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Selection for Seed Cotton Yield and Adaptability among Cotton (*Gossypium hirsutum* L.) Genotypes

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Abstract: Two promising cotton (*Gossypium hirsutum* L.) lines viz., AEHM-74/11/89 and AEC-76/3/89 along with three commercial check varieties Chandi 95, NIAB-78 and Rehmani were evaluated for their yield performance under five contrasting environments having different agro-climatic conditions in the Sindh province. The genotypes were evaluated for their mean yield performance and stability analysis was worked out. Mean square of genotypes, environments and their interactions (G x E) were highly significant ($P \leq 0.01$). The advanced strain AEC-76/3/89 produced the highest mean seedcotton yield (2116.9 kg ha^{-1}) over all the environments with unit regression (b=1.11) and the lowest deviation from regression ($S^2d=0.047$) value showing wide adaptation and stability. The local check variety Rehmani produced the lowest yield, whereas, NIAB-78 had comparatively low (1969.8 kg ha^{-1}) seedcotton yield with wide adaptability (b=0.91) and ($S^2d=0.089$) over environments.

Key words: Genotype x environment interaction, seedcotton, stability and adaptation

Introduction

Cotton is an important cash crop of Pakistan grown over 2.98 m ha with average yield of 641 kg ha^{-1} (Anonymous, 1999-2000). It plays a vital role in the economy of our country (Soomro, 2000). The yield of cotton varieties varies widely due to variation in climatic and soil factors, which complicates the identification of superior genotypes (Baloch, *et al.*, 1997). The yielding ability of a genotype is the result of its interaction with the environmental conditions (Fittouh, *et al.*, 1969; Rehman *et al.*, 1993 and Baloch, 2001). The genotype x environment (G x E) interactions detects different pattern of response among the genotypes across environments. Biologically, it occurs when the contribution (level of expression) of the genes regulating the trait differ among environments (Basford and Cooper, 1998 and Sial *et al.*, 1999). To reduce the size of (G x E) interactions and facilitate breeding programme, it is important to identify predictable environmental variation, as suggested by Allard and Bradshaw (1964). The climatic factors such as temperature, moisture, soil fertility, day length and sowing time vary across years and locations (Bull *et al.*, 1992; Sial *et al.*, 2000 and 2001). This requires the development of varieties with wide adaptation and high yield and others with specific adaptation and high yield.

Genotype x environment (G x E) interaction is regarded as the basic measure of stability (Eberhart and Russell, 1966 and Perkins and Jinks, 1968). Eberhart and Russell, (1966) proposed a method of measuring genotypic stability in which the genotypic yields in the respective environment are obtained by subtracting the mean yield of all genotypes over all the environments from the average yield of all genotypes at each location. A genotype is said to be stable if the regression (b) coefficient value is close to 1.0 and deviation from regression (S^2d) is equal to 0 (zero). A genotype with 'b' value higher or lower than 1.0 would be regarded unstable. Gauch (1988) and Basford and Cooper (1998) introduced some other models such as cluster analysis and additive main effects and multiplicative interaction (AMMI) analysis for explaining G x E interactions. New methods have been developed for the interpretation of GxE interaction; however, these involve more mathematical computations for drawing meaningful inferences.

The present study was conducted with the objective to identify the genotypes with high yield and stability of performance over wide and also for specific environments.

Materials and Methods

Two advanced strains/ lines of cotton (*Gossypium hirsutum* L.) AEHM-74/11/89 and AEC-76/3/89 of different origin along with three commercial check varieties Chandi 95, NIAB-78 and Rehmani were evaluated in zonal varietal trial (ZVT) in the Sindh province during Kharif season 1999-2000. These trials were conducted at five contrasting sites viz. Nuclear Institute of Agriculture (NIA) Tando Jam, Cotton Research Institute (CRI) Mirpurkhas, Cotton Research Institute (CRI) Sakrand, Farash Farm Hala and Cotton Research Station (CRS) Kotdiji having different agro-climatic conditions. The crop was sown in Randomized Comlete Block Design (RCBD) in triplicate fashion. Eight rows (6m long each) with 22.5 and 75cm plant to plant and row to row distances were grown. Data for seedcotton yield were recorded from six central rows in kg plot^{-1} basis at each site and then converted in to kg ha^{-1} by multiplying with a factor. The data were subjected to analysis of variance (ANOVA) and the means were compared by using Duncan's Multiple Range (DMR) tests (Duncan, 1970). Stability analysis was performed with the objective to observe genotypes x environment interaction (GxE) according to method proposed by Eberhart and Russell (1966), Finlay and Wilkinson (1963). Regression coefficient (b) and deviation from regression (S^2 d) were obtained as a parameter of stability and adaptability.

Results and Discussion

Pooled analysis of variance for seedcotton yield showed highly significant ($P \leq 0.05$) differences among genotypes (G), location (L) and genotype x environment (G x E) interactions, suggesting genetic variability among genotypes and environments (Table 1). The highest mean seedcotton yield (2116.7 kg ha^{-1}) was produced by the genotype AEC-76/3/89 followed by local check variety Chandi 95 (2034.3 kg ha^{-1}) and NIAB-78 (1975.8 kg ha^{-1}) table 2. The commercial variety Rehmani had the lowest yield (1793.9 kg ha^{-1}) with low 'b' value (0.658) indicating its poor performance as compared with other genotypes. AEHM-74/11/89 produced comparatively better yield (1930.3 kg ha^{-1}) but had highest regression (1.277) and deviation from regression (S^2d=0.126) value showing specific adaptability (Table 3) The AEHM-74/11/89 strain exhibited statistically better seedcotton yield (1930.3 kg ha^{-1}) than the Rehmani (control).

The highest mean seedcotton yield (2511.5 kg ha^{-1}) was produced by AEC-76/3/89 at CRS, Kotdiji. The Kotdiji was proved to be the highest (2251.1 kg ha^{-1}) yielding site; followed by NIA, Tando Jam (2164.9 kg ha^{-1}). Whereas, the lowest site mean yield (1442.3 kg ha^{-1}) was recorded at CRS, Sakrand (Table 2).

The mean seedcotton yield over all environments is shown in table 2 and stability parameters regression coefficient (b), S.E. (b) and deviation from regression coefficient (S^2d) are presented in table 3. Stability analysis of each genotype showed wide variation among genotypes for seed cotton yield across environments. The regression coefficient (b) ranged from 0.658 in Rehmani to 1.277 in AEHM-74/11/89 genotype. Finlay and Wilkinson (1963) suggested that the ideal genotype is one, which has maximum yield potential in the most favourable environments and maximum phenotypic stability. Genotype AEC-76/3/89 had the highest mean seedcotton yield (2116.7kg ha^{-1}) with unit regression (b=1.117) and low values of S.E (b) and S^2d (0.127 and 0.047 respectively). These findings indicated that this genotype is high yielding as well as stable with wide adaptation over a range of environments. Similar results of genotype x environment interaction analysis for yield and other associated characters have also been reported in many other crop plants by other investigators (Fittouh *et al*., 1969; Rehmani *et. al*., 1993 and Baloch, 2001;) Chandi 95 had regression coefficient (b) value close to unity (1.047) with the highest S^2d value (0.286 and S.E (b) value (0.270) suggesting its specific adaptation to favourable environments. Similar results have been observed by various researchers (Baloch, 1997; Basford and Cooper, 1998; Sial *et al.,* 2000 and 2001). The well known commercial variety NIAB 78 produced comparatively low yield (1969.8 kg ha^{-1}) showing wide

Table 1: Pooled analysis of variance for seed cotton yield (kg plot $^{-1}$) of advanced cotton lines/genotypes

Source of variation	D.F	Mean square	F.value
Seed cotton yield (kg plot $^{-1}$)			
Locations (L)	4	11.665	158.48***
Genotypes (G)	4	1.694	23.02***
Location x Genotype (L x G)	16	0.456	6.19***
Error	48	0.074	-

Table 2: Seedcotton yield (kg ha^{-1}) of cotton genotypes tested over different locations in the Sindh

	Locations					
Genotype	NIA, Tando Jam	CRS, Mirpurkhas	CRI, Sakrand	Farash Farm, Hala	CRS, Kotdigi	Mean over locations
AEHM-74/11/89	2113.3ab	1894.4b	1291.6b	1926.7b	2429.0a	1930.3c
AEC-76/3/89	2224.5ab	2203.0a	1532.0a	2116.9a	2511.5a	2116.9a
Chandi 95	2278.3a	2249.6a	1399.3ab	2127.6a	2116.8bc	2034.3b
NIAB-78	2124.0ab	2149.2a	1506.9a	1829.8bc	2235.6b	1969.8bc
Rehmani	2084.6 b	1697.0c	1481.8a	1747.3c	1962.5c	1793.9d
Site mean	2164.9b	2038.6c	1442.3e	1949.7d	2251.1a	-

Values associated with different letters are significantly different from each other t 1% level

Table 3: Stability parameters for seedcotton yield in five cotton genotypes

Advance strains/ Genotypes	Mean yield (kg ha^{-1})	Regression coefficient (b)±s.e.(b)	Variance due to deviation from regression (S^2d)
AEHM-74/11/89	1930.3c	1.277±0.185	0.126
AEC-76/3/89	2116.9a	1.117±0.127	0.047
Chandi 95	2034.3b	1.047±0.270	0.286
NIAB-78	1969.8bc	0.911±0.156	0.089
Rehmani	1793.9d	0.658±0.203	0.157

stability and adaptation (b=0.91 and S^2d=0.89) over all the locations.

Stability analysis has demonstrated that two newly developed cotton lines (AEHM-74/11/89 and AEC-76/3/89) are less responsive to changed environmental conditions, having more stability and adaptation and can be grown over range of environments in the Province of Sindh.

References

Anonymous, 2000. Agricultural Statistics of Pakistan 1999-2000. Government of Pakistan, Ministry of Food, Agri. and Livestock, Islamabad, Pakistan.

Allard, R.W. and A.D. Bradshaw, 1964. Implications of genotypes-environment interactions in applied plant breeding. Crop Sci., 4: 503-508.

Baloch, M.J., B.A. Soomro, H. Bhutto and G.H. Tunio, 1994. Stability analysis for comparing cotton varieties (*Gossypium hirsutum* L.) Pak. J. Sci. Ind. Res., 37: 528-530.

Baloch, M.J., H. Bhutto and A.R. Lakho, 1997. Combining ability estimates of highly adapted tester lines crossed with pollinator in breds of cotton. Pak. J. Sci. Ind. Res., 40: 95-98.

Baloch, M.J., 2001. Stability and adaptability analysis of some quantitative traits in upland cotton. Pak. J. Sci. Ind. Res., 44: 105-108.

Basford, K.E. and M. Cooper, 1998. Genotype x environment interactions and some considerations of their implications for wheat breeding in Australia. Aust. J. Agric. Res., 49: 153-174.

Bull, J.K., M. Cooper, I.H. Delacy, K.E. Basford and D.R. Woodruff, 1992. Utility of repeated checks for hierarchical classification of data from plant breeding trials. Field Crop Res., 30: 79-95.

Duncan, D.B., 1970. Multiple range and multiple F. test. Biometrics, 11: 1-42.

Eberhart, S.A. and W.A. Russell, 1966. Stability parameters for comparing varieties. Crop Sci., 6: 36-40.

Finlay, K.W. and G.N. Wilkinson, 1963. The analysis of adaptation in plant breeding programme. Aust. J. Res., 14: 742-754.

Fittouh, A.H.A., J.O. Rawlings and P.A. Miller, 1969. Classification of environments to control genotype by environment interactions with an application to cotton. Crop Sci., 9: 135-140.

Gauch, Jr. H.G., 1988. Model selection and validation for yield trials with interaction. Biometrics, 44: 705-715.

Perkins, J.M. and J.L. Jinks, 1968. Environmental and genotype x environmental components of variability. Heredity, 23: 339-359.

Rehman, H.A., W.S. Khan and N. Murtaza, 1993. Genotype-environment interaction and stability of seed quality traits in *Gossypium hirsutum* L. cultivars. The Pakistan Cottons, 37: 21-28.

Sial, M.A., K.D. Jamali, M.A. Arain and M. Ahmed, 1999. Adaptibility of semidwarf spring wheat in Sindh Province. Pak. J. Sci. Ind. Res., 42: 342-344.

Sial, M.A., M.A. Arain and M. Ahmed, 2000. Genotype x environment interaction on bread wheat grown over multiple sites and years in Pakistan. Pak. J. Bot., 32: 85-91.

Sial, M.A., M.A. Arain, M.A. Javed and M.A. Rajput, 2001. Genotype x environment interaction for grain yields in bread wheat. Proc. Pak. Acad. Sci., 38: 41-46.

Soomro, A.R., 2000. Assessment of *Gossypium hirsutum* L. F1 hybrids against commercial varieties NIAB 78 and CRIS 9 in Sakrand conditions. Pak. J. Sci. Ind. Res., 43: 184-187.