SHORT COMMUNICATION

Study on Yield Stability of Wheat Genotypes under Rainfed Environments in Intermediate Zone of J&K

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Sixteen wheat genotypes were evaluated to study the stability of yield and its components by growing them during rabi season for three years from 2006 to 2009 at Regional Agricultural Research Station, Rajouri, J&K. Significant mean square due to genotypes revealed the presence of wide variability among the genotypes for all the traits studied. The component of genotypes x environments interaction was observed significant for all the characters except spike length, effective tillers/plant and biological yield. Based on stability parameters, genotypes UP 2964, HPW 230 and VL 895 exhibited higher mean grain yield and least deviation from zero indicating wide stability for yield. These varieties could be recommended for commercial cultivation for this region.

Key Words: G x E interaction, rainfed, stability, wheat

Wheat production is about 80.6 million tons during 2009-10 in India and counts for approximately 12% of world production. India being the second largest in population is also the second largest in wheat consumption after China, with a huge and growing wheat demand. Depending on the population and income growth, poverty alleviation and the rate of urbanization, a demand-supply gap may open at a rate of about 1 to 2% per year which is equivalent to 0.7 to 1.4 mt of wheat, requiring additional production of such quantity growing over the years. Plant breeders while developing improved cultivars, are often confronted with problem of interpreting genotypes x environment interactions evidenced by differences in relative rankings of crop cultivars when compared over a series of environments. G x E interaction for quantitative traits tends to reduce the usefulness of genotypic means, the correlation between genotype and phenotype and progress from selection. In wheat, most of the present day popular varieties are introduction and they usually show inconsistent yield and lack of stability under fluctuating environments over the years at a given location. Therefore, the present study was undertaken to identify the most stable genotypes of wheat for this rainfed area to increase the wheat production per unit area as well as total production.

The present investigation was carried out at the Regional Agricultural Research Station, (SKUAST-J), Rajouri. The experimental material for the study consisted of 16 diverse genotypes. All the genotypes were evaluated in Randomized Block Design with three replications during *rabi* 2006 to 2009 under rain fed environment. Each plot consisted of six rows of 5 m length, spaced 25 cm apart and maintaining an inter-plant distance of 10 cm within rows. All the recommended agronomic practices were followed to raise the good crop. The crop experienced moisture stress during early development in November- December. However, the crop recovered well following sufficient rains from the month of January onwards. Observations were recorded on ten characters. Observations on plant height, spike length, number of grains per spike and1000-grain weight were recorded by randomly selecting five plants in each plot and in each replication, whereas observations on days to 50% flowering, days to maturity, biological yield, harvest index, effective tillers per plant and grain yield were recorded on plot basis. Stability analysis was done by using Eberhart and Russel model (1966).

The pooled analysis of variance observed in Eberhart and Russel, model is presented in Table 1. The mean squares due to genotypes were highly significant for all the traits indicating wide variability among the genotypes. Similar results were also reported by Kheiralla *et al.,* 1993; Ahmad *et al.*, 2003 and Crossa and Joshi, 1998. Highly significant mean squares due to G x E interaction were observed for all the traits except spike length, effective tillers/plant and biological yield. This suggests that these traits were least influenced by the environments (Mohammad *et al.*, 2009). The liner components of G x E interaction was highly significant for days to 50% flowering, days to maturity, plant height, 1000-grain weight, number of grains/spike, biological yield and harvest index. Similar findings were

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Table 1. Analysis of variance for different characters for stability parameters in wheat

Sources of variation	d.f.	Days to 50 % flowering	Days to maturity	Plant height (cm)	Spike length	Effective tillers/plant	1000-grian weight (g)	No. of seeds/ spike	Biological yield (kg)	Harvest index (%)	Grain yield (kg)
Varieties	15	85.896 **	314.986 **	95.994 **	1.351 **	30.785 **	0.239 **	187.48 **	0.622 **	77.591 **	0.49 **
Environments	2	2735.262 **	2697.563 **	19.852 *	6.103 **	8.086	0.78 **	166.10 **	0.004	1.9 **	0.037
Genotype X Env.	30	19.960 **	73.980 **	8.636 *	0.192	4.172	0.042*	22.53 **	0.008	6.4 **	0.041*
Env.+ (Var. x Env.)	32	189.667 **	237.954 **	9.337 *	0.562 **	4.417	0.057 *	31.50 **	0.007	6.131**	0.04
Environments (Lin.)	1	5470.523 **	5395.127 **	39.704 **	12.207 **	16.172 *	0.556 **	332.20 **	0.007	3.99**	0.074
Var.* Env.(Lin.)	15	35.086 **	131.073 **	13.628 **	0.237	4.935	0.062 *	39.71 **	0.011 *	12.59**	0.012
Pooled Deviation	16	4.532 **	15.831 **	3.416	0.138	3.196	0.021	5.021	0.004	0.206	0.065 **
Pooled Error	90	1.082	1.405	2.023	0.216	1.838	0.052	8.31	0.096	9.197	0.018

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

reported by Jagadish *et al.* (1997). However, pooled deviation (non-linear) responses of cultivar as measured by deviation from liner regression were highly significant for days to 50**%** flowering, days to maturity and grain yield per plot, indicating lack of simple or liner relationship of genotype for different years for these traits.

A genotype is considered to be stable in performance if it has high mean performance (xi) unit regression coefficient (bi=1) and least deviation from regression (s^2di= 0) according to Eberhart and Russel (1966). The estimates of stability parameters *viz.* mean (Xi), liner sensitively coefficient (bi) and non-linear sensibility coefficient (S^2di) are given in Table 2. A linear response i.e. b>i was estimated. However, in certain genotypes the bi values were found negative for some traits. Stability parameters (Table 2) showed that all the genotypes revealed average performance across the environments and nine genotypes showed non-significant mean square deviations (s^2d) from zero and could be considered as the stable genotypes across the different environment for seed yield. Three genotypes (UP 2964, HPW 230 and VL 895) had the high mean values and non significant deviation suggesting good stability of the genotypes. Variety HS 365 has the regression coefficient value near to unity but it has low mean value and significant deviation. Similarly another variety VL 898 has high mean performance but significant deviation hence both the varieties cannot be considered stable. For 1000-grain weight varieties VL 872, HS 240, HPW 255 and VL 900 have high mean values and non-significant deviation indicating good stability. Varieties HPW 249, HPW 230, Sonalika and VL 898 for spike length and varieties VL 900 and UP 2962 for tillers per plant recorded high mean values and non significant deviation from zero indicating good stability. Three varieties VL 870, VL 872 and VL 804 also had high mean values but showed significant deviation for 1000-grain weight, therefore, cannot be considered as stable varieties.

Genotype x environment interaction has important effect on the yield components. Therefore, thorough understanding of the variations among cultivars in their response to environment would further improve the probability of predicting and identifying cultivars with superior yield attributes. Also, suitable selection strategies to accommodate the significant G × E interactions need to be developed.

Wheat is the major crop of Jammu and Kashmir during winter, therefore, high yielding genotypes with stability

Table 2. Estimates of stability parameters of some wheat varieties

Genotypes	Days 50% flowering			Days to maturity			Plant height (cm)			Spike length (cm)			Effective tillers/plant		
	μMean	βi	σ²di	μMean	βi	σ²di	μMean	βi	σ²di	μMean	βi	σ²di	μMean	βi	σ²di
HPW-249	130.8	1.03	-1.04	181.1	0.98	-0.94	98.4	1.79	-1.93	10.2	2.07	-0.16	19.6	-3.85	-0.93
HPW-230	138.3	0.92	13.52**	174.2	1.56	23.37**	100.8	1.82	-1.87	9.6	-0.05	0.08	21.0	1.54	0.26
VL-895	130.2	1.34	0.67	174.7	1.21	6.34	105.7	-1.19	2.64	7.9	1.32	-0.21**	16.6	2.29	-1.46
Sonalika	142.2	0.96	4.03	183.3	0.99	5.58	96.6	3.11	3.13	9.9	0.64	-0.13	17.2	1.16	-1.95
VL-870	144.3	0.71	-0.87	193.4	-0.13	38.91	100.2	1.86	-1.86	9.0	1.01	-0.16	22.6	3.1	8.79**
HPW-267	146.6	0.43	-0.64	205.9	-0.07	11.25*	92.9	-0.3	-0.36	9.6	0.05	-0.11	18.7	1.88	5.32**
VL-898	135.9	1.33	2.61	178.0	0.93	-1.19	98.3	0.62	2.68	9.8	0.94	0.03	15.8	2.11	-2.01
UP-2964	144.2	0.74	-1.16	172.1	1.25	8.33	97.4	-0.06	-0.52	8.3	1.3	-0.21**	20.6	1.89	-2
VL-872	135.2	1.55	-0.73	164.2	1.93	95.41**	84.6	-2.45	2.53	8.7	1.71	-0.12	22.1	1.85	3.93*
HPW-255	137.6	1.15	-0.35	177.3	1.53	20.49**	100.5	-1.54	-0.72	9.1	0.85	0.15	20.1	1.65	-2.01
HS-240	135.2	1.18	-1.09	174.7	1.57	6.79	93.7	-3.25	6.46**	9.4	0.67	-0.20**	16.0	3.4	0.3
VL-738	143.0	1.02	0.53	183.1	0.67	9.58	97.2	2.09	-1.83	9.4	0.6	-0.19*	13.6	-1.32	0.76
VL-804	135.7	1.39	2.05	170.0	1.46	-1.36	99.3	3.74	4.69*	8.6	1.15	0.12	23.4	-3.1	8.79**
HS-365	147.0	0.67	2.74	193.2	-0.07	11.25*	83.7	3.27	-1.66	8.2	1.59	-0.02	17.0	-1.61	3.38*
HS-295	142.0	1.03	24.57**	176.2	1.06	-1.34	98.4	1.29	-0.27	9.4	1.17	-0.08	20.6	2.7	-0.39
VL-900	144.0	0.56	9.19**	180.8	1.14	-1.38	95.3	5.22	12.66**	8.8	0.97	-0.21**	25.4	2.31	-1.79

*5% Significant, **1% Significant

Table 2. Estimates of stability parameters of some wheat varieties

Genotypes	1000-grain weight (g)			No. of grains/spike			Biological yield (kg)			Harvest index (%)			Grain yield/plot		
	μMean	βi	σ²di	μMean	βi	σ²di	μMean	βi	σ²di	μMean	βi	σ²di	μMean	βi	σ²di
HPW-249	45.8	1.19	-0.02	68.3	1.54	-7.99*	5.8	-13.89	-0.07	32.1	8.38	-9.88*	2.246	-0.49	-3.05**
HPW-230	45.4	0.58	0.01	35.5	1.65	-7.22*	6.1	10.67	-0.04	37.8	-2.38	-9.99*	2.418	-0.71	0.14
VL-895	46.1	-0.93	-0.03*	42.5	2.43	-4.55	5.9	0.88	-0.09*	32.0	6.03	-9.91*	2.327	1.69	-0.01
Sonalica	45.2	1.31	0.03*	47.9	2.81	0.4	5.7	3.02	-0.09*	26.2	-1.69	-10**	1.663	4.24	5.38**
VL-870	49.1	0.71	-0.04**	37.9	0.98	-7.99*	4.7	1.26	-0.09*	42.6	-2.64	-10**	2.303	-2.75	0.08
HPW-267	50.0	0.59	-0.05**	57.5	3.18	18.57**	4.6	0.63	-0.08*	35.6	4.63	-9.9*	1.651	0.17	-3.01**
VL-898	50.6	-1.51	-0.03*	41.8	1.52	-2.98	5.5	3.9	-0.06*	39.3	1.23	-9.96*	2.373	0.35	0.03*
UP-2964	50.9	0.26	-0.04**	41.8	-1.66	-6.89*	5.6	-1.13	-0.09*	44.2	2.04	-9.85*	2.476	2.07	-0.02
VL-872	53.6	1.56	-0.04**	47.9	1.2	-6.75*	5.0	0.38	-0.09*	34.0	-5.79	-9.27*	1.504	2.8	0.02
HPW-255	45.5	2.48	-0.01	49.0	1.48	-8.01*	5.7	1.38	-0.05	30.5	-1.98	-9.39*	1.551	1.67	4.82**
HS-240	45.4	0.3	-0.01	44.5	1.31	-5.85*	5.4	-3.52	-0.09*	33.1	-0.99	-9.99**	1.727	0.85	0.05
VL-738	51.7	1.57	-0.05**	48.3	-1.54	3.21	5.1	3.14	-0.09*	29.6	-0.26	-10**	1.482	1.72	-4.02**
VL-804	50.5	0.83	-0.03*	50.9	0.71	-7.84*	5.9	2.39	-0.08*	30.9	20.98	-8.94*	1.851	1.64	0.01
HS-365	52.7	0.26	-0.05**	47.8	-0.39	9.49**	5.1	1.63	-0.09*	28.3	3.81	-10**	1.317	0.97	-0.41*
HS-295	51.7	3.63	-0.05**	41.1	-0.3	-5.45*	5.1	1.63	-0.09*	38.1	-10.17	-9.7*	1.536	2.04	0.06
VL-900	52.5	3.17	-0.04**	51.6	1.07	-8.01**	5.0	3.64	-0.09*	37.2	-5.19	-9.94*	2.194	-0.28	0.03

*5% Significant ,**1% Significant

under fluctuating agro-climatic environments would be a great importance for the farmers. The temperature and moisture availability play a major role in the expression of a genotypes in sloppy and undulating field conditions under hilly region of the state. Further, the genotypes with low water requirements and tolerant to low temperature will also enhance the yield potential of wheat crop. The genotypes identified as stable in the present investigation can be utilised in future crossing programme of wheat breeding for the development of desirable genotypes. These genotypes can also be utilised as donor parents to get desirable transgressive -segregants in later generations. The yield stability character is not a single gene controlled it depends on genotypic expression and various environmental factors, therefore, to utilize the potential of these genotypes in wheat breeding programme a suitable breeding method should be followed.

References

Ahmad I, M Asif, M Asim, MM Sohail, MY Mujahid, NS Kisana, SZ Mustafa and Z Ahmed (2003) Analysis of Wheat Genotypes for Yield Stability in Rainfed Environments. *Pak. Bot.* **6:** 1509-1511.

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

Jagadish R, R.K Pannu, V Singh, RS Singh, B Saini, Jag Shoran, K Jose, AA Ismail and G Nagar (1997) Rainfed tolerance and stability of some spring wheat cultivars. *Assiut. J. Agric. Sci.* **28:** 75-88.

Kheiralla KA, MM EI-Defrawy and Serif (1993) Genetic analysis of grain yield, bio-mass and harvest index in wheat under rainfed stress and normal moisture condition. *Assiut. J. Agric. Sci.* **24:** 163-183.

Mohammad Reza, AhmedAmri Reza, Haghparast and Ceccarelli Salvatore (2009) Yield stability of rainfed durum wheat and GGE biplot analysis of multi-environment trials. *Crop Pastureci.* **61:** 92-101.

Vargas CM and Joshi AK (1998) Performance of Yield and Stability of Advanced Wheat Genotypes under Heat Stress Environments of the Indo-Gangetic Plains. *Crop Sci*. **47:** 1561-1573.