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Stability of Wheat Genotypes for Grain Yield under Diverse Rainfed Ecologies of Pakistan

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Abstract: Thirteen genotypes developed for rainfed areas of Pakistan viz., NR-155, 97C027, SN-6, PR-72, BWL-9736, NR-149, 96R37, DN-14, V-97005, 95C004, NR-178, CHAKWAL-97, SN-16, were evaluated for stability of grain yield under twelve diverse environments. The interaction between the genotypes and environments (G X E interaction) was used as an index to determine the yield stability of genotypes under all the environments. Both predictable (linear) and unpredictable (non-linear) portions of variation were found to be significant indicating equal importance in determining the stability of grain yield. The genotypes "96R37" and SN-16" were the most adapted showing considerable good performance in the entire set of environments under study.

Key words: Stability, grain yield, environment, genotypes

Introduction

Pakistan has varied agro-climatic regions including high mountainous valleys and irrigated plains. The environmental factors such as, temperature, fertility status, soil characteristics especially rainfall in the rainfed areas of the country play an important role in the varietal performance. The adaptability of a variety over diverse environments is usually tested by the degree of its interaction with different environments under which it is grown. A variety or genotype is considered more adaptive or stable, if it has high mean yield but a low degree of fluctuation in yielding ability when grown over diverse environments. However, Eberhart and Russell's Model (1966) is one of the best techniques used to rank the genotypes for stability. They defined a stable variety as having unit regression over the environments (b=1.00) and minimum deviation from the regression (S^2d_i=0). Therefore, a variety with a high mean yield over the environments, unit regression coefficient (b=1) and deviations from regression as small as possible (S^2d_i=0) will be a better choice as a stable variety.

The stability parameters studied in three cereals by Yue *et al.* (1990) indicated that wheat crop in general was more stable in yield than maize and sorghum. G X E interaction has been reported in maize (Aslam *et al.* 1988), rice (Qayyum *et al.* 2000), mash (Zubair et al 2002) and mungbean (Zubair and Ghafoor 2001), but very little information is available on stability of rainfed wheat varieties. Thus, this study was undertaken to evaluate 13 wheat genotypes for their yield stability under diverse rainfed ecologies of Pakistan.

Materials and Methods

The experimental material comprised of thirteen advance rainfed lines or candidate varieties (NR-155, 97C027, SN-6, PR-72, BWL-9736, NR-149, 96R37, DN-14, V-97005, 95C004, NR-178, CHAKWAL-97, SN-16) developed by various plant breeders in the country. All the material was evaluated at twelve locations representing different climatic conditions in the country (Table 1). At each location the trial was conducted in Randomized Complete Block Design with four replications. The experimental plots consisted of six rows of four meter length. Row to row distance was 30 centimeters and plants were spaced at 10 centimeters. Stability parameters were worked out as suggested by Eberhart and Russell (1966), using a computer software written by P. Chatwachirawong, Department of Agronomy, Faculty of Agriculture, Kasetsart University, Thailand in Q-Basic.

Results and Discussion

Pooled analysis of variance showed highly significant differences among the genotypes and environments for grain yield (Table 2), indicting the presence of variability among the genotypes as well as environments under study. The genotype x environment (G X E) interaction was further partitioned into linear and non linear components. Mean squares for these components were found significant indicating the presence of both predictable and unpredictable components of "G X E" interaction. The G X E (linear) interaction was highly significant when tested against pooled deviation which revealed that there were genetic differences among genotypes for their regression on the environmental index. Finlay and Wilkinson (1963) considered linearity of regression as a measure of stability. Eberhart and Russell (1966) emphasized that both linear (b_i) and non linear components of G X E interaction should be considered in judging the phenotypic stability of a particular genotype. Samuel *et al.* (1970) suggested that the linear regression

Table 1: Rainfed locations of Pakistan where thirteen genotypes of wheat were tested

Locations	Research institutes/stations
Upland of Balochisan	Agricultural Research Institute, Sariab, Quetta
Upland of Balochisan	Arid Zone Research Center, Quetta
Northern Punjab	Adaptive Research Farm, Kot Nainan, Shakargah
Northern Punjab	Tobacco Research Station, Kunjah
Northern Punjab	Barani Agricultural Research Institute, Chakwal
Northern Punjab	National Agricultural Research Centre, Islamabad
Northern Punjab	Barani Agricultural Research Station, Fatehjang
Southern parts of NWFP	Agricultural Research Institute, D.I.Khan
Southern Parts of NWFP	Arid Zone Research Institute, D.I.Khan
Southern Parts of NWFP	Agricultural Research Station, Sarai Naurang
Plains of NWFP	Nuclear Institute for Food and Agriculture, Tarnab, Peshawar
Plains of NWFP	Cereal Crop Research Institute, Pirsabak

Table 2: Pooled analysis of variance for grain yield in Wheat

Source of variation	df	MS
Genotypes	12	857125.31**
Environment	11	6492978.00**
Genotype x Environment	132	150039.45**
Environment + (G X E)	143	637957.81**
Environment (linear)	1	71422840.00**
G X E (linear)	12	738724.50**
Pooled deviation	130	84157.19*
Pooled error	465	62883.82

** significant at 1% level, * significant at 5% level

Table 3: Stability parameters for grain yield of rainfed wheat genotypes grown in twelve rainfed locations of Pakistan

Genotype	Mean	b_i	S^2d_i
NR-155	1978	1.067	222198.05
97C027	2070	1.224	13917.90
SN-6	1762	0.321	202826.83
PR-72	1178	0.140	14242.58
BWL-9736	1997	1.023	27252.65
NR-149	2152	1.370	121103.00
96R37	2102	1.064	12496.40
DN-14	1955	0.973	55834.39
V-97005	2085	1.130	32846.95
95C004	2046	0.991	38444.00
NR-178	2107	1.267	134880.20
CHAKWAL-97	2159	1.335	65472.30
SN-16	2200	1.074	12527.25
Average	1984	1.00	73387.88

could simply be regarded as a measure of response of a particular genotype whichh depends largely upon a number of environments, whereas the deviation from regression line was considered as a measure of stability, genotype with the lowest or non significant standard deviation being the most stable and vice versa.

The simultaneous consideration of three parameters of stability (Table 3) for the individual genotype revealed that the genotypes “96R37” and SN-16” showed regression closer to unity, grain above the average and low deviation from regression. Hence these genotypes may be considered as stable genotypes. Although the genotypes NR-149 and Chakwal-97 were higher yielding but they showed high b_i (regression) value along with high deviation from regression and hence may be considered for some specific environment. The genotype NR-155 produced slightly lower grain yield than the average and had b_i = 1.067 and non significant standard deviation indicating less response to environmental changes. The genotypes 97C027, BWL-9736, V-97005 and NR-178 produced more grain yield than the average yield of all the genotypes over the entire environments. They had regression value more than 1.0 indicating sensitivity to environmental changes but give higher yield when environments were conducive. The wheat lines *i.e.* PR-72 and DN-14 had regression values less than 1.0 with grain yield less than the grand mean yield indicating average stability with poor adaptation to environmental fluctuations. The yield of 95C004 was higher than the grand mean yield. It possessed below average linear response showing less sensitivity to environmental changes. This genotype had highly significant deviation and thus can be regarded as having below average stability with poor response to favorable conditions. The genotype SN-6 had regression value less than unity or 1.0 with highly significant deviation value. This genotype had below average yield and its stability parameters revealed greater stability to environmental changes with specific adaptation to unfavorable environments.

Thus on the basis of this study it can be concluded that the genotypes “96R37” and SN-16” were most adapted and best suited under various rainfed ecologies in Pakistan.

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