



Stability for grain yield and its contributing traits in bread wheat (*Triticum aestivum*)

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ABSTRACT

In a study set of forty seven genotypes of common bread wheat (*Triticum aestivum* L. emend Fiori & Paol) were evaluated over four years during 2007-08 to 2010-11 to assess the stability of these genotypes for yield and its contributing traits over years and environments. Analysis of variance of stability with respect to 12 traits revealed highly significant variance due to environment for all traits which indicated differential effect of different seasons. The variance for genotypic effect was highly significant for all traits indicating thereby differential response of all the genotypes. Genotype × environment (linear) interaction was also significant for flag leaf length, flag leaf width, peduncle length, grains per spike and 1000-grain weight indicating substantial amount of predictable G × E interaction. Environmental indices indicated that performance of genotypes over four environments varied apparently and environment E₂ showed highest favourable impact on grain yield. Varieties K 9107, UP 2382 and PBW 443 were found to be stable across the environments for grain yield and NW 1076 was the highest yielding stable variety in which superior yield was resulted from high mean values of six contributing traits, while variety LOK 1 was the only variety showed stable performance for all 12 traits. The stability of different yield contributing traits varied in compensating manner in different genotypes imparted grain yield stability. The varieties HD 2824, UP 2382, NW 1076, DBW 16, DBW 39, GW 173, HUW 234, NIAW 917, LOK 1, HD 2851 and PBW 154 have shown higher mean values, desirable regression coefficient and non-significant deviation from the regression coefficient for yield and its contributing traits. Based on stability parameters these varieties can be considered as stable performers and may be utilized for hybridization programmes to improve wheat yields.

Key words: Bread wheat, G × E interaction, Regression coefficient, Stability analysis

Wheat (*Triticum aestivum* L. emend. Fiori & Paol) is the second most important cereal crop, plays an important role in food and nutritional security of India (Anonymous 2011). It has been used as a major source of food since prehistoric times. India stands second in wheat production with 93.51 million tonnes contributing 14.45 per cent to the global wheat production during 2012-13 (Anonymous 2014). High yielding varieties boosted wheat productivity from less than one tonne/hectare during 1960's to around 3.1 tonnes/hectare during 2012-13. Wheat crop is grown under diverse agro-climatic conditions leading to wide fluctuation in productivity from region to region, since the growing period of the crop becomes restricted due to sudden increase in the temperature after winter (Banerjee *et al.* 2006). Environmental changes have serious implications on genotypic yield manifestations. This leads to the inconsistent

performance of varieties due to genotype × environment interactions, as grain yield is a complex trait that largely depends on several contributing attributes. Therefore, information on phenotypic stability would be of great use for effective selection of varieties as well as for future wheat breeding programmes. Allard and Bradshaw (1964) defined stability as adaptation of varieties to unpredictable and transient environmental conditions. This technique has been used to select stable genotypes unaffected by environmental changes. Since, productivity is the function of genotypic adaptation and stability is the measure of genotype × environment interaction. An understanding of environmental and genotypic causes leading to these interactions are highly important at all the stages of plant breeding including plant architecture, parental selection, selection based on traits and selection based on yield (Jackson *et al.* 1996, Van and Hunt 1998).

The relative ranking of genotype during various seasons for a given attribute is rarely the same that ultimately, poses difficulty in identifying superior genotypes. Therefore, it is necessary to select genotype(s) showing stability in performance over a wide range of environments (Das *et al.* 2010). The stability of a genotype over diverse environments is usually tested by the degree of its interaction with different environments under which it is grown (Asif *et al.* 2003).

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The concept of stability has been defined in several ways and several biometrical methods including univariate and multivariate ones have been developed to assess stability (Lin *et al.* 1986, Becker and Leon 1988, Crossa 1990). The most widely used one is the regression method, based on regressing the mean value of each genotype on the environmental index or marginal means of environments (Romagosa and Fox 1993, Tesemma *et al.* 1998). A good method to measure stability was previously proposed by Finlay and Wilkinson (1963) and was later improved by Eberhart and Russell (1966). The precise knowledge on the nature and magnitude of genotype \times environmental interaction is highly important in understanding the stability in yield of a particular variety for its better exploitation under given situation(s). This understanding can be used to establish breeding objectives, identify ideal test conditions and formulate recommendations for areas of optimal cultivar adaptation (Singh and Chaudhary 2007). Therefore, an attempt was made to study the stability parameters of yield and its contributing traits of different bread wheat genotypes evaluated over four seasons.

MATERIALS AND METHODS

The experimental material consisted of 46 released varieties and one advance genotype (DBW 28) of bread wheat obtained from Directorate of Wheat Research, Karnal. Needless to mention that these varieties were developed at different centres/institutes of All India Coordinated Wheat and Barley Improvement Project (AICW & BIP) and released for cultivation in different agro-ecological conditions. There were twelve varieties from Uttar Pradesh and Uttaranchal (UP 2382, C 306, UP 2425, NW 1076, HUW 468, K 9107, HUW 234, NW 1014, VL 616, VL 804, VL 829, HUW 510), nine from Delhi (HD 2733, HD 2824, DL 153-2, DL 788-2, HD 2189, HD 2687, HD 2851, HW 2004, WR 544), six from Punjab (PBW 343, PBW 502, PBW 296, PBW 443, PBW 154, PBW 373), five varieties and one advanced genotype from Haryana (DBW 17, DBW 14, DBW 16, DBW 39, CBW 38 and DBW 28), four from Gujarat (GW 322, GW 366, LOK 1, GW 173), three from Rajasthan (Raj 3077, Raj 4120, Raj 4037), three from Himachal Pradesh (HS 240, HS 375, HS 420), two from Madhya Pradesh (MP 4010, HI 1531) and two from Maharashtra (NIAW 34 and NIAW 917).

Field experiments were carried out at Directorate of Seed Research, Mau located at 25°89' N latitude and 83°46' E longitude at an altitude of 209 feet above mean sea level. The trials were conducted over four years from 2007-08 to 2010-11 at same site in successive seasons representing four different environments E₁, E₂, E₃ and E₄, respectively. The experiment location falls under North Eastern Plains Zone (NEPZ), depicted as fertile plains of the Ganges-Ghaghara doab. The average rainfall is 800 mm of which more than 80 per cent is received during the monsoon. Soil of experimental plots was silty loam having 55.9, 31.0 and 13.1 per cent proportions of sand, silt and clay, respectively, and slightly alkaline with pH ranging from 7.5 to 8.1. The

organic carbon, available N, P and K were 0.32 per cent, 206 kg/ha, 19.7 kg/ha and 215 kg/ha, respectively. Experiments were laid out in randomized complete block design (RCBD) with 3 replications in plot size of 9.0 m² (6 \times 1.5m) during every season. The genotypes were planted in 6 rows of six meter keeping a distance of 25 cm between the rows and recommended cultivation practices prescribed for wheat were followed precisely.

The field observations were recorded from each plot for twelve metric traits, viz. days to 50% spike emergence, flag leaf length (cm), flag leaf width (cm), peduncle length (cm), plant height (cm), number of effective tillers/m², number of grains per spike, number of spikelets per spike, number of grains per spikelet, grain weight per spike (g), 1000-grain weight (g) and grain yield/m² (g). The data on number of effective tillers and total grain yield was recorded on per m² basis, while, days to 50% spike emergence was recorded on plot basis. Observations on remaining characters were recorded on ten randomly selected competitive plants from middle four rows in each plot of every replication. Standard procedures for analysis of variance were followed. Data were first subjected to the analysis followed for randomized block design as per Panse and Sukhatme (1967). Stability analysis was carried out following Eberhart and Russel (1966). Estimates of mean performance (\bar{x}), regression coefficient (bi) and deviations from regression (S²di) were used to draw inferences on stability of genotypes.

RESULTS AND DISCUSSION

For each environment analysis of variance on 12 characters was carried out separately as well as pooled over the years. Analysis of variance revealed significant differences amongst genotypes in each of the four environments as the estimates for variance due to genotype were highly significant for all the traits indicating the presence of considerable amount of genetic variability in the genotypes. The analysis of variance of stability (Table 1) revealed that the variance due to environment was significant for all the traits which indicate the distinct and differential effect of different environments over four seasons. Similarly, the variance for genotypic effect was also highly significant for all the traits indicating thereby differential response of all the genotypes. The variance due to genotype \times environment (G \times E) have shown highly significant interaction for flag leaf length and flag leaf width indicating differential response to the varieties with different environments. The significant G \times E interaction has been reported for various traits by Jatsara and Paroda (1980), Banerjee *et al.* (2006), Yadav *et al.* (2009) and Gowda *et al.* (2010) which confirm the findings of present investigation. Mean squares due to environment + (genotype \times environment) interactions were highly significant for days to spike emergence, flag leaf length, flag leaf width, peduncle length, number of effective tillers, number of grains per spike, number of grains per spikelet, grain weight per spike, 1000-seed weight and grain yield which showed that genotypes interacted considerably with

Table 1 Analysis of variance for yield and its contributing traits in wheat under different environments (pooled over four consecutive years)

Character / Source	Genotype	Environment	Genotype × Environment	Environment + (Genotype × Env.)	Environment (linear)	Genotype × Environment (linear)	Pooled deviation	Pooled error
d.f.	46	3	138	141	1	46	94	368
Days to 50% spike emergence	82.554**	1235.575**	4.181	30.381**	3706.724**	1.890	5.213**	0.886
Flag leaf length (cm)	12.656**	62.735**	2.585**	3.865**	188.205**	6.806**	0.464	1.638
Flag leaf width (cm)	0.069**	0.181**	0.006**	0.010**	0.542**	0.014**	0.002	0.006
Padanical length (cm)	61.380**	1173.733**	5.220	30.082**	3521.199**	7.257*	4.113**	2.557
Plant height (cm)	235.205**	190.160**	14.070	17.816	570.479**	13.766	13.919**	8.917
Effective tillers/m ²	7925.813**	64385.030**	2299.290	3620.263*	193155.100**	1524.112	2629.711**	1488.013
Grains/spike	139.839**	1937.590**	16.420	57.295**	5812.770**	22.487*	13.101	12.546
Spikelets/spike	10.197**	75.285**	3.115	4.651	225.854**	1.511	3.834**	1.920
Grains/spikelet	0.146**	3.756**	0.051	0.130**	11.269**	0.050	0.051	0.024
Grain weight/spike (g)	0.140**	11.433**	0.045	0.287**	34.299**	0.057	0.038**	0.024
1000-grain weight (g)	77.000**	1197.048**	10.124	35.378**	3591.143**	13.802*	8.109**	2.810
Grain yield/m ² (g)	5681.52**	221627.300**	2913.258	7566.749**	664882.100**	1840.387	3376.295**	1486.332

*Significant at P = 0.05; **Significant at P = 0.01

environmental conditions that existed over different seasons. However, this interaction was non-significant for the characters like plant height and number of spikelets per spike indicating thereby that these two characters of all the genotypes under all the four environmental conditions had been following more or less similar pattern. Similar results for various traits were also reported earlier by Ashraf *et al.* (2001), Okuyama *et al.* (2005), Nagarajan *et al.* (2007), Yadav *et al.* (2009) and Gowda *et al.* (2010).

Genotype × environment (linear) interaction was significant for five traits namely; flag leaf length, flag leaf width, peduncle length, number of grains per spike and 1000-grain weight, indicating substantial amount of predictable G×E interaction. Hence, it would be possible to predict the performance of genotypes over wide range of environments for these traits. Significant G×E (linear) interaction for different traits has also been reported earlier by Banerjee *et al.* (2006), Singh and Chaudhary (2007) and Ranjana and Kumar (2013). Eight characters (days to 50% spike emergence, peduncle length, plant height, number of effective tillers, number of spikelet per spike, grain weight per spike, 1000-grain weight and grain yield) were having highly significant pooled deviation which indicated that some portion of G×E interaction was unpredictable. Significant deviations from regression have also been reported earlier by Asif *et al.* (2003), Rasul *et al.* (2006), Nagarajan *et al.* (2007) and Hassan *et al.* (2013).

Eberhart and Russell (1966) emphasized the need of considering both linear regression coefficient (bi) and non-linear, i.e. deviation from regression (S²di) components of G×E interactions in measuring the stability of genotypes. Linear regression could be simply regarded as a measure of response of particular genotype, whereas the deviation from regression as the measure of stability (Paroda and Hayes 1971, Jatsara and Paroda 1980 and Yadav *et al.* 2009). The

genotypes with lowest deviation around regression line (S²di) were considered to be stable and vice-versa. Along with above measures, the high mean performance was also considered as a requirement for identifying high yield and stable genotypes. Thus, in present investigation three measures, viz. higher mean performance, regression coefficient (bi = 1) and deviation from regression (S²di = 0) were used to identify superior and stable genotypes.

The estimates of stability parameters for the twelve characters presented (Table 2) revealed that varieties DBW 16, DL 788-2, DBW 39, HUW 234, GW 322 and PBW 373 possessed minimum deviation from regression (S²di) indicating their high predictability in terms of grain yield. Genotype VL 829, MP 4010 and HS 240 were found to be stable which possessed regression coefficient (bi) value very close to unity with non-significant S²di values, however, the mean yield of these varieties was comparatively low. The varieties K 9107, UP 2382 and PBW 443 with superior mean performance, regression coefficient near to one and non-significant S²di values showed average stability for grain yield. This indicates that these genotypes performed better across environments. Based on mean performance, six varieties DL 788-2, DBW 39, HD 2189, NIAW 34, NIAW 917 and PBW 154 having higher mean yield with regression coefficient (bi) less than one and non-significant mean square deviation (S²di) signifies their stability for unfavourable conditions and showing above average stability. Eleven genotypes NW 1076, HD 2824, GW 173, HD 2851, HUW 234, PBW 343, GW 322, HUW 468, DBW 16, DBW 28 and PBW 296 had regression coefficient greater than unity and non-significant deviation from regression means thereby, these were suitable to favourable conditions, indicating average stability. Madariya *et al.* (2001) emphasized that grain yield is a complex character and the analysis of individual yield component can lead to

Table 2 Mean performance and stability parameters of genotypes for seed yield and yield components over environments

Genotype	Days to 50% spike emergence			Flag leaf length (cm)			Flag leaf width (cm)			Peduncle length (cm)		
	X	bi	S ² di	X	bi	S ² di	X	bi	S ² di	X	bi	S ² di
Raj 3077	76.67	0.93	1.47	28.12	3.07*	-1.66	1.81	2.21	-0.01	36.67	1.17	-0.04
PBW 343	80.08	0.52	19.00**	24.23	2.44	0.61	1.81	1.92	0.00	32.11	1.01	1.25
PBW 502	81.50	0.85	0.72	22.42	1.99	-0.85	1.83	1.27	-0.01	32.35	0.87	-2.30
HD 2733	81.92	1.07	3.10*	24.84	1.01	-1.50	1.85	0.78	0.00	30.06	0.16	0.42
HD 2824	81.42	0.97	6.54**	25.68	0.64	-0.01	1.96	1.24	-0.01	32.46	0.61	-1.03
GW 322	78.33	1.05	-0.96	26.70	0.80	-1.74	1.82	0.41*	-0.01	34.53	0.82	1.37
GW 366	74.25	1.13	7.41**	25.70	0.53	-1.44	2.04	1.90	0.00	36.61	0.68	-2.18
DL 153-2	74.67	0.76	5.18**	23.76	1.54*	-1.74	1.94	0.51	-0.01	39.61	1.16	-2.49
DL 788-2	72.67	0.79	6.33**	24.95	0.74	-1.67	2.09	2.31	0.02*	38.30	1.05	2.04
DBW 17	80.58	1.07	2.24	24.14	0.43	-1.61	1.76	-1.48*	0.00	29.34	0.58	8.62*
LOK 1	72.00	0.86	1.64	24.74	2.12	-1.14	1.65	1.54	0.00	38.39	1.36	3.04
UP 2382	77.33	0.93	-1.05	28.04	2.01	-1.38	2.02	2.47*	-0.01	36.67	0.81	-0.58
CBW 38	79.67	0.92	-0.83	23.93	0.39	-1.41	1.65	0.09	-0.01	36.74	1.71*	-0.91
NW 1076	75.50	1.06	0.22	24.75	2.00	-1.53	1.86	2.35	0.00	37.99	0.97	0.11
HUW 468	76.25	0.94	1.20	25.94	0.01	-1.42	1.84	-0.15*	-0.01	38.25	1.30	-2.21
Raj 4120	78.25	1.12	0.16	28.06	2.02*	-1.60	1.96	1.78	0.00	35.47	0.99	-0.44
Raj 4037	77.58	1.19	1.74	22.54	-0.50*	-1.50	1.77	1.04	-0.01	34.93	1.45	-1.90
C 306	79.08	0.90	1.10	24.20	-0.25*	-1.70	1.60	0.48	-0.01	44.69	1.59	25.98**
DBW 14	71.75	0.80	-0.12	25.79	1.70	-0.29	1.89	1.62	-0.01	32.20	1.18	-0.28
DBW 16	82.17	0.91	1.26	23.90	-0.61	-0.14	1.72	-0.70*	-0.01	32.62	0.70	-1.96
DBW 28	80.17	0.94	1.94	26.75	0.85	-1.60	1.72	0.29	0.00	37.07	1.12	-2.14
DBW 39	80.08	1.13	-0.42	23.24	0.43	-1.47	1.73	0.67	-0.01	31.80	0.79*	-2.69
GW 173	70.58	1.13	12.81**	29.17	3.66*	-0.48	1.73	0.97	-0.01	36.74	0.56	8.17*
HD 2189	74.33	0.88	3.21*	23.62	0.69*	-1.75	2.00	0.28*	-0.01	41.17	1.42*	-2.73
HD 2687	81.42	0.85	10.77**	25.64	-0.28	-0.65	1.97	0.42*	-0.01	33.56	0.97	-2.53
HI 1531	79.17	1.08	0.41	25.43	0.57*	-1.74	1.65	0.52	0.01	37.20	0.68*	-2.78
HS 375	86.50	1.14	1.43	27.31	-2.34*	-1.64	2.03	2.55*	-0.01	36.98	1.33	6.10*
HS 420	81.42	1.13	-0.83	27.10	0.35	-1.57	1.92	0.69	0.00	40.06	0.94	3.93
HW 2004	79.58	1.03	1.30	24.31	-0.63*	-1.36	1.59	-0.24	0.00	45.24	1.11	4.52
K 9107	77.92	1.25	-0.29	28.73	-0.15*	-1.76	1.79	1.17	-0.01	43.03	1.02	-2.37
HUW 234	76.75	0.95	-1.10	25.07	0.06	-1.44	2.01	0.16	0.00	40.10	1.43*	-2.69
NIAW 34	75.33	0.81	4.93**	23.59	2.28*	-1.72	1.70	1.84*	-0.01	35.24	1.20	-1.68
NIAW 917	79.83	0.96	4.58**	23.46	0.40*	-1.70	1.76	-0.98*	-0.01	33.12	0.99	-2.26
MP 4010	73.83	1.00	1.87	26.32	2.25*	-1.49	2.00	2.77*	-0.01	39.14	0.84	1.06
NW 1014	74.58	0.98	0.75	28.20	1.56	-1.63	1.88	1.41	0.00	38.71	1.20	-0.36
PBW 296	83.83	1.14	5.50**	26.58	1.55	-1.07	1.96	1.24	-0.01	34.54	0.56	0.56
PBW 443	77.58	1.12	0.16	25.12	0.93	-1.72	1.85	1.70	-0.01	35.45	0.85	-0.86
HS 240	84.42	1.21	14.34**	28.22	-2.02*	-1.70	1.84	0.28*	-0.01	36.85	0.44	8.85*
UP 2425	74.33	1.03	6.65**	29.05	3.12	-0.62	1.90	2.11	0.00	41.21	1.37*	-2.29
VL 616	86.08	1.03	2.21	28.48	0.96	-1.70	1.82	-0.27*	-0.01	47.47	1.00	5.26
VL 804	82.92	1.20	4.81**	25.90	-0.06*	-1.59	1.94	-0.37*	-0.01	39.33	1.09	1.49
VL 829	88.92	0.79	13.34**	27.34	1.90	-1.46	1.76	1.05	-0.01	34.49	1.01	6.60*
WR 544	66.67	1.13	9.99**	25.83	2.78*	-1.23	1.86	1.37	-0.01	43.33	1.33	9.33*
HD 2851	72.25	1.25	7.81**	26.41	0.05*	-1.76	1.89	0.03*	-0.01	34.61	0.96	-1.02
HUW 510	72.92	1.26	23.19**	26.53	0.63	-0.95	2.09	-0.31	0.00	35.56	0.81	-2.55
PBW 154	76.75	0.86	-0.69	26.22	1.78*	-1.66	2.01	3.60	0.00	38.43	0.86	-2.38
PBW 373	83.83	0.92	7.71**	26.64	3.62	0.33	2.03	2.45*	-0.01	35.27	0.95	11.28**
Pop.mean	78.163			25.801			1.858			36.93		
SE (mean)	1.318			0.393			0.0264			1.171		
SE (bi)	0.257			0.34			0.426			0.234		

*Significant at P= 0.05; **Significant at P = 0.01

Table Contd.

Table 2 Contd.

Genotype	Plant height (cm)			No. Tillers/m ²			Grains/spike			Spikelets/spike		
	X	bi	S ² di	X	bi	S ² di	X	bi	S ² di	X	bi	S ² di
Raj 3077	94.08	1.98	11.79	466.08	0.47	-1074.32	50.42	0.84	2.31	17.69	1.28	0.52
PBW 343	90.15	1.92	7.53	477.50	0.61	-1212.15	46.29	0.82	-13.18	17.05	1.60	-1.66
PBW 502	89.26	3.10	-5.97	437.00	1.48	-634.35	50.15	0.05	7.47	17.40	0.98	-0.03
HD 2733	85.94	-0.15	41.46**	552.50	0.95	13207.78**	43.98	1.11	-11.52	17.08	2.64	-0.61
HD 2824	93.21	1.48	-2.88	469.50	1.29	2834.20	51.89	0.63	-7.35	17.89	0.71	-1.75
GW 322	89.35	0.74	26.05*	429.50	0.60	103.13	56.19	1.05	-5.63	17.22	0.65	-1.15
GW 366	94.81	0.27	2.22	425.42	0.57	-402.22	47.32	1.02	16.69	16.03	0.16	-0.94
DL 153-2	89.37	0.70	-5.78	402.42	0.21	-1398.26	37.99	0.97	-0.61	15.70	1.53	-1.71
DL 788-2	83.79	1.15	13.77	469.08	1.69	4088.33*	42.20	0.94	-6.48	14.71	1.04	1.30
DBW 17	79.79	1.84	-6.99	439.58	0.25	2864.80	54.01	1.36	8.57	18.18	1.59	-1.58
LOK 1	91.90	-0.38	3.08	489.92	1.18	-854.92	42.37	1.50	-9.68	14.62	1.57	-1.62
UP 2382	88.09	1.44	-9.19	396.33	1.01	1069.46	55.03	1.73*	-10.44	18.37	1.33	-0.27
CBW 38	97.18	0.64	1.91	477.58	0.32	1082.67	49.91	0.89	-2.06	16.57	0.63	-0.84
NW 1076	97.26	-0.05	-9.36	439.83	0.79	-105.51	59.49	0.89	1.33	17.81	0.82	-0.59
HUW468	91.12	1.33	8.25	431.00	1.35	296.22	60.85	1.42	-1.21	18.40	0.72	-0.54
Raj 4120	89.32	3.44	2.12	438.92	1.50	195.11	50.55	1.33	-4.75	17.21	1.65	-0.04
Raj 4037	83.31	0.16	-3.78	482.42	1.45	-177.98	43.29	1.43	-6.09	15.83	1.62	-1.86
C 306	110.61	-2.44	13.04	434.33	0.53	1865.01	46.70	1.21	6.76	16.54	0.64*	-2.03
DBW 14	81.09	1.80	23.34*	396.00	1.21	2532.13	48.59	1.03	-9.59	16.99	1.22	-1.88
DBW 16	88.25	0.97	14.07	480.58	0.94	-1835.93	51.21	1.17	-8.96	16.77	1.13	-1.92
DBW 28	94.09	1.53	-5.72	371.50	0.07	-258.91	58.33	0.78	27.41	19.10	0.59	-0.89
DBW 39	88.42	2.34	3.67	415.50	1.20	2263.82	55.23	1.21	-13.36	18.00	0.67	-1.53
GW 173	81.17	0.40	1.48	512.08	0.68	5304.71*	42.40	1.03	-3.89	15.07	1.12	-0.68
HD 2189	96.58	1.20	-8.33	397.67	0.88	2533.17	56.82	1.09	4.37	17.41	1.05	-1.50
HD 2687	86.04	1.43	21.71*	447.08	1.16	-990.24	56.91	1.25	-10.02	18.80	1.52	-1.86
HI 1531	104.01	1.14	1.72	493.33	2.47	6610.47*	48.88	1.26	-11.71	16.37	0.37	-1.28
HS 375	98.37	-0.13	3.01	389.00	0.78	-1361.02	56.07	1.00	22.71	19.69	0.47	3.83
HS 420	95.03	-0.11	11.67	397.25	0.33	-1049.55	62.82	2.04*	-10.87	19.24	0.90	-1.25
HW 2004	111.64	-0.55	7.13	478.33	0.96	2156.49	48.37	1.13	-9.75	16.39	0.97	-1.80
K 9107	106.33	0.56	2.04	486.25	-0.14	-671.74	46.72	1.01	-2.52	17.32	1.98	0.70
HUW234	98.56	0.75	-3.76	470.83	1.13	-1665.84	54.09	0.89	4.98	18.17	0.65	-1.35
NIAW 34	97.00	0.45	-7.82	411.50	0.85	4281.91*	53.59	1.11	-3.68	17.57	0.64	-1.04
NIAW917	91.13	2.03*	-9.58	472.50	1.06	-764.02	54.34	0.73	6.21	17.72	0.27	-1.72
MP 4010	86.56	2.23	-7.77	468.83	1.32	-889.07	41.68	0.47	1.95	16.16	0.57	-0.15
NW 1014	100.92	1.47	-9.52	443.33	0.92	-1139.90	51.47	0.78	0.96	18.29	0.81	-1.21
PBW 296	94.62	0.72	10.16	488.08	0.34	-1560.38	46.67	1.12	31.64*	17.41	0.86	-1.65
PBW 443	88.83	1.61	-8.25	511.08	1.66	-1613.11	47.29	0.67	-12.41	16.60	1.29*	-2.05
HS 240	95.12	0.64	2.89	457.33	2.48	7951.10**	51.26	1.51	11.07	17.92	1.26	-0.25
UP 2425	91.93	-0.02	-3.25	370.92	1.09	225.27	44.87	1.04	-9.04	16.28	1.69	-1.60
VL 616	104.90	-0.09	11.22	431.17	2.76	-1063.07	43.68	0.92	-6.30	16.99	1.50	-0.48
VL 804	97.99	0.52	0.47	464.58	0.91	-1397.58	57.42	0.98	-7.10	19.42	1.13	-1.92
VL 829	99.98	-0.26	0.31	365.92	-0.08	-1111.44	54.51	1.76	35.48*	20.24	1.12	11.22**
WR 544	96.41	2.09	-7.07	400.08	1.55	-1184.59	52.23	0.45	14.86	17.55	0.63	1.25
HD 2851	76.09	2.41	31.54*	552.25	1.12	-1268.58	38.46	-0.15*	-13.25	13.26	-0.59	2.33
HUW 510	84.41	1.44	5.91	457.33	1.10	458.96	43.76	0.26*	-12.92	15.23	0.28*	-2.03
PBW 154	97.99	1.06	-9.03	510.92	1.24	2526.60	48.71	1.18	-1.42	16.74	1.48	-0.42
PBW 373	94.25	2.22	17.38	414.50	0.76	-1689.09	53.68	0.08*	-8.59	22.77	0.25	109.75**
Pop.mean	92.90			449.25			50.18			17.31		
SE (mean)	2.153			29.608			2.09			1.131		
SE (bi)	1.07			0.80			0.32			0.89		

*Significant at P=0.05; **Significant at P=0.01

Table Contd.

Table 2 Contd.

Genotype	Grains/spikelet			Grain weight/spike (g)			1000-grain weight (g)			Grain yield/m ² (g)		
	X	bi	S ² di	X	bi	S ² di	X	bi	S ² di	X	Bi	S ² di
Raj 3077	2.86	0.94	-0.02	1.83	0.52*	-0.02	36.64	0.33	6.02	350.42	1.07	12637.15**
PBW 343	2.74	1.05	0.02	1.88	1.04	0.02	39.34	1.52	13.04**	391.08	1.23	660.62
PBW 502	2.87	0.63	-0.02	1.99	0.83	-0.01	39.50	1.39	-2.57	365.17	0.62	5201.93*
HD 2733	2.62	0.67	0.11**	1.84	1.24	0.01	40.87	1.32	7.40*	394.33	1.54	7918.86**
HD 2824	2.91	0.85	-0.01	1.91	1.08	-0.02	36.69	1.49*	-2.78	420.92	1.29	1890.42
GW 322	3.26	0.39	0.02	2.10	0.96	-0.01	37.10	0.83	-3.15	370.92	1.34	277.62
GW 366	2.96	1.53	-0.02	2.09	1.46	0.10*	43.09	2.09	11.39*	412.08	1.70	6664.51*
DL 153-2	2.44	1.33	0.10**	1.96	0.98	0.00	51.11	0.82	-3.08	334.25	0.50*	-1690.09
DL 788-2	2.91	1.47	0.19**	1.75	0.80	-0.01	41.52	0.83	0.27	373.17	0.80	-28.44
DBW 17	2.98	1.28	-0.01	1.94	1.07	0.01	38.30	0.31	6.33	390.17	0.11	4966.39*
LOK 1	2.91	1.95	0.00	1.99	1.36	-0.01	46.12	0.94	5.29	340.50	1.33	-969.34
UP 2382	3.02	1.90	0.03	2.16	1.19	-0.01	38.49	0.59	-1.79	405.58	0.91	1656.82
CBW 38	3.04	1.35	0.00	1.88	0.84	-0.02	37.22	0.79*	-3.26	366.33	1.04	2076.22
NW 1076	3.30	0.51	0.15**	2.25	0.90	-0.01	37.61	0.81	-2.80	434.58	1.44	1004.88
HUW468	3.30	0.55	0.11**	2.01	0.89	0.01	32.95	0.40	-1.38	394.33	1.21	-1063.71
Raj 4120	2.95	1.40*	-0.03	2.01	1.04	-0.02	39.15	0.80	-2.37	360.08	0.37	5718.33*
Raj 4037	2.73	1.41	0.01	1.70	0.97	-0.02	39.05	0.86	24.04**	348.58	0.65	999.95
C 306	3.01	0.76	-0.02	1.83	0.90	0.01	36.39	0.85	12.12*	271.58	0.83	8797.59**
DBW 14	2.86	1.00	-0.01	2.14	1.02	-0.02	43.12	0.86	0.24	361.08	0.76	4368.36*
DBW 16	3.05	0.93	-0.01	1.78	1.21	-0.02	34.17	1.38*	-3.07	397.08	1.38	22.72
DBW 28	3.05	0.70	-0.01	2.17	1.20	0.07*	36.79	1.52*	-2.66	385.08	1.17	1443.44
DBW 39	3.08	1.02	0.01	2.26	1.18	-0.02	40.49	0.97	-3.19	411.50	0.67	-80.96
GW 173	2.80	0.77	-0.01	1.80	0.80	-0.01	42.85	0.37	-0.24	419.50	1.50	-649.00
HD 2189	3.27	0.82	0.09*	2.34	0.84	0.10**	40.90	0.69	22.64**	387.42	0.76	-686.56
HD 2687	3.08	0.64	-0.02	1.99	1.06	-0.03	34.81	0.87	-2.77	369.92	0.88	3857.40*
HI 1531	3.00	1.12	0.02	1.75	1.01	-0.02	35.49	0.80	1.31	351.33	0.36	7311.10**
HS 375	2.88	-0.19	0.26**	1.74	1.28	0.17**	30.25	1.48	14.92**	335.00	1.39	817.20
HS 420	3.28	1.67	0.03	2.08	1.57*	-0.02	31.92	1.15	-3.00	346.17	1.06	691.81
HW 2004	2.95	1.11	-0.03	2.00	1.01	-0.02	40.82	0.88	-2.92	317.83	0.82	-1635.12
K 9107	2.72	1.17	0.01	1.93	1.30*	-0.03	40.86	1.72	4.18	385.42	0.96	-908.94
HUW234	2.98	1.32	0.03	2.15	1.07	0.07*	38.84	1.34	4.22	410.83	1.17	243.28
NIAW 34	3.04	1.05	-0.01	2.13	1.17	-0.03	38.98	1.06	-1.97	369.17	0.87	972.10
NIAW 917	3.07	0.88	0.00	1.95	0.77	0.03	35.52	0.88	-1.45	387.75	0.55	834.17
MP 4010	2.60	0.99	0.00	1.82	0.54	0.01	43.42	0.69	1.77	364.50	1.01	875.90
NW 1014	2.82	0.64	-0.01	1.97	0.69	0.00	37.90	0.51*	-2.44	350.25	0.73	-529.62
PBW 296	2.68	1.74	0.01	1.87	1.32*	-0.03	39.08	1.38	29.09**	370.92	1.15	-1263.95
PBW 443	2.86	0.55	0.00	1.77	0.70	-0.02	37.11	0.86	1.06	383.33	0.93	322.50
HS 240	2.87	1.51	0.00	1.83	0.86	0.03	35.38	0.35	-0.04	347.58	1.02	-363.61
UP 2425	2.77	1.10	-0.02	2.38	1.15	0.00	51.27	1.22	7.11*	365.00	1.78	2003.55
VL 616	2.59	1.31	0.07*	1.47	1.11	-0.01	32.68	1.69	-1.27	262.75	1.09	-1507.44
VL 804	2.96	0.49	-0.01	1.89	1.19	0.01	32.43	1.45	6.26	355.50	1.32	-1558.59
VL 829	2.70	1.48	0.07*	2.02	1.42	0.01	36.22	1.15	-1.70	267.42	0.99	-1372.95
WR 544	2.97	0.35*	-0.03	2.21	0.35	0.02	42.45	0.23*	-2.12	391.25	0.82	3695.51*
HD 2851	3.11	1.35	0.01	1.61	0.27*	-0.02	41.90	0.95	2.80	411.00	1.29	-914.78
HUW510	2.87	0.40*	-0.02	1.94	0.51	-0.01	43.90	0.78	-0.56	355.08	0.93	1468.95
PBW 154	2.94	0.78	0.07*	2.14	1.25	0.30**	41.67	1.19	64.91**	390.92	0.45	679.34
PBW 373	3.04	0.30	0.02	1.95	1.08	-0.02	33.83	1.61	29.66**	324.17	1.20	301.41
Pop.mean	2.93			1.961			38.855			368.06		
SE (mean)	0.13			0.112			1.644			0.0335		
SE (bi)	0.46			0.228			0.325			0.488		

*Significant at P= 0.05; **Significant at P = 0.01

simplification in explaining stability for grain yield. Hence, it has been observed (Table 2) that variety LOK 1 was the only genotype which showed stable performance for all the twelve characters with non-significant regression coefficient and S^2di values although, its average grain yield (340.5 g) was slightly lower than the population mean (368.06 g/m²). It is important to indicate here that LOK 1 has been a popular variety for cultivation in Gujarat, MP, Rajasthan and parts of UP under normal sown, high fertility and irrigated conditions. Variety NW 1076 was the highest yielding (434.58 g) with respect to grain yield followed by HD 2824 (420.92 g), GW 173 (419.5 g), DBW 39 (411.5 g), HD 2851 (411.0 g), HUW 234 (410.83 g) and UP 2382 (405.58 g). The high grain yield in NW 1076 was resulted from superior mean values of days to heading, flag leaf width, peduncle length, grains/spike, spikelets/spike and grain weight/spike. Similarly, the high grain yield of genotype HD 2824 was accompanied by flag leaf width, number of effective tillers/m², number of grains/spike and spikelets/spike. Likewise, in GW 173 it was resulted from 1000-grain weight and plant height, in DBW 39 from 1000-grain weight, grains/spike, grains/spikelet, grain weight/spike, spikelets/spike and plant height, in HD 2851 from 1000-grain weight and effective tillers/m², in HUW 234 from effective tillers/m², grains/spikelet, grains/spike, spikelets/spike, flag leaf width and days to 50% spike emergence and in UP 2382 from flag leaf length, plant height, days to 50% spike emergence, grains/spikelet, grain weight/spike and spikelets/spike. According to stability criteria's, the varieties HD 2824, UP 2382, NW 1076, DBW 16, DBW 39, GW 173, HUW 234, NIAW 917, HD 2851 and PBW 154 were found to be superior in yield, which was compensated by stability of different contributing traits and revealed wider adaptability over the environments. Madaria *et al.* (2001) and Singh and Chaudhary (2007) also reported similar findings where stability of number of tillers/m², 1000-grain weight and other component traits varied in compensating manner in different genotypes imparting them stability for grain yield.

Variety MP 4010, was found to be highly stable for days to 50% spike emergence, possessed regression coefficient (bi) exactly one with non-significant S^2di value and desirably lower mean values, while 27 varieties showed linear predictability due to non-significant deviation from regression (S^2di). Varieties NW 1076, Raj 4037, K 9107 and PBW 443 possessed desirable mean values and regression coefficient greater than unity with non-significant S^2di and hence, were stable and suitable for favourable environments whereas, eight varieties Raj 3077, LOK 1, UP 2382, HUW 468, DBW 14, HUW 234, NW 1014 and PBW 154 having regression coefficient less than unity were stable and suitable for unfavourable conditions with respect to 50% spike emergence. For flag leaf length, variety HD 2733 revealed average stability with regression coefficient near to unity and mean performance (24.84 cm) closer to population mean (25.8 cm) and all the varieties showed linear predictability with non-significant S^2di values.

Varieties UP 2382, NW 1014, PBW 296, UP 2425, VL 829 and PBW 373 having high mean performance with non-significant regression coefficient greater than one, showed their stability for favourable environment whereas, genotypes GW 322, HUW 468, DBW 28, HS 420, VL 616 and HUW 510 were found to be suitable for unfavourable environment with higher mean values and regression coefficient less than one. For flag leaf width, 15 varieties possessed deviation from regression (S^2di) exactly zero indicating their high predictability and 10 varieties signifies their stability for favourable environment whereas, four varieties DL 153-1, HS 420, HUW 234 and HUW 510 showed their suitability under unfavourable environment.

For peduncle length, variety VL 616 was highly stable exhibited regression coefficient exactly one with non-significant deviation from regression and higher mean performance. Based on three parameters, genotypes DL 153-2, DL 788-2, LOK 1, HUW 468, DBW 28, HW 2004, K 9107, NW 1014 and VL 804 were found to suit under favourable environment and varieties NW 1076, HS 420, MP 4010 and PBW 154 under unfavourable environment in terms of peduncle length. Since, peduncle length has got significant contribution for storage and translocation of carbohydrates from source to sink (Singh and Chaudhary 2007) these genotypes can ideally be used under disadvantageous conditions. For plant height, all the varieties except HD 2733, GW 322, DBW 14, HD 2687 and HD 2851 showed linear predictability with non-significant S^2di values and all the varieties except NIAW 917 exhibited non-significant regression coefficient. Variety DBW 16 showed average stability with desirable mean, regression coefficient near to one and non-significant S^2di values while, 12 varieties, namely PBW 343, PBW 502, DL 788-2, DBW 17, UP 2382, HUW 468, Raj 4120, Raj 4037, DBW 39, MP 4010, PBW 443 and HUW 510 with regression coefficient higher than unity were suitable for favourable environment and 4 varieties DL 153-2, LOK 1, GW 173 and UP 2425 showed their suitability for unfavourable environment.

With respect to number of effective tillers/m², all the varieties exhibited non-significant regression coefficient and varieties HW 2004, NIAW 917 and UP 2382 showed high stability due to regression coefficient near to unity with non-significant S^2di values. Based on stability criteria's of superior mean performance, non-significant linear regression and deviation from regression, 11 varieties HD 2824, LOK 1, Raj 4037, HUW 234, MP 1040, PBW 443, HD 2851, HUW 510 and PBW 154 were found suitable for favourable environment and varieties PBW 343, CBW 38, DBW 16, K 9107, PBW 296 and VL 804 for unfavourable environment. For number of grains per spike, varieties HS 375 and VL 804 having regression coefficient one with non-significant deviation from regression and higher mean values showed their high stability. Higher mean performance along with non-significant regression coefficient greater than unity, indicated that the varieties GW 322, DBW 17, HUW 468, Raj 4120, DBW 16, DBW 39, HD 2189, HD 2687, NIAW 34 and HS 420 were stable and suitable for

favourable environment. Similarly, another eight genotypes Raj 3077, HD 2824, NW 1076, DBW 28, HUW 234, NIAW 917, NW 1014 and WR 544 were suitable for unfavourable environment. For number of spikelets per spike, variety PBW 502 showed average stability having unit linear regression coefficient and non-significant S^2_{di} values with higher mean performance. The varieties Raj 3077, DBW 17 UP 2382, HD 2189, HD 2687, K 9107, HS 420 and VL 804 were found stable to suit under favourable environment whereas, 13 varieties showed above average stability due to regression coefficient values less than one.

For number of grains per spikelet, six varieties LOK 1, CBW 38, NIAW 917, MP 4010, PBW 443 and HS 420 possessed deviation from regression (S^2_{di}) exactly zero indicating their high predictability. Variety CBW 14 was highly stable possessed regression coefficient exactly one along with non-significant deviation from regression and mean values closer to population mean. Varieties DBW 39 and MP 4010 were also exhibited average stability due to values of regression coefficient near to one. Ten varieties GW 366, DBW 17, UP 2382, CBW 38, HI 1531, HS 420, HW 2004, HUW 234, NIAW 34 and HD 2851 possessed higher mean values with non-significant regression coefficient greater than unity and non-significant deviation from regression were found to be suitable under favourable environment and eight genotypes GW 322, C 306, DBW 16, DBW 28, HD 2687, NIAW 917, VL 804 and PBW 373 were suitable for unfavourable environment. For grain weight per spike (g), three varieties NW 1014, DL 153-2 and UP 2425 showed high predictability due to exactly zero values of S^2_{di} . High stability was exhibited by DL 153-2, DBW 14 and HW 2004 with superior mean performance, non-significant deviation and regression coefficient near to unity. As per the stability criteria, the varieties PBW 502, LOK 1, UP 2382, Raj 4120, DBW 39, HD 2687, NIAW 34, UP 2425, VL 829 and WR 544 showed suitability under favourable environment and varieties GW 322, NW 1076, HUW 468 and NW 1014 were suitable for unfavourable environment with respect to grain weight per spike. In terms of 1000-grain weight (g), 36 varieties have shown linear predictability with non-significant S^2_{di} values and 41 varieties exhibited non-significant linear regression coefficient. Two varieties DBW 39 and HD 2851 revealed average stability for 1000-grain weight with regression coefficient near to one, non-significant S^2_{di} values and high mean performance. Varieties PBW 502, K 9107 and NIAW 34 for favourable environment and DL 153-2, DL 788-2, LOK 1, Raj 4120, DBW 14, GW 173, HW 2004, MP 4010 and HUW 510 were found stable and suitable for unfavourable environment in terms of 1000-grain weight, based on stability parameters.

The comparison of environmental indices (Table 3) indicated that the performance of genotypes over four environments with respect to the grain yield varied apparently and indicated that environment E_2 (season 2008-09) showed highest favourable impact on grain yield (432.17g) followed by E_1 (season 2007-08) with 398.88 g.

Table 3 Effect of environment in the expression of grain yield and yield-contributing traits

Character	Environmental indices			
	E_1	E_2	E_3	E_4
Days to 50% spike emergence	2.936	-5.418	-3.106	5.589
Flag leaf length (cm)	-1.718	0.408	0.535	0.775
Flag leaf width (cm)	-0.090	0.051	0.024	0.015
Peduncle length (cm)	-1.106	-2.082	-4.075	7.263
Plant height (cm)	-2.668	0.932	2.017	-0.280
Effective tillers/m ²	0.816	34.965	15.624	-51.404
Grains/spike	8.093	1.818	-6.655	-3.256
Spikelets/spike	1.530	-0.033	0.070	-1.568
Grains/spikelet	0.166	0.180	-0.418	0.072
Grain weight/spike (g)	0.603	0.125	-0.570	-0.158
1000-grain weight (g)	5.483	1.437	-6.649	-0.271
Grain yield /m ² (g)	30.819	64.110	-95.323	0.394

Similarly, 1000-grain weight under E_2 and E_1 was found to be on higher side with number of effective tillers, number of grains per spike, number of grains per spikelet and grain weight per spike. Moreover, the early maturity of genotypes under E_2 might also be contributed towards higher grain yield by minimizing the adverse impact of terminal heat as indicated by reduced days to heading. Plant height was found to be reduced under E_1 whereas days to 50% spike emergence was reduced under the environment E_2 . Therefore, it appears that under favourable environments, the grain yield invariably associated with semi-dwarf plant height, early heading, high tiller number, more grains per spike and per spikelet, higher grain weight per spike and 1000-grain weight. The extent of flag leaf traits, viz. length and width also supports the performance in respect of the grain yield. Environment E_3 followed by E_4 were found to be unfavourable in terms of grain yield, where most of the major yield contributing traits, viz. 1000-grain weight, grains/spike, effective tillers/m², grain weight/spike and grains/spikelet were in lower side as indicated by negative values of environmental indices. Mean performance for grain yield and other contributing traits under unfavourable environment E_3 was although low, but their range indicates that some of the genotypes could perform as good as under favourable environment (E_2). Singh and Chaudhary (2007) and Gowda *et al.* (2010) reported similar finding in wheat.

The genotype by environment interaction for grain yield in wheat has been reported in numerous studies under several designations such as different response patterns, adaptation, or stability of a genotype. The adaptability of a genotype to a range of environments can be best explained by its phenotypic stability (Elfadl *et al.* 2012). This concept of stability implies that a stable variety may not necessarily respond to improved growing conditions with increased yield (Becker 1981). Identification of yield-contributing traits, and acknowledgement of genotype by environment interaction (GEI) and yield stability are important for breeding new cultivars adapted to specific environmental

Table 4 List of genotypes along with stability performance over different environments for grain yield and yield-contributing traits

Character	Grain yield/m ² (g)	Days to 50% spike emergence	Flag leaf length (cm)	Flag leaf width (cm)	Peduncle length (cm)	Plant height (cm)	Effective tillers/m ²	Grains/spike	Spikelets/ spike	Grains/ spikelet	Grain weight/ spike (g)	1000-grain weight (g)
Genotypes suitable for all environ- ments	PBW 343, UP 2382, K 9107	MP 4010	HD 2733		VL 616, NIAW 917, Raj 4120, PBW 343, VL 829	DBW 16	HW 2004, NIAW 917, UP 2382	HS 375, VL 804	PBW 502	CBW 14, DBW 39, MP 4010	DL 153-2, DBW 14, HW 2004	DBW 39, HD 2851
Genotypes suitable for favourable environment	HD 2824, GW 322, NW 1076, HUIW 468, DBW 16, DBW 28, GW 173, HUIW 234, PBW 296, HD 2851	NW 1076, Raj 4037, K 9107, PBW 443	UP 2382, NW 1014, PBW 296, UP 2425, VL 829, PBW 373	HD 2824, GW 366, NW 1076, Raj 4120, DBW 14, NW 1014, PBW 296, UP 2425, WR 544, PBW 154	DL 153-2, DL 788-2, LOK 1, HUIW 468, DBW 28, HW 2004, K 9107, NW 1014, VL 804	PBW 343, PBW 502, DL 788-2, DBW 17, UP 2382, HUIW 468, DBW 16, HUIW 468, Raj 4120, DBW 39, K 9107, Raj 4120, DBW 39, MP 4010, PBW 443, HD 2851, HUIW 510, PBW 154	HD 2824, LOK 1, Raj 4037, HUIW 234, MP 1040, PBW 443, HD 2851, HUIW 510, PBW 154	GW 322, DBW 17, HUIW 468, Raj 4120, DBW 16, DBW 39, HD 2189, HD 2687, NIAW 34, HS 420	Raj 3077, DBW 17, UP 2382, HD 2189, HD 2687, K 9107, HS 420, HS 420, VL 804	GW 366, DBW 17, UP 2382, CBW 38, DBW 39, HI 1531, HD 2687, HS 420, NIAW 34, HW 2004, HUIW 234, NIAW 34, HD 2851	PBW 502, LOK 1, UP 2382, Raj 4120, DBW 39, HD 2687, NIAW 34, UP 2425, VL 829, WR 544	PBW 502, K 9109, NIAW 34
Genotypes suitable for unfavourable environment	DL 788-2, DBW 39, HD 2189, NIAW 34, NIAW 917, PBW 443, PBW 154	Raj 3077, LOK 1, UP 2382, HUIW 468, DBW 14, HUIW 234, NW 1014, PBW 154	GW 322, HUIW 468, DBW 28, HS 420, VL 616, HUIW 510	DL 153-1, HS 420, HUIW 234, HUIW 510	NW 1076, HS 420, MP 4010, PBW 154	DL 153-2, LOK 1, GW 173, UP 2425	PBW 343, CBW 38, DBW 16, K 9107, PBW 296, VL 804	Raj 3077, HD 2824, NW 1076, DBW 28, HUIW 234, HUIW 917, NW 1014, WR 544	HD 2824, NW 1076, HUIW 468, DBW 28, DBW 39, HS 420, HS 375, HUIW 234, NIAW 34, NIAW 917, NW 1014, HS 375, HUIW 234, WR 544	GW 322, C 306, DBW 16, DBW 28, HD 2687, NIAW 917, VL 804, PBW 373	GW 322, NW 1076, HUIW 468, NW 1014	DL 153-2, DL 788-2, LOK 1, Raj 4120, DBW 14, GW 173, HW 2004, MP 4010, HUIW 510

conditions (Rao *et al.* 2002). Selection of genotypes for adaptability could be severely limited in terms of GEI. Therefore, it is necessary to assess the environmental sensitivity of genotypes in terms of higher yield and stability (Thillainathan and Fernandez 2001).

On the basis of mean performance, regression coefficient and deviation from regression values, some of the genotypes have been identified with stability of performance under favourable and unfavourable environments in terms of grain yield and its component traits (Table 4). These stable genotypes may be used to develop a new strain with combination of stable characters and/or the varieties exhibited stable yield performance could be exploited for general cultivation. The stability of different contributing traits varied in compensating manner in different genotypes in imparting them to grain yield stability. In nut shell, varieties HD 2824, UP 2382, NW 1076, DBW 16, DBW 39, GW 173, HUW 234, NIAW 917, LOK 1, HD 2851 and PBW 154 have shown higher mean values, desirable regression coefficient and deviation from the regression coefficient for yield and contributing traits, and were good in yield also may be exploited for yield enhancement of wheat under varying environments.

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