	2.43*	-0.02	22.10	0.45	3.58	3.25	1.02	0.12
L3 × T2	3.96	0.26	0.01	22.59	3.41*	6.70*	2.69	1.11	0.13
L3 × T3	3.92	0.16	0.17*	24.34	1.42	1.56	2.69	0.35	-0.06
L4 × T1	4.12	0.40	0.05	24.23	-1.28	-0.28	3.25	0.58	0.40
L4 × T2	4.09	1.21	0.01	26.55	-0.26	-1.34	3.75	1.87*	0.16
L4 × T3	3.61	0.27	-0.03	24.34	1.51	18.37**	3.56	1.25	-0.06
L5 × T1	4.03	1.29	-0.04	21.30	2.14	-0.58	3.25	1.69	-0.09
L5 × T2	3.72	1.23	0.03	24.77	0.10	0.36	3.25	1.02	0.12
L5 × T3	4.08	1.34	-0.04	27.39	2.70	3.47	3.00	1.47	0.06
L6 × T1	3.81	0.63	0.16*	23.14	2.10	8.66**	2.81	1.00	0.22
L6 × T2	4.26	0.85	0.01	24.87	-0.45	-1.66	2.94	0.69	0.12
L6 × T3	4.16	0.26	-0.03	22.62	1.81	4.17	2.88	0.70	0.06
L7 × T1	4.23	0.89	0.05	23.23	0.78	13.30**	3.25	1.51	0.14
L7 × T2	4.03	0.87	0.11	22.36	1.69	-0.34	3.75	1.11	0.24
L7 × T3	3.78	1.25	0.00	22.87	-0.47	23.79**	3.31	0.92	-0.09
Checks									
Pant Sankar Makka-1	4.02	1.09	0.06	22.44	1.98	4.48	3.12	1.15	0.23
Vivek hybrid-9	4.00	0.99	0.01	23.12	0.20	0.83	31.9	1.91*	0.07
MEAN	3.891	1.0000		22.837	0.9999		2.909	1.0000	
SE (±)	0.18	0.67		1.76	1.06		0.25	0.50	

*, ** Significant at 5% and 1% probability levels, respectively.

bi (1.06) and S^2di (0.06) across the environments because it follows the high mean, regression coefficient equal to unity and deviation from regression near to zero as per the Eberhart and Russell (1966). The hybrids suitable for rich environment were L_3 x T_1 and $L_7 \times T_2$ indicating average performance over the environments because high value of regression coefficient than unity. However, $L_6 \times T_1$ and$L_6 \times T_2$ were found to be average stability for poor environment for ear length characters because low value of regression coefficient than unity. Arunkumar and Singh (2004), Karadavut and Akilli (2012) and Nadagaud *et al.* (2012) observed similar results.

Among lines L_5 (0.15), L_7 (0.31) and two tester, T_2 (0.30) and T_3 (0.21) and crosses L_3 x T_3 (0.17) and L_6 x T_1 (0.16) exhibited significant deviation from linearity (S^2di) indicated that the performance of the genotypes over environments unpredictable for this character. The regression coefficient showed non- significant difference among all the genotypes except L_2 x T_1 (2.29) and L_3 x T_1 (2.43) cross indicating average performance over the environment. The most desirable and stable parent and hybrids across the environments were L_6 with mean (4.01), *bi* (0.96) and S^2di (0.05) Pant Sankar Makka-1 with mean (4.02), *bi* (1.09) and S^2di (0.06) and Vivek hybrid-9 (4.00) mean value, *bi* (0.99) and S^2di (0.01). The tester T_1 and hybrids $L_1 \times T_2$, $L_2 \times T_1$ and $L_4 \times T_2$ were suitable for rich environment because of high mean and high regression coefficient value indicated average performance. The other set of crosses namely $L_2 \times T_3$, $L_3 \times T_2$, $L_3 \times T_3$, $L_4 \times T_1$, $L_6 \times T_2$, $L_6 \times T_3$, $L_7 \times T_1$ and $L_7 \times T_2$ were identified for poor environment for the ear diameter character. Similar findings were obtained by Arunkumar and Singh (2004), Karadavut and Akilli (2012) and Nadagaud *et al.* (2012).

100-kernel weight (g) showed the line L_7 (2.92) and cross L_3 x T_2 (3.41) exhibited stable performance over the environments due to significant regression coefficient. Among the parental lines, the line $L_2$and T_3 exhibited non-significant deviation from linearity (S^2di) indicating predictable and stable performance over the environments.The values of S^2di were significant for the crosses $L_1 \times T_2$ (12.11), $L_3 \times T_2$ (6.70), $L_4 \times T_3$ (18.37), $L_6 \times T_1$ (8.66), $L_7 \times T_1$ (13.30) and $L_7 \times T_3$ (23.79) indicated that the performance of the genotypes over environments was unpredictable for the character. The most desirable and stable cross was $L_1 \times T_3$ with mean value (23.31), *bi* (1.05) and S^2di (0.15) across the environments. The other set of crosses $L_2 \times T_1$, $L_3 \times T_3$, $L_4 \times T_3$ and $L_7 \times T_1$ were suitable for rich environment because high mean and high regression coefficient value indicating average performance over the environments. The crosses $L_2 \times T_3$, $L_5 \times T_2$ and Vivek hybrid-9 were observed to be suitable for poor environment indicating average performance over the environments for this character. Similar results were reported by Arunkumar and Singh (2004), Nagabhushan *et al.* (2010), Karadavut and Akilli (2012) and Nadagaud *et al.* (2012).

For the yield (kg/plot) character all the crosses except $L_4 \times T_2$(1.87), and Vivek hybrid-9 (1.91) showed non-significant *bi* values indicating stable performance of the genotypes over the environments. The values of S^2di were non-significant for all the crosses including checks,*viz.* Pant Sankar Makka-1 and Vivek hybrid-9. The line L_1 with mean value (18.00), *bi* (1.09) and S^2di (0.22) and crosses $L_3 \times T_1$ (3.25) mean value, *bi* (1.02) and S^2di (0.12), $L_5 \times T_2$ high mean value (3.25), *bi* (1.02) and S^2di (0.12) and $L_7 \times T_3$ (3.31) mean, *bi* (0.92) and S^2di (-0.09) were most desirable and stable across the environments because the results are following Eberhart and Russell (1966) model. The crosses $L_4 \times T_2$, $L_4 \times T_3$, $L_5 \times T_1$, $L_5 \times T_3$, $L_7 \times T_1$ Pant Sankar Makka1 and Vivek hybrid-9 were found to be suitable for rich environment because of high mean and regression coefficient greater than unity indicated average performance over the environments. whereas, other set of crosses $L_1 \times T_2$, $L_1 \times T_3$, $L_2 \times T_3$, $L_4 \times T_1$, $L_6 \times T_2$ and $L_7 \times T_3$ exhibited adaptability to poor environment because high mean performance and the value of regression coefficient lower than the unity indicating that these genotypes exhibit average performance over the environments. These results are in agreement with the result of Arunkumar and Singh (2004), Karadavut and Akilli (2012) and Nadagaud *et al.,* (2012).

As the objective of the investigation is to identify the stable traits for assessing the genotypes, importance is given to yield and yield contributing characters. Among the genotype studied, L_4 x T_3 and L_6 x T_2 for ear length, L_6andT_3 parents, crosses L_1 x T_3, L_7 x T_1 and L_7 x T_2 and two check Pant Sankar Makka-1 and Vivek hybrid 9 for ear diameter, L_1 x T_3 for 100 kernel weight and $L_1$and L_3 x T_1, L_5 x T_2 and L_6 x T_1 for yield character showed stable reaction. The cross alone L_1 x T_1 (8.09) for ear height, L_2 x T_2 (2.29) L_3 x T_1 (2.43) for ear diameter, line L_7 (2.92) and cross L_3 x T_2 (3.41) for 100 kernel weight and line L_2 and cross L_4 x T_2 and check Vivek hybrid 9 for yield showed significant value of regression coefficient.

Hence, it is concluded that the ear length, ear diameter, 100 kernel weight and yield characters may be considered for assessing the genotypes for normal, low nitrogen, high nitrogen and water logging environmental stress conditions in maize, as they show stable reaction over environments.

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