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ADAPTABILITY OF SEMIDWARF SPRING WHEAT IN SINDH PROVINCE

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The improvement of yield stability in spring wheat is a major plant breeding objective. The yield of ten spring wheat genotypes were determined for three seasons (1992-1994) at nine sites in Sindh province. The genotypes environments interaction was highly significant (P≤0.01). Heterogeneity between regression for genotypes (P≤0.05) and deviation from regression (P≤0.01) were significant. Genotype SI88123 had the highest mean yield over environment and was generally adapted to all the environments. WRS-01, SI88155 and SI88231 had lower mean yield over environments.

Key words: Wheat genotypes, Environmental factors, Yield, *Triticum aestivum* L.

Introduction

Breeding genotypes with wide adaptability has long been a universal goal among plant breeders. There are certain environmental factors such as temperature, day length and humidity (Jamali 1991), which affect the performance of a genotype. Stability in performance of a genotype over a range of environments is a desirable attribute of newly developed cultivars and depends on the magnitude of genotype x environment (G x E) interactions (Ahmad *et al* 1996). Several methods have been proposed to analyze genotype x environment interactions. The joint regression analysis is one of the most commonly used methods for studying yield stability (Yates and Cochran 1938; Finlay and Wilkinson 1963; Eberhart and Russell 1966; Perkins and Jinks 1968). It expresses the performance of an individual genotype vs. an environmental index which corresponds to the additive environmental effects. The aim of this study was to evaluate the performance of genotypes under different ecological zones of Sindh province.

Materials and Methods

Ten genotypes of spring wheat (*Triticum aestivum* L.) including two check varieties Soghat 90 and Sarsabz were evaluated for three seasons from 1991-92 to 1993-94 across nine sites in Sindh province. Each genotype was planted in six rows of 5 metre length. A randomized complete block design with four replicates was used in each trial. The 27 trials were conducted in different ecological zones of Sindh province in the month of November. At maturity, the central four rows were harvested for grain yield determination.

Results and Discussion

Environmental index values are given in Table 1, whereas, the results of stability analysis are presented in Table 2. Genotypes, environments and genotype x environment (G x E) interaction mean squares were highly significant (P≤0.01) for plot yield. Heterogeneity between regression and deviation from regression were significant at P≤0.05 and P≤0.01 levels, respectively. Heterogeneity between regression results suggest that some of genotype x environment interactions are due to a linear function of the additive environmental values and the linear regression coefficient (b) significantly differs between the genotypes (Mather and Jinks 1982; Bulmer 1980). Deviation from regression results suggest that a major portion of G x E interaction was due to deviations from their linear response to environment (Perkins and Jinks 1968; Kaltsikes and Larter 1970; Yassin 1973; Jamali 1991). The environmental factors such as high temperature, rainfall and humidity may be the cause of the deviation of varieties from their linear response to environments.

Table 1
Environmental index values for various environments of Sindh province

Sites	1991-92	1992-93	1993-94	Total
Tando Jam	+0.283	-0.495	+0.993	+0.781
Umarkot	+0.329	+0.824	+0.014	+1.167
Badin	-0.175	-1.434	-0.466	-2.075
Sanghar	+0.589	-1.074	+0.674	+0.189
Nawabshah	+1.335	+1.012	+0.841	+3.188
Khairpur	-0.261	+0.249	+0.199	+0.187
Sukkur	-0.507	+0.586	+0.806	+0.885
Dadu	+0.572	-0.681	-0.789	-0.898
Jacobabad	-0.711	-1.468	-0.366	-2.545
Total	+1.454	-2.481	+1.906	--

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Stability parameter results are presented in Table 3. The regression of genotype mean yield on the environmental index resulted in regression coefficients (b) ranging from 0.921 in SI 88231 to 1.062 in WRS-01. Mean yield over all environments ranged from 2.232 kg in WRS-01 to 2.480 kg in SI88123. SI88123 had the highest yield with regression value b=1.057, which suggests that the line is generally adapted to all environments.

The ideal genotype as proposed by Eberhart and Russell (1966) would have a high mean performance over a range of environments, a regression coefficient (b=1.00), and deviation mean square (S^2d) from regression of zero. According to Finlay and Wilkinson (1963), genotypes with a slope near 1.00 and a high mean yield were regarded as being well adapted to all environments. Genotypes with significantly high or low slope are regarded as being specifically adapted to favourable or poor environments, respectively.

Table 2

Analysis of variance of pooled data for grain yield

Source of Variation	DF	MS	F value	Probability
Genotypes	009	0.130	4.33	0.01
Environments (Joint regression)	026	5.812	193.73	0.01
G x E	234	0.063	2.11	0.01
Heterogeneity between regression	009	0.144	2.40	0.05
Deviation from regression (Remainder)	225	0.060	2.00	0.01
Replicated error	810	0.030	--	--

Table 3

Stability parameters for grain yield

Genotype	Mean yield (kg/plot)	b ± S.E.(b)	S^2d
WRS-01	2.232	1.062±0.050	0.037
SI8878	2.433	1.031±0.048	0.035
SI8887	2.391	0.979±0.065	0.063
SI88123	2.480	1.057±0.059	0.052
SI88126	2.448	1.056±0.088	0.117
SI88155	2.337	1.023±0.050	0.038
SI88171	2.374	0.951±0.055	0.045
SI88231	2.339	0.921±0.068	0.069
Soghat 90	2.377	0.965±0.044	0.029
Sarsabz	2.400	1.019±0.061	0.057

The other superior genotypes were SI88126, SI8878, Sarsabz and SI8887. These genotypes were less responsive to environmental changes as their regression coefficients (b) values did not differ significantly from the unity and they had comparatively higher yields than the grand mean yield over all the environments. These are also being regarded as generally adaptable to all the environments.

SI8878 had a comparatively better stability than the generally adaptable genotypes (SI8887, SI88123, SI88126 and Sarsabz) due to lower values of SE(b) and S^2d. However, SI88126 had the highest values of SE(b) and S^2d than the remaining nine genotypes which makes this genotype less stable according to the definition of stability (Eberhart and Russell, 1966). Lines WRS-01, SI88155 and SI88123 had poor performance in two out of three seasons at Badin, Dadu and Jacobabad. In this study, Nawabshah had a favourable environment (Table 1), where the genotypes had the highest yield; whereas, Badin, Jacobabad and Dadu were poor yielding environments. Badin, Jacobabad and Dadu are rice growing areas and there is a shortage of irrigation water for wheat crop. Yau *et al* (1991) concluded that different breeding strategies should be followed within irrigated and rainfed areas. The performance of genotypes at Tandojam, Umerkot, Sanghar and Khairpur was similar.

Genotypes SI88171 and Soghat 90 had average stability over all the environments. Soghat 90 had comparatively the lowest values of SE(b) and S^2d which suggest that, this variety had the highest stability, but comparatively low yield than other genotypes in this study. Similar results of stability analysis for crop plants were also reported by other investigators (Arain and Siddiqui 1977; Chakroun *et al* 1990; Helms 1993). The seasonal effect is often the most important environmental factor affecting yield and year interactions are major components of the G x E interactions (Yang and Baker 1991; Lin and Binns 1988, 1989). In this study the season 1992-93 had a very poor yield compared to seasons 1991-92 and 1993-94. The possible reason for low yield in 1992-93 was heavy rains and hail storms after anthesis, which induced lodging and affected the grain filling and maturity of the crop. However, Dumoulin *et al* (1996) did not find any significant difference among years, in spite of yearly change in rainfall. The line SI88123 which combines both high grain yield and better stability may be promoted as a new variety.

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