STABILITY ANALYSIS FOR GRAIN YIELD AND ITS COMPONENTS IN BREAD WHEAT (*Triticum aestivum* L.)

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ABSTRACT

A study was carried out to investigate stability of grain yield per plant and its components along with biochemical parameters in bread wheat. The genotype x environment interactions (G x E) were significant for days to maturity, number of grains per spike, 1000-grain weight, grain yield per plant, biological yield per plant and water absorption, when tested against the pooled error. Higher magnitude of mean squares due to environment (linear) indicated that differences between environments were considerable for all the characters except, harvest index, protein content and wet gluten content. The partitioning of Environments + (Genotype x Environment) mean squares showed that environment (linear) differed significantly and were quite diverse with regards to their effect on the performance of the genotypes for grain yield and majority of yield components. The non-linear components of G x E interaction (pooled deviation) were significant against pooled error for all the characters except grain yield per plant. Among the parents, GW 366, WR 885 and HD 2932, while among the hybrids, K 9906 x RAJ 3765, GW 173 X WH 1059 and HD 2932 X RAJ 3765 were most promising with respect to per se performance and stability.

KEY WORDS: G x E interaction, regression coefficient, stability, wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important staple food crop next to rice, consumed by nearly 35 per cent of the world population and providing nearly 20 per cent of the total food calories. It is the major crop for food and nutritional security in India and also at global level. It occupies about 32 per cent of the total acreage under cereals in the world. Crop yield in which the plant breeder is most interested is dependent on the genotype, the environment and the interaction between genotype and environment. The result of the genotype x environment interaction is expressed as the adaptability and stability of the genotype. When interaction between genotype and environment exists, ranking of genotype will be different under different environments. The stability of productivity is, therefore, very important. Hence, it is always desirable to study the stability of hybrids in respect of economically important characters. The estimates of genotype x environment interactions give an idea of stability or buffering ability of populations under study. The present investigation was, therefore, undertaken in bread wheat to access the magnitude of genotype x environment interaction and stability parameters for grain yield and its component traits.

MATERIALS AND METHODS

The experimental materials comprised of 10 parents (LOK 1, GW 366, GW 173, HD 2932, DL 788-2, WH 1059, K 9906, KRL 213, RAJ 3765 and WR 885) and their 45 F_1 hybrids. Thus, a set of 55 entries (45 hybrids and 10 parents) was evaluated in three different environments created by sowing wheat at three different dates (E_1 - Early sowing : 26th October, 2011; E_2 - Timely sowing : 17th November, 2011 and E_3 - Late sowing : 6th December, 2011) following randomized block design with three replications in each environment during *rabi* 2011-12 at Wheat Research Station, Junagadh Agricultural University, Junagadh. The observations were recorded for grain yield per plant (g) and their eleven yield component traits *viz.*, days to heading, days to maturity, plant height (cm), number of effective tillers per plant, length of main spike (cm), number of spikelets per main spike, peduncle length of main spike (cm), number of grains per main spike, 1000-grain weight (g), biological yield per plant (g) and harvest index (%), and three biochemical parameters like protein content (%), wet gluten content (%) and water absorption (ml). The statistical analysis for genotype x environment interaction and stability was carried out according to Eberhart and Russell (1966).

RESULTS AND DISCUSSION

The stability analysis (Table 1) indicated that the genotype x environment interactions (G x E) were significant for days to maturity, number of grains per spike, 1000-grain weight, grain yield per plant, biological yield per plant and water absorption, when tested against the pooled error. This suggested that genotypes interacted significantly in different environments for these traits. Higher magnitude of mean squares due to environment (linear) indicated that differences between environments were considerable for all the characters, except harvest index, protein content and wet gluten content and that these characters were influenced greatly by environments suggesting thereby that large differences between environments along with the greater part of genotypic response was a linear function of environment. This also indicated that environments created by sowing dates was justified and had linear effects. These results are in corroboration with the earlier findings of Kamani (2009), Taghouti *et al.* (2010), Sakin *et al.* (2011) and Rajiv Kumar (2012). The partitioning of Environments + (Genotype x Environment) mean squares showed that environment (linear) differed significantly and were quite diverse with regards to their effect on the performance of the genotypes for grain yield and majority of yield components. Further, the higher magnitude of mean squares due to environment (linear) as compared to genotype x environment (linear) indicated that linear response of environment accounted for the major part of total variation for majority of the characters studied. The significance of mean squares due to genotype x environment (linear) component against pooled deviation for days to maturity, plant height, number of spikelets per main spike, number of grains per main spike, grain yield per plant, biological yield per plant and wet gluten content suggested that the genotypes were diverse for their regression response to change with the environmental fluctuations for above mentioned traits. Similarly, the variances due to environments (linear) were significant for all the traits, except harvest index, protein content and wet gluten content, when tested against pooled error as well as pooled deviation. The non-linear components of G x E interaction (pooled deviation) were significant against pooled error for all the characters, except grain yield per plant. This suggested that predictable as well as unpredictable components were involved in the differential response of stability. Similar results were reported by Singh and Chaudhary (2007) and Rajiv Kumar (2012).

Breeding genotypes with only high yield potential is not justifiable because the yield potential may not be expressed in all the situations. Therefore, equal importance should also be given to improve yield stability (Ceccarelli, 1989). It has been suggested by many workers that stability is a genetically controlled characters (Bradshaw, 1965 and Scott, 1967). Therefore, breeding for stability of performance is necessary. Stability for yield may be dependent upon stability for yield components. Hence, information on relative stability of yield component is essential. The stability parameters of parental lines revealed that GW 366 recorded highest mean for grain yield per plant as well as unit regression and non-significant deviation from regression. Moreover, it was also found stable for the components like days to heading, number of effective tillers per plant, 1000-grain weight, biological yield per plant and protein content (Table 2). However, performance of protein content unpredictable as evident from significant deviation from regression. The parent WR 885 was second highest in grain yield per plant with unit regression and non-significant deviation from regression for grain yield per plant and all its component traits except days to heading, days to maturity, plant height, number of effective tillers per plant and length of main spike. HD 2932 ranked third with respect to grain yield per plant and found stable for component like days to heading, days to maturity, plant height, number of grains per main spike, 1000-grain weight, biological yield per plant, harvest index and wet gluten content.

The top ten high yielding and stable hybrids listed in Table 2. It is evident from the data that these hybrids had high grain yield per plant as well as unit regression and non-significant deviation from regression along with high stability for the component traits mentioned against each cross. The symbols '*' and '**' indicated that the performance of particular cross was better in favourable and unfavourable environment, respectively, with respect to particular component trait while '+' indicates unpredictable performance. The genotypes which are specially adapted for better or poor environments are due to adaptive plasticity or individual adaptability. The genotype may create different phenotypes in different environments, each of which being better adapted for the situation. This type of behavior has been regarded as adaptive plasticity (Mather, 1943), individual adaptability (Cook and Johnson, 1968) and individual buffering (Allard and Bradshaw, 1964).

CONCLUSION

From the present study, it was found that among the parents, GW 366, WR 885 and HD 2932, and among the hybrids, K9906 x RAJ 3765, GW 173 XWH 1059 and HD 2932 X RAJ 3765 were most promising with respect to *per se* performance and stability. These parents offer best possibility to be utilized in hybridization programme for the development of stable high yielding varieties through the exploitation of superior segregants in segregating generations.

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Table 1: Analysis of variance for stability parameters for grain yield and its components

Source of Variation	d. f.	Days to Heading	Days to Maturity	Plant Height (cm)	Number of Effective Tillers Per Plant	Length of Main Spike (cm)	Number of Spikelets Per Main Spike	Peduncle Length of Main Spike (cm)	Number of Grains Per Main Spike
Genotype	55	71.07**	41.67**	112.12**	3.83*	2.47**	8.04**	20.44**	90.25**
Environment + (G x E)	112	17.53**	31.47**	61.51**	2.63	0.79**	1.99**	12.42	55.83**
Environment (E)	2	584.65**	1301.42**	1932.90**	36.38**	17.12**	49.36**	231.05**	1222.46**
G x E	110	7.22	8.38**	27.49	2.02	0.49	1.13	8.45	34.62**
Environment (linear)	1	1169.31**	2602.84**	3865.80**	72.77**	34.23**	98.72**	462.11**	2444.91**
G x E (linear)	55	8.16	14.70**	35.75**	1.73	0.57	1.51**	7.66	47.85**
Pooled deviation	56	6.16**	2.03**	18.88**	2.26**	0.40**	0.74**	9.07**	21.00**
Pooled error	330	0.57	0.46	0.65	0.21	0.12	0.16	0.34	2.86

Source of Variation	d. f.	1000-Grain Weight (g)	Grain Yield Per Plant (g)	Biological Yield Per Plant (g)	Harvest Index (%)	Protein Content (%)	Wet Gluten Content (%)	Water Absorption (ml)
Genotype	55	54.85**	26.37**	217.73**	36.19**	0.93	2.47	12.21**
Environment + (G x E)	112	8.20**	8.02**	44.76**	12.20	0.67	3.50	8.98**
Environment(E)	2	292.94**	303.59**	1470.93**	83.61**	0.09	99.52**	249.09**
G x E	110	3.02**	2.65**	18.83**	10.90	0.68	1.76	4.61**
Environment (linear)	1	585.87**	607.19**	2941.87*	167.22	0.17	199.04	498.17**
G x E (linear)	55	5.34	4.51**	24.25**	10.69	0.49	0.93**	7.70
Pooled deviation	56	0.68**	0.78	13.17**	10.91**	0.84**	2.54**	1.50**
Pooled error	330	0.15	0.81	2.46	1.09	0.01	0.09	0.43

,** significant at 5 per cent and 1 per cent levels of significance, respectively.

Table 2: Stable parents and hybrids (top ten) identified on the basis of high mean for grain yield per plant and stability parameters.

Sr. No.	Parents/Hybrids	Grain Yield Per Plant (g)	bi	S^2di	Stable For Component Traits
Parents					
1.	GW 366	18.94	1.46	-0.63	DH,TP,TW,BY,PC$^+$
2.	WR 885	18.29	0.88	-0.77	SS,PL$^+$,GS$^+$,TW$^+$,BY,HI$^+$,PC,WGC,WA
3	HD 2932	17.64	0.31	-0.75	DH$^+$,DM,PL$^+$,GS$^+$,TW,BY$^+$,HI$^+$,WGC
Hybrids					
1.	K9906 x RAJ 3765	22.84	1.21	-0.26	TP,LS,BY, WGC
2.	GW 173 XWH 1059	22.51	1.58	-0.62	DH*,DM$^+$,PH,TW,BY,HI
3.	HD 2932 X RAJ 3765	21.21	1.15	-0.56	PH$^+$,TP,SS,GS$^+$,BY,WGC,WA$^+$
4.	WH 1059 X KRL 213	19.31	0.84	-0.74	DH$^+$, PH$^+$,TP$^+$, GS$^+$,TW,BY$^+$
5.	LOK 1 X RAJ 3765	18.73	1.40	-0.38	DH,DM, TP$^+$,PL,BY,WGC
6.	LOK 1 X GW 173	18.44	1.11	-0.70	DH**,DM$^+$, PH$^+$,PL,TW,BY$^+$,PC,WGC$^+$
7.	LOK 1 X GW 366	18.43	1.28	-0.38	DH,DM*,PH$^+$,BY,PC$^+$,WGC$^+$,WA
8.	DL 788-2 X WR 885	18.23	1.38	-0.78	DH, PH$^+$,GS$^+$,HI, PC$^+$,WGC,WA
9.	HD 2932 X K 9906	18.19	1.43	-0.75	DH$^+$, DM$^+$, TP$^+$,LS,SS,PL,PC, WGC$^+$
10.	DL 788-2 X RAJ 3765	17.59	0.93	-0.43	DH,DM**,LS$^+$,SS$^+$,PL$^+$, HI$^+$,PC$^+$

** and** indicates better for favourable and unfavorable environments, respectively.*
\+ *indicates unpredictable performance*

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