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ASSESSMENT OF YIELD STABILITY OF BREAD WHEAT (*Triticum aestivum* L.) GENOTYPES UNDER DIFFERENT DATES OF SOWING IN MADHYA PRADESH

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Abstract: *Fifty-four genotypes of wheat [Triticum aestivum (L.)] were subjected to stability analysis for seed yield and its components under three environments. From pooled analysis of variance, it was observed that the individual environment effect was highly significant for all traits suggesting that these characters vary with the environments. The partitioning of G X E interaction showed that genotype x environment (linear) effects were significant only for 1000-grain weight revealing considerable differences among environments and their predominant effect on the character. Significant variance due to environments (linear) against pooled deviation for all the characters studied indicated considerable differences among the environments and their predominant effects on the characters. For grain yield per plant GW-273 X MP-3269, GW-366 X MP-3269, HD-2864 X JW-3211, GW-322 X JW-3211 and JW-1201 X JW-3288 showed above average stability as regression coefficient was less than unity (bi<1) and minimum deviation from regression (S^2di~0). The genotypes GW-273 X JW-3211, GW-322 X JW-3288, JW-1201 X JW-3336, JW-1201 X MP-3269, JW-1202 X JW-3336, HI-1544 X MP-3269 and HI-1544 X JW-3211 were most stable across the environments for grain yield per plant as regression coefficient (bi) being near to unity with minimum deviation from regression (S^2di~0).*
Keywords: *G X E interaction, regression coefficient, wheat, stability.*

Introduction: Wheat (*Triticum aestivum* L.) is a self-pollinated crop of the *Poaceae* family and of the genus *Triticum*, is the world's largest cereal crop. It has been described as the 'King of cereals' because of the acreage occupied, high productivity and the prominent position it holds in the international food grain trade. It is grown in temperate, irrigated to dry and high-rain-fall areas and in warm, humid to dry, cold environments. A specific genotype does not always exhibit the same phenotypic expression under all environments and different genotypes respond differently to a specific environment. Genotype x environment interaction can be exploited to breed varieties for different agro-climatic regions or to identify varieties possessing considerable high yield potential coupled with stable performance over different environments. Thus, the screening of genotypes for stability of performance under varying environmental conditions has become an essential part of any breeding programme. In the present investigation, an attempt has been made to evaluate wheat genotypes for yield and its component characters under different environments to identify genotypes with stable performance in variable environments.

Materials and Methods

The research work was carried out in the experimental area of the Department of Plant Breeding and Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P). The present investigation was undertaken to study the experimental material consisting of 54 genotypes of wheat (including 40 F_1s, 10 lines and 4 testers) in randomized block design with three replication during *Rabi* 2014-15 with three different dates of sowing i.e. 13/11/2014 [E1] (normal sown condition), 11/12/2014 [E2] (late sown condition) and 05/01/2015 [E3] (very late sown condition) by dibbing of seeds in row. The crop was raised using recommended package of practices. Observations were recorded on five randomly taken plants from each genotype in all the three replications for number of productive tillers per plant, number of spikelets per ear, ear length, ear weight, number of ears per plant, number of grains per ear, 1000-grain weight and grain yield per plant. The data were statistically analyzed and the genotypes were assessed for their stability of performance over environments following the method described [1].

Results and Discussion

The analysis of variance for stability revealed that genotypic differences were highly significant for number of spikelets per ear, ear length, ear weight, number of grains per ear and 1000-grain weight. From pooled analysis of variance, it was observed that the individual environment effect was highly significant for all traits suggesting that these characters vary with the environments (Table 1). The partitioning of G X E interaction showed that genotype x environment (linear) effects were significant only for 1000-grain weight revealing considerable differences among environments and their predominant effect on the character. Significant variance due to environments (linear) against pooled deviation for all the characters studied indicated considerable differences among the environments and their predominant effects on the characters. This could be due to the variations in weather and soil conditions over different locations. Pooled deviation effects were significant for all the traits when tested against effective pooled error indicated importance of linear and non-linear components for all the traits The magnitude of linear components were more than non-linear components for all the characters indicated its major role in the expression of these traits and the performance of the genotypes for these traits may be predicted across the environments with great precision [2-5].

Table 1. Pooled analysis of variance for different characters of wheat

Source of variation	D.F	No. of productive tillers/pt.	Number of spikelets per ear	Ear length	Ear weight	Number of ears per plant	Number of grains per ear	1000-grain weight	Grain yield per plant
Rep within Env.	6	1.276	0.603	0.247	0.038	1.346	4.835	0.968	1.926
Varieties	53	2.755	5.676**	1 276**	0.322**	3.383	45.381**	24.080**	28.135
Env.+ (Var.* Env.)	108	4.163	1.682	0.415	0.203	4.510	13.964	18.301**	47.346*
Environments	2	70.537**	33.065**	7.310**	4.900**	63.888**	277.687**	604.959**	1697.69**
Var.* Env.	106	2.911	1.090	0.285	0.115	3.390	8.988	7.232	16.208
Environments (Lin.)	1	141.074**	66.131**	14.619**	9.799**	127.776**	555.375**	1209.91**	3395.38**
Var.* Env.(Lin.)	53	2.323	1.098	0.264	0.111	2.921	9.366	10.220**	9.436
Pooled Deviation	54	3.434**	1.062**	0.300**	0.117**	3.787**	8.451**	4.165**	22.554**
Pooled Error	318	0.492	0.407	0.128	0.033	0.592	3.509	0.555	1.650

**, ** indicate level of significance at 5% and 1%, respectively*

According to Eberhart and Russell (1966), an ideal genotype may be characterized as having high mean performance with regression coefficient (bi=1) and minimum (non-significant) deviation from regression (S^2di=0). Accordingly, the mean (x) and deviation from regression (S^2di) are considered as measures of stability and linear regression (bi) is used for evaluating the genotypes response. The stability parameters were worked out for all the traits. The mean values, regression coefficient (bi) and deviation from regression (S^2di) for fifty-four genotypes over environments are presented in table 2.

Table 2. Estimated stability parameters for different characters in Wheat

Sr. No.	Parents + Hybrids	No. of productive tillers per plant			Number of spikelets per ear		
		Mean	Mean	Mean	Mean	βi	S^2Di
1	GW-273	10.77	2.296	0.3065	18.66	1.769	-0.3651
2	GW-322	11.82	0.852	-0.0516	18.00	0.735	-0.3245
3	GW-366	11.00	2.395	-0.4437	17.24	2.313	-0.4063
4	JW-1201	10.64	2.093	-0.1213	18.44	3.196	-0.3913
5	JW-1202	8.97	-0.094	12.1310**	19.28	1.972	-0.2874
6	JW-1203	9.23	2.312	3.0079*	18.93	0.749	0.6445
7	LOK-1	8.42	1.330	-0.5053	15.64	1.264	1.3777
8	HD-2864	9.48	-0.097	-0.2080	15.55	1.390	0.8277
9	HD-2932	11.24	0.176	-0.0865	17.51	0.697	0.1446
10	HI-1544	11.07	1.919	-0.3024	16.13	2.348	0.9429
11	JW-3336	10.84	1.383	-0.5055	16.35	2.991	0.3802

12	JW-3288	10.35	1.360	-0.3784	16.80	0.440	-0.3268
13	MP-3269	9.71	1.173	4.7543*	18.62	1.218	0.6999
14	JW-3211	9.24	0.244	-0.3396	21.11	0.856	2.7578*
15	GW-273 X JW-3336	8.40	0.250	0.1393	17.02	0.337	0.0314
16	GW-273 X JW-3288	11.42	2.094	2.0017	20.26	1.076	-0.2557
17	GW-273 X MP-3269	9.91	-0.343	-0.2339	20.57	0.686	-0.3711
18	GW-273 X JW-3211	11.88	-0.122	13.7245**	20.66	-0.306	0.4710
19	GW-322 X JW-3336	11.12	1.795	0.3270	18.40	0.008	0.1586
20	GW-322 X JW-3288	12.15	2.118	18.7222**	20.40	-0.138	0.3130
21	GW-322 X MP-3269	9.84	1.834	0.5210	18.35	0.347	-0.3329
22	GW-322 X JW-3211	10.35	0.377	-0.5024	21.06	-1.327	-0.3977
23	GW-366 X JW-3336	9.82	-0.180	-0.0552	16.80	1.210	6.4735**
24	GW-366 X JW-3288	10.51	2.354	9.2081**	18.75	2.124	0.2619
25	GW-366 X MP-3269	10.15	-0.885	4.4383*	17.51	0.408	1.3177
26	GW-366 X JW-3211	11.32	2.982	10.3619**	19.06	-1.321	0.0493
27	JW-1201 X JW-3336	13.64	0.984	1.4119	18.93	1.921	-0.3443
28	JW-1201 X JW-3288	11.20	0.345	13.2893**	19.11	0.971	0.8999
29	JW-1201X MP-3269	10.65	0.517	-0.4139	19.55	0.341	-0.3276
30	JW-1201 X JW-3211	10.57	-0.076	2.4681	20.93	0.159	0.6610
31	JW-1202 X JW-3336	9.75	1.663	17.5370**	18.97	0.716	5.5521**
32	JW-1202 X JW-3288	12.04	0.724	6.6768**	20.40	0.176	6.0586**
33	JW-1202X MP-3269	11.35	1.345	3.6248*	19.24	1.417	0.3428
34	JW-1202 X JW-3211	10.71	-1.176	-0.0567	19.06	0.427	1.6064
35	JW-1203 X JW-3336	10.93	0.658	-0.3316	18.93	0.737	-0.3994
36	JW-1203 X JW-3288	10.66	0.970	0.3408	20.20	1.863	2.2298
37	JW-1203X MP-3269	9.86	0.474	-0.1339	19.02	0.640	-0.4029
38	JW-1203 X JW-3211	10.95	1.129	2.7881	20.17	1.275	-0.2547
39	LOK-1 X JW-3336	9.77	-0.615	2.9525*	16.81	2.051	-0.3527
40	LOK-1 X JW-3288	10.62	1.367	-0.4947	17.20	2.062	-0.2462
41	LOK-1 X MP-3269	9.40	1.227	3.8897*	18.57	1.561	0.9182
42	LOK-1 X JW-3211	10.15	0.309	0.7495	18.60	0.199	3.7102*
43	HD-2864 X JW-3336	11.17	2.124	7.6419**	18.00	0.910	-0.2769
44	HD-2864 X JW-3288	10.22	1.275	-0.0039	18.37	1.191	1.2513
45	HD-2864 XMP-3269	11.08	1.388	4.3690*	19.02	1.074	0.1809
46	HD-2864 X JW-3211	11.24	-0.154	3.3814*	19.51	0.088	0.4810
47	HD-2932 X JW-3336	11.16	2.587	-0.5011	17.98	1.339	-0.4024
48	HD-2932 X JW-3288	10.15	1.240	0.3656	18.13	1.467	0.1891
49	HD-2932 XMP-3269	10.28	0.738	4.4024*	17.31	-0.278	0.0845
50	HD-2932 X JW-3211	10.04	1.679	0.7852	19.33	-0.306	0.4710
51	HI-1544 X JW-3336	9.27	0.699	1.2635	17.07	2.200	-0.3885
52	HI-1544 X JW-3288	9.44	0.637	0.0711	17.66	2.141	-0.3976
53	HI-1544 X MP-3269	10.31	1.366	0.2232	17.60	1.762	0.1953
54	HI-1544 X JW-3211	10.41	0.959	5.8983**	19.31	0.774	0.7429
	Population Mean	**10.49**			**18.56**		
	S.E (±)	**1.31**	**1.14**		**0.72**	**0.93**	

**, ** indicate level of significance at 5% and 1%, respectively.*

Table 2 Contd…

Sr. No.	**Parents + Hybrids**	**Ear length**			**Ear weight**		
		Mean	**Bi**	**S²Di**	**Mean**	**βi**	**S²Di**
1	GW-273	10.52	1.062	-0.0235	2.83	1.908	0.0335
2	GW-322	10.40	1.230	0.1282	2.93	0.911	0.0034
3	GW-366	9.56	2.000	-0.0551	3.24	1.419	0.0140
4	JW-1201	10.00	1.405	-0.0624	2.68	1.636	0.5601**
5	JW-1202	10.10	1.988	0.2800	2.88	1.192	-0.0207
6	JW-1203	9.97	0.837	-0.1007	3.10	1.038	0.0059
7	LOK-1	9.54	1.619	1.9729**	2.62	0.934	0.0785
8	HD-2864	9.54	1.803	0.0597	2.20	0.788	-0.0297
9	HD-2932	9.60	1.311	-0.1197	2.37	0.330	-0.0317
10	HI-1544	9.59	1.138	1.1176*	2.40	0.037	0.6160**
11	JW-3336	9.26	3.676	-0.1235	2.46	2.267	0.2171*
12	JW-3288	9.69	1.207	-0.0139	2.17	1.199	0.1007
13	MP-3269	11.30	0.957	-0.0958	3.31	0.304	-0.0286
14	JW-3211	10.95	3.258	-0.0646	3.20	1.426	0.0342
15	GW-273 X JW-3336	9.64	-0.360*	-0.1301	2.44	0.631	0.0403

16	GW-273 X JW-3288	11.29	1.235	0.3289	3.13	0.337	0.2222*
17	GW-273 X MP-3269	11.75	-0.344	0.2388	3.31	-0.280	-0.0262
18	GW-273 X JW-3211	11.60	0.485	-0.0213	3.31	1.472	-0.0318
19	GW-322 X JW-3336	11.21	0.329	0.3988	3.06	0.638	0.0091
20	GW-322 X JW-3288	11.70	1.173	-0.0941	3.26	1.292	0.0112
21	GW-322 X MP-3269	10.71	-0.115	0.0226	3.04	1.135	0.2523*
22	GW-322 X JW-3211	11.21	-0.100	-0.0347	3.11	0.197	0.1589
23	GW-366 X JW-3336	10.08	1.349	0.9552*	2.88	1.926	0.0261
24	GW-366 X JW-3288	10.22	1.222	0.3812	2.82	-0.818	0.1155
25	GW-366 X MP-3269	10.64	1.742	0.3859	2.93	0.450	0.1705
26	GW-366 X JW-3211	10.96	-0.116	-0.1271	3.37	1.879	-0.0306
27	JW-1201 X JW-3336	11.20	1.343	-0.0185	3.20	1.913	0.3432**
28	JW-1201 X JW-3288	11.00	0.093	0.6748	3.35	0.704	0.1826
29	JW-1201 X MP-3269	12.04	0.953	-0.1113	3.24	1.118	-0.0255
30	JW-1201 X JW-3211	11.28	-0.094	0.0738	3.46	1.211	0.2077*
31	JW-1202 X JW-3336	10.64	2.286	0.6880	2.88	2.306	0.0361
32	JW-1202 X JW-3288	10.86	1.825	-0.0160	3.26	1.238	0.1247
33	JW-1202 X MP-3269	11.00	0.311	0.0059	3.22	2.387	-0.0323
34	JW-1202 X JW-3211	10.58	-0.028	-0.1122	3.22	1.572	-0.0160
35	JW-1203 X JW-3336	11.01	1.488	-0.0087	3.11	1.419	0.0140
36	JW-1203 X JW-3288	10.82	0.795	-0.1108	3.11	2.233	-0.0280
37	JW-1203 X MP-3269	11.24	2.603	-0.1259	3.28	1.432	0.5046**
38	JW-1203 X JW-3211	10.68	1.312	-0.1300	3.22	1.829	-0.0236
39	LOK-1 X JW-3336	10.38	0.471	-0.0295	3.20	-0.027	-0.0239
40	LOK-1 X JW-3288	10.34	2.009	0.0471	2.88	2.537	-0.0153
41	LOK-1 X MP-3269	11.31	2.222	0.6667	3.63	-0.375	0.1085
42	LOK-1 X JW-3211	10.92	-0.190	0.4334	3.22	-0.374	0.2117*
43	HD-2864 X JW-3336	10.94	0.992	-0.0703	2.77	1.145	-0.0010
44	HD-2864 X JW-3288	10.68	0.412	1.1002*	2.68	0.945	0.1105
45	HD-2864 X MP-3269	11.56	-1.258	-0.1275	3.37	0.481	-0.0183
46	HD-2864 X JW-3211	11.35	0.033	0.0826	3.24	0.738	-0.0218
47	HD-2932 X JW-3336	10.46	1.727	-0.1026	3.15	0.988	-0.0113
48	HD-2932 X JW-3288	10.18	1.468	0.2249	2.75	0.457	-0.0321
49	HD-2932 X MP-3269	10.91	0.292	0.1460	3.40	1.015	-0.0093
50	HD-2932 X JW-3211	10.89	1.118	0.0782	2.77	0.561	-0.0068
51	HI-1544 X JW-3336	10.23	0.961	-0.0772	2.71	0.481	-0.0183
52	HI-1544 X JW-3288	10.59	1.856	-0.0608	2.96	1.758	0.1334
53	HI-1544 X MP-3269	10.94	0.251	0.3203	3.18	-0.132	0.0894
54	HI-1544 X JW-3211	10.65	-1.242	0.5219	2.95	0.093	0.2976*
	Population Mean	**10.66**			**3.00**		
	S.E (±)	**0.38**	**1.05**		**0.24**	**0.80**	

**, ** indicate level of significance at 5% and 1%, respectively.*

Table 2 Contd…

Sr. No.	**Parents + Hybrids**	**Number of ears per plant**			**Number of grains per ear**		
		Mean	**Bi**	**S²Di**	**Mean**	**βi**	**S²Di**
1	GW-273	13.33	3.115	2.2228	53.48	1.795	2.9056
2	GW-322	13.82	1.170	0.1216	51.66	0.734	-1.5330
3	GW-366	12.55	2.027	-0.1485	49.31	2.373	0.4597
4	JW-1201	12.68	2.171	-0.0952	52.80	3.377	6.5573
5	JW-1202	10.65	0.192	12.3788**	54.86	2.085	-3.3477
6	JW-1203	10.57	1.495	0.3471	54.26	0.931	-0.7053
7	LOK-1	10.62	1.661	0.1086	44.93	0.892	18.3255
8	HD-2864	11.55	-0.061	-0.6024	44.51	1.674	2.4126
9	HD-2932	12.64	-0.355	3.0457	50.73	0.767	0.2613
10	HI-1544	13.51	3.393	1.1694	46.40	2.029	7.9494
11	JW-3336	12.66	1.595	-0.5864	47.22	2.661	9.1821
12	JW-3288	12.26	1.468	-0.3425	48.51	0.503	-3.0539
13	MP-3269	11.31	0.907	7.1745**	53.95	0.743	3.3833
14	JW-3211	11.15	-0.122	-0.6023	61.00	1.151	30.3948*
15	GW-273 X JW-3336	10.22	0.161	0.6342	49.44	0.046	-1.8634
16	GW-273 X JW-3288	13.66	2.253	4.7839*	58.48	0.905	-0.3123
17	GW-273 X MP-3269	11.21	-0.802	-0.0021	59.24	0.488	-3.1696
18	GW-273 X JW-3211	13.82	-0.301	13.6723**	59.57	-0.526	-1.9562
19	GW-322 X JW-3336	13.32	1.727	-0.0456	53.33	-0.124	10.3081

20	GW-322 X JW-3288	14.35	1.989	24.7879**	58.75	-0.093	9.0834
21	GW-322 X MP-3269	11.88	1.370	1.2308	52.82	0.519	-2.1785
22	GW-322 X JW-3211	12.21	0.354	-0.5110	60.37	-1.308	4.0745
23	GW-366 X JW-3336	11.75	-0.301	0.1613	48.15	1.715	38.9797**
24	GW-366 X JW-3288	12.05	1.231	14.4814**	53.97	2.180	-1.3330
25	GW-366 X MP-3269	12.52	-0.706	5.2750*	50.82	0.957	12.3418
26	GW-366 X JW-3211	13.08	3.819	7.0729**	54.91	-1.199	9.0572
27	JW-1201 X JW-3336	15.75	0.816	2.1936	54.46	1.890	-3.2951
28	JW-1201 X JW-3288	13.08	0.037	13.1009**	54.20	1.126	1.0455
29	JW-1201 X MP-3269	12.26	0.491	-0.5813	56.35	0.298	-3.4637
30	JW-1201 X JW-3211	12.52	-0.343	0.2410	59.66	0.165	10.5151
31	JW-1202 X JW-3336	12.60	0.953	17.5496**	54.51	1.045	42.3534**
32	JW-1202 X JW-3288	14.72	1.272	4.7809*	58.11	0.488	40.7455**
33	JW-1202 X MP-3269	13.42	1.452	2.4447	55.31	1.125	1.6821
34	JW-1202 X JW-3211	12.64	-1.227	-0.5661	54.73	-0.041	6.1650
35	JW-1203 X JW-3336	12.88	0.489	-0.5272	54.48	0.829	-3.5329
36	JW-1203 X JW-3288	12.60	0.698	0.5445	58.20	1.953	8.9831
37	JW-1203 X MP-3269	11.74	0.113	0.0364	54.17	0.465	-3.4937
38	JW-1203 X JW-3211	12.82	1.144	1.9162	57.37	1.149	-1.0483
39	LOK-1 X JW-3336	11.84	-0.814	3.3930	48.06	2.029	0.2194
40	LOK-1 X JW-3288	12.28	1.316	-0.5609	49.51	1.791	-1.6456
41	LOK-1 X MP-3269	10.82	0.536	5.1716*	52.37	1.770	4.0900
42	LOK-1 X JW-3211	11.88	0.132	1.2409	53.71	-0.342	27.8355*
43	HD-2864 X JW-3336	12.88	1.795	6.3605**	51.33	1.009	-0.4843
44	HD-2864 X JW-3288	12.48	1.322	-0.2390	52.08	1.202	4.1766
45	HD-2864 X MP-3269	13.28	1.573	1.8949	53.84	1.235	-0.1714
46	HD-2864 X JW-3211	12.97	-0.199	4.7613*	55.24	0.232	-0.8997
47	HD-2932 X JW-3336	13.26	2.510	-0.3255	51.02	1.603	-3.1682
48	HD-2932 X JW-3288	11.76	1.555	0.5566	51.91	1.270	-0.5952
49	HD-2932 X MP-3269	11.66	1.734	6.9522**	50.86	0.974	4.3140
50	HD-2932 X JW-3211	12.34	2.830	2.0062	54.86	-0.857	-2.5111
51	HI-1544 X JW-3336	11.58	0.254	0.3358	48.95	2.236	-3.3757
52	HI-1544 X JW-3288	11.83	0.638	1.4080	51.26	1.952	-3.3060
53	HI-1544 X MP-3269	11.76	2.069*	-0.6054	50.86	1.381	1.4464
54	HI-1544 X JW-3211	12.48	1.406	2.5915	55.31	0.749	1.7571
	Population Mean	**12.44**			**53.26**		
	S.E (±)	**1.36**	**1.26**		**2.05**	**0.90**	

**, ** indicate level of significance at 5% and 1%, respectively.*

Table 2 Contd…

S. N.	**Parents + Hybrids**	**1000-grain weight**			**Grain yield per plant**		
		Mean	**βi**	**S²Di**	**Mean**	**βi**	**S²Di**
1	GW-273	37.55	1.672	5.7797**	19.02	1.424	0.0039
2	GW-322	36.77	1.331	-0.1663	18.38	1.184	-1.6180
3	GW-366	43.66	0.881	2.2593	22.42	1.514	0.3407
4	JW-1201	37.33	0.886	4.0629*	19.73	1.152	29.4432**
5	JW-1202	39.44	-1.205	4.7808 *	15.97	1.099	-0.4761
6	JW-1203	33.66	0.773	-0.3881	17.33	1.044	0.6810
7	LOK-1	41.77	1.621	20.8775**	15.10	1.219	-1.4002
8	HD-2864	34.44	1.075	0.2950	13.97	0.902	-1.2879
9	HD-2932	36.88	1.544	2.5329	15.72	0.495	-0.6263
10	HI-1544	37.66	1.969	2.1416	17.99	1.220	0.2809
11	JW-3336	36.55	1.086	-0.0326	15.28	0.999	13.9642*
12	JW-3288	40.00	1.920	3.0731	14.09	0.827	14.4693*
13	MP-3269	36.66	1.373	0.0707	17.94	0.868	3.4799
14	JW-3211	34.44	0.272	1.6280	15.77	0.395	-0.6165
15	GW-273 X JW-3336	37.55	0.805	7.1988**	15.07	1.069	0.3924
16	GW-273 X JW-3288	34.88	-0.445	1.7500	22.56	0.863	61.8690**
17	GW-273 X MP-3269	36.11	0.120	-0.3662	21.21	0.092	0.0531
18	GW-273 X JW-3211	36.88	0.422	2.6353	26.40	1.064	0.1689
19	GW-322 X JW-3336	35.11	0.705	1.2498	22.48	1.595	0.2769
20	GW-322 X JW-3288	33.77	0.484	4.4800*	24.06	0.995	0.3610
21	GW-322 X MP-3269	35.22	1.352	-0.5562	18.90	0.687	-1.2637
22	GW-322 X JW-3211	36.44	2.020	-0.3447	22.47	0.643	0.0638
23	GW-366 X JW-3336	38.00	0.507	0.5682	18.56	0.422	-1.5699

24	GW-366 X JW-3288	39.11	0.725	-0.2749	20.67	0.734	74.8182**
25	GW-366 X MP-3269	36.77	0.489	6.8163**	19.45	0.237	0.1289
26	GW-366 X JW-3211	38.88	0.845	0.3984	19.24	1.455	0.1112
27	JW-1201 X JW-3336	35.55	1.328	33.3385**	24.62	0.954	0.0231
28	JW-1201 X JW-3288	38.11	2.162	5.1886*	21.40	0.502	-0.4743
29	JW-1201 X MP-3269	40.00	1.413	8.2607**	21.48	0.986	0.5736
30	JW-1201 X JW-3211	40.44	0.966	0.8106	25.97	1.458	219.8007**
31	JW-1202 X JW-3336	38.88	1.347	-0.2563	21.09	0.932	0.0942
32	JW-1202 X JW-3288	37.22	1.451	0.5896	23.81	1.956	9.5822*
33	JW-1202 X MP-3269	44.44	1.547	11.2225**	22.66	1.826	20.0271**
34	JW-1202 X JW-3211	36.55	1.436	-0.4483	22.85	1.176	73.0153**
35	JW-1203 X JW-3336	41.00	1.122	-0.5623	19.37	0.757	2.0433
36	JW-1203 X JW-3288	37.22	1.347	-0.2563	18.19	0.984	0.3988
37	JW-1203 X MP-3269	48.33	1.560	-0.2316	18.76	1.038	-0.0416
38	JW-1203 X JW-3211	38.33	1.221	0.7090	21.88	1.155	-0.6550
39	LOK-1 X JW-3336	39.11	1.714	14.9960**	18.02	0.619	7.6072
40	LOK-1 X JW-3288	35.88	2.543	2.6058	17.60	1.305	4.3436
41	LOK-1 X MP-3269	41.33	0.532	1.1023	17.38	0.829	12.2073*
42	LOK-1 X JW-3211	38.22	0.845	0.3984	18.36	0.682	25.4188**
43	HD-2864 X JW-3336	36.00	1.368	1.0419	18.30	1.416	41.3858**
44	HD-2864 X JW-3288	39.22	0.845	0.3984	18.77	0.909	1.1548
45	HD-2864 X MP-3269	34.44	1.183	8.5857**	24.04	1.735	60.6581**
46	HD-2864 X JW-3211	37.44	0.445	1.7500	19.64	0.736	0.0729
47	HD-2932 X JW-3336	37.11	0.493	25.1657**	16.27	1.040	61.6089**
48	HD-2932 X JW-3288	37.88	0.427	4.5410*	19.39	1.237	-0.9613
49	HD-2932 X MP-3269	40.11	1.341	1.9068	19.63	1.479	61.8792**
50	HD-2932 X JW-3211	41.33	0.773	-0.3881	16.85	0.929	6.6558
51	HI-1544 X JW-3336	43.44	1.222	1.5932	16.38	0.429	0.1352
52	HI-1544 X JW-3288	40.11	-0.126	2.2652	14.45	0.712	35.8501**
53	HI-1544 X MP-3269	40.11	0.026	-0.5044	19.43	1.023	0.1561
54	HI-1544 X JW-3211	39.22	0.240	0.2244	22.05	1.001	0.0713
	Population Mean	**38.19**			**19.41**		
	S.E (±)	**1.44**	**0.43**		**3.35**	**0.59**	

**, ** indicate level of significance at 5% and 1%, respectively.*

Genotypes JW-1203 X JW-3288 for number of productive tillers per plant; HD-2864 X MP-3269, GW-273 X JW-3288 and JW-1201 X JW-3288 for number of spikelets per ear; MP-3269, JW-1201 X MP-3269 and HD-2864 X JW-3336 for ear length; JW-1203, HD-2932 X JW-3336 and HD-2932 X MP-3269 for ear weight; JW-3211, GW-322, GW-366, JW-1201, JW-3336 GW-322 X JW-3336, JW-1202 X JW-3211 and HD-2864 X JW-3288 for number of ears per plant; JW-1203 and GW-273 X JW-3288 for number of grains per ear; JW-1201 X JW-3211 for 1000 grain weight and GW-273 X JW-3211, GW-322 X JW-3288, JW-1201 X JW-3336, JW-1201 X MP-3269, JW-1202 X JW-3336, HI-1544 X MP-3269 and HI-1544 X JW-3211 for grain yield per plant had regression coefficient (bi) values close to unity with minimum deviation from regression (S^2di~0) and above average yield, thus these genotypes suitable for general adaptation, i.e., suitable over all environmental conditions and they are considered as stable genotypes.

Genotypes GW-322, HD-2932, JW-1201 X MP-3269 and JW-1203 X JW-3336 for number of productive tillers per plant; JW-1203, GW-273 X MP-3269, GW-273 X JW-3211, GW-322 X JW-3288, JW-1201 X MP-3269, JW-1201 X JW-3211, JW-1203 X JW-3336, JW-1203 X MP-3269, HD-2864 X JW-3211, HD-2932 X JW-3211 and HI-1544 X JW-3211 for number of spikelets per ear; GW-273 X MP-3269, GW-273 X JW-3211, GW-322 X JW-3336, GW-322 X MP-3269, GW-322 X JW-3211, GW-366 X JW-3211, JW-1201 X JW-3288, JW-1201 X JW-3211, JW-1202 X MP-3269, JW-1203 X JW-3288, HD-2864 X JW-3211, HD-2932 X MP-3269, LOK-1 X JW-3211 and HI-1544 X MP-3269 for ear length; MP-3269, GW-273 X JW-3288, GW-273 X MP-3269, GW-322 X JW-3336, GW-322 X JW-3211, JW-1201 X JW-3288, LOK-1 X JW-3336, LOK-1 X MP-3269, LOK-1 X JW-3211, HD-2864 X MP-3269, HD-2864 X JW-3211 and HI-1544 X MP-3269 for ear weight; JW-1201 X JW-3211, JW-1203 X JW-3336, JW-1203 X JW-3288 and JW-1203 X MP-3269 for number of ears per plant; HD-2864 X JW-321for number of grains per ear; GW-366 X JW-3288, GW-366 X JW-3211, LOK-1 X JW-3211, HD-2864 X JW-3288, HD-2932 X JW-3211, HI-1544 X MP-3269 and HI-1544 X JW-3211 for 1000 grain weight and GW-273 X MP-3269, GW-366 X MP-3269, HD-2864 X JW-3211, GW-322 X JW-3211 and JW-1201 X JW-3288 for grain yield per plant exhibited high mean value with regression coefficient less than unity (bi<1) and minimum deviation from regression ($S^2di\sim0$) indicating their above average stability and these genotypes specifically adapted to unfavorable environmental conditions. Earlier workers [6-10] have also identified stable wheat strains for cultivation under different environments.

Summarizing, the present study on stability analysis in wheat over seasons has demonstrated that the genotypes GW-273 X JW-3211, GW-322 X JW-3288, JW-1201 X JW-3336, JW-1201 X MP-3269, JW-1202 X JW-3336, HI-1544 X MP-3269 and HI-1544 X JW-3211were found to be promising for grain yield per plant. These genotypes may be further promoted as future cultivar or to be used in future breeding programme as pre-breeding lines.

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References

1. Eberhart, S.A. and Russel, W.A. (1966). Stability parameters for comparing varieties. *Crop Sci.*, 6:36-40.
2. Jena, S.N., Muduli, K.C. and Tripathy, S. (2005). Genoype x environment interaction and stability analysis in wheat. *Indian Agriculturist*, 49(3/4): 183-188.
3. Ulker, M., Sonmez, M., Ciftcic, V., Yilmaz, N. and Apa, R. (2006). Adaptation and Stability Analysis in The Selected Lines of Tir Wheat. *Pak. J. Bot.*, 38(4): 1177-1183.
4. Javed, A., Khan, S.B., Rasul, I., Zulkiffal, M. and Hussain, M. (2007). Effect of sowing dates on yield and yield components in wheat using stability analysis. *International Journal of Agriculture & Biology*, 9(1): 129–132.
5. Kabir, M., Hussain, R., Rahman, A.M.M., Hakim, M.A. and Sarker, M.A.Z. (2009). Stability analysis of wheat for grain yield affected by different environment. *Bangladesh Rese, Publications J.*, 3(1): 833-840.
6. Mishra, D.K., Khan, R.A., Baghel, M.S. (2000). Stability of wheat varieties under various dates of sowing. *Annals of Agricultural Research*, 21(4): 564-566.
7. Hamam, K.A. and Khaled, A.S. (2009). Stability of wheat genotypes under different environments and their evaluation under sowing dates and nitrogen fertilizer levels. *Australian Journal of Basic and Applied Sciences*, 3 (1): 206-217..
8. Soleman Mohamed Al-Otayk. (2010). Performance of Yield and Stability of Wheat Genotypes under High Stress Environments of the Central Region of Saudi Arabia. JKAU: Met., *Env. & Arid Land Agric. Sci.*, 21(1): 81-92.
9. Singh, N., Tiwari, R.K. and Singh, S. (2012). Effect of dates of sowing on growth and heat use pattern of wheat cultivars. *JNKVV Res J.*, 46(2): 235-238.
10. Surya Kant, Singh, R.A., Lamba Arya, R.K. and Panwar, I.S. (2014). Effect of terminal heat stress on stability of yield and quality parameters in bread wheat in south-west Haryana. *Journal of Wheat Research*, 6(1):64-73.