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STABILITY ANALYSIS FOR PHYSIOLOGICAL PARAMETERS AND GRAIN YIELD IN BREAD WHEAT (*TRITICUM AESTIVUM L.*)

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SUMMARY

A study was conducted at Indian Agricultural Research Institute, New Delhi using 36 diverse wheat genotypes and three sowing conditions (irrigated, restricted irrigation and rainfed conditions) to assess the stability of genotypes for yield and physiological parameters. The pooled analysis of variance with respect to all the traits indicated that the variance due to environment was significant for all the traits except canopy temperature depression at anthesis which showed the distinctly differential effect of the different sowing conditions in the name of environment. The variance for genotypic effect was also highly significant for all the traits under study indicating thereby differential response of all the genotypes selected for the study. The varieties BACANORA T 88, BHRIKUTI, BL 1804, CHIRIYA 3, CHIRIYA 7, CNO 79/PRULLA, GW 273, GW 326, HD 2189, HD 2819, KANCHAN, HD 2781, MP 4010, NEPAL 1, NL 623, HD 2987, C 306 and PBW 175 have shown higher mean values, desirable regression coefficient and deviation from the regression coefficient. Based on the mean performance, linear regression and S^2d values, the above varieties can be said stable as per the criteria of the stability analysis. The environmental index for normal sowing was 498.25 which gradually decreased in the restricted irrigation and rainfed sowing. Stress susceptibility index can serve as an indication for selecting genotypes with higher yield and higher tolerance to stress. The higher the value of stress tolerance index (STI) of a genotype better is the stress tolerance. The STI had high positive correlation with the grain yield under normal and both the stress conditions.

***Key words*: Bread wheat, physiological traits, stability analysis**

INTRODUCTION

Food security in the world is challenged by increasing food demand and threatened by declining water availability (Zwart and Bastiaanssen 2004). Water deficit is considered to be among the most severe environmental stresses and the major constraint on plant productivity; losses in crop yield due to water stress probably exceeds the loss from all other causes combined. The deficit has an evident effect on plant growth that depends on both severity and duration of the stress (Araus *et al*. 2002; Bartel and Souer 2004).

Selecting and breeding for drought tolerance has been the main challenge of wheat breeders throughout the last 50 years (Nouri-Ganbalani *et al.* 2009). The ability of a cultivar to produce high and satisfactory yield over a wide range of stress and non-stress environments is very important (Ahmad *et al*. 2003). Finlay (1968) believed that stability over environments and yield potential are more or less independent of each other.

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Blum (1979) suggested that one method of breeding for increased performance under water stressed conditions might be to breed for superior yield under optimum conditions on the assumption that the best lines would also perform well under sub optimal conditions.

The most widely used criteria for selecting high yield performance are mean yield, mean productivity and relative yield performance in drought stressed and more favourable environments (Ahmad *et al*. 2003). Relative yield could be used to assess the yield potential of a genotype under water stressed conditions. Higher relative yield shows that the genotype performed relatively well under drought. Genotype by environment interactions are important source of variation in any crop and the term stability is sometimes used to characterize a genotype which shows relative constant yield independent of changing environmental conditions (Sabaghniaa *et al.* 2006; Aminzadeh 2010).

Information about phenotypic stability is useful for the selection of crop varieties as well as for breeding programmes. An understanding of environmental and genotypic causes leading to G x E interactions are important at all stages of plant breeding including ideotype design, parental selection, selection based on traits and selection based on yield (Jackson *et al.* 1996; Yan and Hunt 1998). This understanding can be used to establish breeding objectives, identify ideal test conditions and formulate recommendations for areas of optimal cultivar adaptation. Thus, this study was undertaken to evaluate wheat genotypes for their yield stability under diverse moisture regimes.

MATERIAL AND METHODS

Field experiments were conducted at Experimental Farm, Division of Genetics, Indian Agricultural Research Institute, New Delhi, India (28^o 41’ North latitude and 77^o13’ East latitude, 228 m above mean sea level). The experiment was sown in three agronomic conditions (rainfed, restricted irrigation and irrigated conditions). Material for the present study comprised of 36 elite genotypes of bread wheat. The experiment was laid out in a 6 x 6 double lattice design with two replications. Each genotype was planted with the help of self propelled Norwegian seed drill. The gross plot size of the experiment was 1.38 x 6.0 m, with rows at 23 cms apart. The standard cultivation practices prescribed for wheat under irrigated conditions were followed precisely. The field observations were recorded in crop growing season. The data were recorded on 10 plants from each plot for most of the traits. The data was recorded on yield per plot. The canopy temperature depression (CTD) was measured at anthesis and 10 days after anthesis using a portable infrared thermometer (Model AG-42, Teletemp Corporation, Fullerton, CA) with a view of 2.5^0. Relative water content was determined following the method described by Weatherley (1950). Membrane thermal stability was estimated using procedures as described by Onwueme (1979). The stability analysis was carried out with the model proposed by Eberhart and Russell (1966) using software MSTAT C (1989). Data on yield and other yield related parameters were subjected to stress related parameters viz. mean productivity (MP), geometric mean productivity (GMP), tolerance (TOL), stress susceptibility index (SSI) and stress tolerance index (STI). Different stress tolerance attributes were calculated as: Stress intensity (SI) = 1- Ys/Yn, Ys = Mean yield in stress environments Yn = Mean yield in optimum environment, Mean Productivity (MP) = (Ys+Yn)/2 (Rosielle and Hamblin, 1981), Tolerance (TOL) = Yn-Ys (Rosielle and Hamblin, 1981), Stress susceptibility index (SSI) = 1-{Ys/Yn}/SI (Fischer and Maurer, 1978), Geometric mean productivity (GMP) = Ys x Yn, Stress tolerance index (SSI) = Yn x Ys /Yn^2 (Fernandez, 1993).

The performance of test material under normal (irrigated conditions) conducive to high productivity and stress environments (restricted irrigation and rainfed conditions), were taken into account, to work out the stress tolerance parameters. The correlation of yield under normal (Yn) and stress (Ys) environments with stress tolerance parameters were worked out (Al-Jibouri *et al*. 1958).

RESULTS AND DISCUSSION

The pooled analysis of variance with respect to all the traits has been presented in the Table 1**.** The variance due to environment was significant for all the traits under

Table 1. Analysis of Variance of yield and yield contributing traits under different environments

Source of variations	d.f.	Yield	CTD I	CTD II	Mem. Injury	RWC
Varieties (V)	35	346192.66**	5.70**	5.02**	1208.86**	51.30**
Environments (E)	2	7833964.80**	1.15**	1.53**	107.12**	353.25**
V x E	70	31292.39**	0.04	0.05	2.64	13.80**
Pooled error	105	33288.02	0.05	0.02	3.15	1.89
Env. + (Vx E)	72	248033.29**	0.07	0.09	5.54	23.23**
Envron (linear)	1	15667921.0**	2.30**	3.06**	214.20**	706.77**
V x E (linear)	35	42217.57**	0.05	0.05	3.05	21.26**
Pooled deviation	36	19801.69	0.03	0.04	2.17	6.16

*Significant at 5% and ** significant at 1% level
CTD = Canopy temperature depression
RWC = Relative water content

consideration which indicated the distinct and differential effect of the different sowing conditions except canopy temperature depression at anthesis. The variance for genotypic effect was also highly significant for all the traits under study indicating thereby differential response of all the genotypes selected for the study except canopy temperature depression at anthesis. The variance due to variety x environment have shown significant interaction for the all the characters showing differential response to the varieties with different environments. These results are in line with the findings obtained by Nagarajan (2005).

Highly significant mean squares due to environment + genotype x environment interactions revealed that the genotype interacted considerably with environmental conditions that existed under different conditions of sowing. The pooled deviation also contributed to the different traits which suggest that the varieties together in the name of genotypes differed considerably for all these characters under the study.

For grain yield (g/plot), none of the varieties have shown significantly higher S^2d values. The linear regression (*bi*) values were significant for HI 1500, C 306+ Lr 24 and HS 375. The rest of the varieties showed non-significant values for *bi*. The varieties BACANORA T 88, BHRIKUTI, BL 1804, CHIRIYA 3, CHIRIYA 7, CNO 79/PRULLA, GW 273, GW 326, HD 2189, HD 2819, KANCHAN, HD 2781, MP 4010, NEPAL 1, NL 623, HD 2987, C 306 and PBW 175 showed higher mean values which was more than the population mean of 2643 g/plot. For the physiological traits CTD I (canopy temperature depression at anthesis) and CTD II (canopy temperature depression 10 days after anthesis), the varieties CHIRIYA 3, CHIRIYA 7, HD 2189, HS 420, NEPAL 1, C 306+Lr 28, CNO79/ PRULLA, NL 623 were found stable across all the three sowing conditions. Rest of the varieties showed preference for one or the two environments. For membrane injury percent varieties CHIRIYA 7, HD 2923, HI 1500, HS 375, KANCHAN, were found stable. Similarly for relative water content, GW 322, HD 2189, HD 2944, HS 420, KANCHAN, HD 2781 and C 306+Lr 28 were found stable across all the environments based on the values of mean, regression coefficient and deviation from regression coefficient.

According to Eberhart and Russell (1966), a desirable genotype should have high mean, with bi=1, and S^2di =0. Whereas, Paroda and Hays (1971), Jatasra and Paroda (1979) and Becker (1981) suggested that linear genotypes and S^2di could be considered as better measure of stability. Based on the mean performance, regression coefficient (bi) values and deviation from regression values, some of the genotypes have been

Table 2. Stability parameters, mean regression coefficient (bi) and deviation from regression S^2d for the characters under study

Genotypes	Yield (g/p)			CTD I			CTD II			Membrane injury percent			Relative water content		
	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)
BACANORA T 88	2655.17	1.28	29836.94	3.28	1.29	0	1.08	0.49	-0.01	68.21	0.47	-1.5	71.73	0.37	-0.94
BAVIACORA	2475	1.18	-16609	6.01	1.81**	0.01	3.37	1.73**	0.01	32.51	-0.06**	-0.78	77.38	0.55	-0.87
BHRIKUTI	3235	1.43	14667.56	4.08	1.51*	-0.02	2.14	0.43*	-0.01	64.61	1.49*	-1.38	72.19	-0.03**	-0.3
BL 1804	2970.17	0.79	-14745.1	3.42	0.98	0	1.25	1.63**	0.02	74	-0.09	0.97	73.15	0.5	0.27
CBW 09	2473	0.75	-13230.1	3.73	1.05	-0.01	1.41	-0.13**	0.26	84.62	0.5	-0.56	74.19	1.93**	2.29
CHIRIYA 1	2270	1.33	44072.05	3.37	0.37*	0	0.94	-0.34**	0	86.67	0.66	-1.52	74.78	1.75	3.92
CHIRIYA 3	2672.5	0.85	-14762.2	6.02	0.05**	-0.02	3.56	1.04	0.1	34.23	0.41	-1.42	75.01	0.02**	0.51
CHIRIYA 7	3070.83	1.17	-11867.5	6.49	1.58	-0.02	4.02	2.42**	0.01	29.78	0.94	-0.27	77.29	0.54	-0.93
CNO 79/ PRULLA	3144.17	1.18	-4289.57	5.4	0.15**	0	4.21	1.47	0.06	33.72	0.61	-1.16	79.5	0.48	-0.91
GW 273	2850.83	1.26	-16295.9	5.36	-0.15**	-0.02	3.96	0.54	-0.01	36.15	0.41	-1.34	79.17	0.58	-0.25
GW 322	2599.17	1.13	-1552.11	4.86	-0.14**	-0.02	3.66	2.16**	0.03	26.21	0.92	-1.54	82.35	1.16	1.77
GW 326	2746.67	0.82	-10347.2	5.05	0.24**	-0.02	3.53	1.85**	0.02	37.66	0.83	1.73	74.26	-0.11	-0.84
HD 2189	2742.5	1.13	-16548	5.4	0.81	-0.02	3.41	1.98**	0.03	39.74	0.40*	-1.55	79.98	1.13	10.72**
HD 2819	3074.17	1.04	-5922.47	5.58	0.01**	-0.02	3.83	1.38**	-0.01	39.01	1.01	-1.57	81.28	0.45	-0.7
HD 2923	2423.33	0.88	-15152.4	3.52	2.02**	-0.02	1.08	0.77	-0.01	59.76	1.37	-1.47	74.8	2.53**	17.82**
HD 2944	2111.67	0.6	-6648.83	6.35	1.73**	-0.02	3.39	1.50*	0	36.18	0.43**	-1.53	82.78	0.78	-0.53
HI 1500	2543.33	1.77**	74487.85	3	2.14**	-0.02	0.88	0.41**	-0.01	57.89	1.11	-0.92	66.72	1.99**	3.71**
HS 375	2276.67	1.57**	-2075.8	3.37	2.88**	0.03	1.23	1.25	0.01	66.41	1.09	-1.37	76.2	3.54**	21.47**
HS 420	2369.33	0.76	36377.89	6.03	1.46	-0.02	3.43	1.37*	0.06	34.98	1.09	-0.39	83.28	0.85	-0.93
HW 5206	2640	0.68	1271.44	3.22	3.16**	-0.01	1.48	1.63**	-0.01	68.26	1.60*	-0.93	76.85	0.64	-0.52
KANCHAN	2689.17	0.8	-11686	3.67	1.83*	-0.02	1.39	1.72**	0.03	72.1	1.09	2.91	78.3	0.86	-0.93
HD 2781	2735.83	0.82	-10592.1	3.59	-0.13	0.19	1.66	1.84**	0	78.08	1.81**	0.26	80.81	0.83	5.29**
MP 4010	3130.83	1.2	17872.94	6.38	1.98*	0.06	4.28	1.97**	0.02	29.03	0.38*	1.94	77.88	-0.44	-0.13
NEPAL 1	2863.33	0.48	-16220.4	6.81	1.2	-0.01	4.36	1.81**	0.24	29.89	0.85	-1.29	79.88	-1.32	36.30**

Genotypes	Yield (g/p)			CTD I			CTD II			Membrane injury percent			Relative water content		
	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)	Mean	Reg. Coef. (B)	Mean Sq. Dev. (SD)
NEPAL 6	2135	0.7	-7256.27	3.22	1.53*	0.05	2.01	-0.01**	-0.01	73.1	1.89**	0.87	67.78	2.89**	54.35**
NL 623	3326.67	1.3	-13010.3	5.27	0.36**	-0.02	3.46	1.1	0.03	37.52	0.73	-1.5	78.38	0.00**	-0.94
NL 835	2382.5	0.83	-2935.22	5.69	-0.56	0.01	3.28	1.79	0.1	34.66	0.39**	-1.16	79.54	0.00**	-0.94
NL 838	2137.5	0.82	8956.55	4.37	1.48*	0.16	3.3	0.22**	-0.01	35.51	-0.23**	13.74**	75.76	0.00**	-0.94
PBW 343	1895	0.68	-11119.5	2.67	1.36	0.07	1	0.10**	-0.01	79.34	2.51**	5.28**	73.36	1.67**	1.64
HD 2987	2846.67	1.16	3392.02	2.43	0.59	0	1.09	0.36**	-0.01	69.95	2.29**	-1.42	74.68	1.63**	0.24
RS 926	2425.83	0.96	-14504.5	2.67	-0.32	0.04	1.19	0.31**	-0.01	69.98	1.66*	3.52*	72.02	1.95**	13.04**
RS 927	2345.83	1.22	35028.21	3.03	1.53*	-0.02	0.87	0.43*	0.02	68.68	2.40**	11.77**	70.66	1.46	0.43
C 306 +LR 24	2763.33	0.36**	-4573.55	5.61	1.44*	0.06	3.78	0.48	0	31.67	0.33**	0.85	79.63	0.52	1.48
C306 +LR 28	2852.5	0.65	-16631.6	5.84	0.96	-0.02	3.91	0.88	-0.01	30.66	0.99	-0.69	80.56	1.17	11.47**
K 8027	2577	1.22	-4005.58	2.56	-0.05**	-0.02	0.96	-0.13**	-0.01	60.92	2.36**	-1.19	70.95	2.26**	5.47**
PBW 175	2700.83	1.19	110294.1	2.65	-0.15**	-0.02	0.9	-0.47	0	82.45	1.39	5.94**	72.92	2.89**	7.14**
Pop mean	2643.09			4.445			2.481			52.61			76.27		
SEm±	99.5			0.1264			0.1328			1.04			1.7547		
SE of B	0.2133			0.7083			0.6443			0.6034			0.56		

** Significant at 5% and ** significant at 1% level* identified to suit with stability of performance under unfavorable environments in respect of grain yield and physiological traits (Table 3). In the present study, it seems that the above stable genotypes could be used to develop a new strain with combination of stable characters. Madariya *et al.* (2001) also reported similar findings.

Effect of environment on the expression of grain yield and physiological parameters

The effect of environment (irrigated, partially irrigated and rainfed), which is taken as indicator for the moisture stress exposure to the 36 genotypes and worked out as comparison of mean of the genotypes over the three environments for physiological parameters by way of environmental index is presented in the Table 4. A perusal of the table shows that for grain yield (g/plot), the environmental index for normal sowing was 498.25 which gradually decreased in the restricted irrigation and rainfed sowing. For the physiological traits like CTD at anthesis and CTD at 10 days after anthesis, the values of environmental index indicated that the character can be better utilized for rainfed sowing. Membrane injury index showed negative values for irrigated (-0.799) and restricted irrigation (-1.101) and positive values for the rainfed sowing (1.912). Relative water content showed a value of 4.127 for normal irrigated sowing, -0.450 for the restricted irrigation and -3.612 for rainfed sowing. However, breeders must be aware of the difficulties in selection. As reported by Rharrabti *et al.* (2003), an integrated selection system designated to maximize the probability of producing stable quality wheat with a high level of performance should be developed. The cultivation of more unsuitable cultivars should be recommended only for specific regions and agronomic conditions where they can attain a high performance with regard to quality traits independent of seasonal effects.

Relative efficacy of different selection parameters

Simple correlation was computed between grain yield and other traits of thirty six genotypes for each of the sowing conditions (Table 4). In the irrigated conditions, DSI (Drought susceptibility index) of grain yield was significantly correlated with DSI of the characters CTD at anthesis, CTD at 10 days after anthesis, membrane injury percent and relative water content. The similar trend was observed for restricted irrigation and rainfed conditions. However, the magnitude of the correlations varied with the different agronomic conditions of sowing. The results suggests that traits like CTD at anthesis,

Table 3. Merit wise performance of the selected wheat genotypes for 17 characters pooled over three sowing conditions

Characters				
Yield (g/plot)	**CTD I**	**CTD II**	**RWC**	**Membrane injury**
Bacanora T 88	CHIRIYA 3	CHIRIYA 7	GW 322	CHIRIYA 7
Bhrikuti	C 306+LR 28	HD 2189	HD 2189	HD 2923
BL 1804	HS 420	NEPAL 1	HD 2944	HI 1500
Chiriya 3	NO 623		HS 420	HS 375
Chiriya 7	CNO79/PRULLA		HD 2781	KANCHAN
GW 273				
GW 326				
HD 2189				
HD 2781				
HD 2987				

Table 4. Effect of environment in the expression of grain yield, quality parameters and morphological traits

Characters	Environmental Index		
	Irrigated	**Restricted Irrigation**	**Rainfed condition**
Grain yield	498.25	-320.7	-366.2
CTD at anthesis	0.331	0.063	-0.299
CTC (10 DAA)	0.168	0.031	-0.190
Membrane injury percent	-0.799	-1.101	1.912
Relative water content	4.127	-0.450	-3.612

CTD at 10 days after anthesis, membrane injury percent and relative water content are important traits under both restricted irrigation and rainfed conditions under severe drought stresses in wheat. The importance of the above traits was confirmed by the earlier reports under similar conditions (Reynolds *et al*. 1998; Singh *et al*. 2007).

The correlation coefficients of normal season and the stress seasons (restricted irrigation and rainfed conditions) grain yield with mean productivity (MP), stress susceptibility index (SSI) and stress tolerance index (STI) are given in the Tables 5 & 6. The lowest SSI was observed in genotype GW 273 followed by GW 322, KANCHAN, C 306+ Lr 24 and HD 2987. All these genotypes had higher value of the mean productivity, geometric mean productivity and heat tolerance index. SSI had high positive correlation with grain yield under optimum and stress environments.

Based on the mean productivity and geometric mean productivity, genotypes are found to be the best are HD 2819 followed by GW 273 followed by GW 322, KANCHAN, C 306+ Lr 24 and HD 2987. The mean productivity had very high correlation with optimum irrigated condition and stress conditions (restricted irrigation and rainfed condition) grain yield. Rosielle and Hamblin (1981) showed that under most yield trials, the correlations between mean productivity and grain yield are positive. Thus the higher mean productivity increases the grain yield and selection based on the MP increases the average performance under both the normal and stress conditions. Similar findings were reported by Golabadi *et al*. (2006). A larger value of TOL represents the relatively more sensitive to stress. Tolerance had high positive correlation with grain yield under optimum conditions, but had negative correlation in stress environments. Therefore, it can not serve as the best selection parameters for the selection of genotypes under normal and stress environments. The smaller the value of SSI, greater is the stress tolerance. The lowest SSI was observed in genotype GW 273 followed by GW 322, KANCHAN, C 306+ Lr 24 and HD 2987. All these genotypes had higher value of the mean productivity. SSI had high positive correlation with grain yield under optimum and stress environments. The results of the present study are in agreement with those of Kirigwi *et al.* (2004) who reported that selection under optimum condition enables the identification of lines with responsiveness to optimum environment, while selecting under stress environment identifies high yielding lines carrying traits for performance under stress conditions. Therefore, stress susceptibility index can serve as an indication for selecting genotypes with higher yield and higher tolerance to stress. The higher the value of stress tolerance index of a genotype better is the stress tolerance. The genotypes GW 273 followed by GW 322, KANCHAN, C 306+ Lr 24 and HD 2987had higher MP, GMP, SSI and STI. Therefore, STI can be utilized for the selection of genotypes with high yield and higher tolerance to moisture stress. The STI had high positive correlation with the grain yield under normal and both the stress conditions. The correlation coefficients are useful in finding degree of association with the yield and yield contributing traits.

Therefore, it can be concluded that on the basis of the results the stress tolerance index is the best parameter to assess the genotype for high performance in the stress and non stress conditions. Grain yield under stress (restricted irrigation and rainfed conditions) and optimum conditions can be improved by improving traits like grains per spike, plant height, grain weight per spike, number of tillers per plant, thousand kernel weight, harvest index, CTD at anthesis, CTD at 10 days after anthesis, membrane injury percent, relative water content and kernel hardness index. Based on the mean performance, linear regression and S^2d values, the

Table 5. Correlation coefficients of grain yield and its drought stress intensity (DSI) of 36 genotypes with different traits and their DSI.

DSI of other Traits	DSI of Grain Yield (kg/ha)		
	Restricted	Optimum Irrigation	Rainfed sowing
Grains per spike	0.423*	0.466*	0.3096
CTD at anthesis	0.6659**	0.5874**	0.6414**
CTD (10 DAA)	0.6139**	0.5541**	0.6234**
Membrane injury percent	0.4432**	0.4038**	0.5069**
Relative water content	0.3128*	0.2498*	0.3298*

** Significant at 5% and ** significant at 1% level*

varieties BACANORA T 88, BHRIKUT, BL 1804, CHIRIYA 3, CHIRIYA 7, CNO 79/PRULLA, GW 273, GW 326, HD 2189, HD 2819, KANCHAN, HD 2781, MP 4010, NEPAL 1, NL 623, HD 2987, C 306 and PBW 175 can be said to be stable as they have shown higher mean values, desirable regression coefficient and deviation from the regression coefficient.

The environmental index for normal sowing (irrigated) was 498.25 which gradually decreased in the restricted irrigation and rainfed sowing. Stress susceptibility index can serve as an indication for selecting genotypes with higher yield and higher tolerance to stress. The higher the value of stress tolerance index of a genotype better is the stress tolerance.

Table 6. Correlation coefficient of normal and stress environment grain yield with stress tolerance parameters.

Stress tolerance parameters	Grain yield (under normal environment)	Grain yield (kg/ha)	
		Under rainfed conditions (very high stress)	Under restricted irrigation (high stress)
Stress tolerance	-0.4469**	0.6632**	0.4896*
Stress susceptibility index	0.5164**	0.6678**	0.5563*
Geometric mean productivity	0.4297*	0.5986*	0.6096*
Mean Productivity	0.7258**	0.7522**	0.7101**
Stress tolerance index	0.7451**	0.7733**	0.7985**

**, **Significant at 0.05 and 0.01 levels, respectively*

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