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Performance of Early Maturing Strains of Cotton (*Gossypium hirsutum* L.) Developed Through Induced Mutation and Hybridization

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Abstract: Two early maturing mutant strains viz. AENB-10/87 AENS-18/87, and a hybrid strain AEH-2/90 along with two commercial varieties; NIAB-78 and Rehmani were evaluated in zonal varietal trials. Genotype AENB-10/87 produced the highest seed cotton (2270 kg ha^{-1}) yield over all environments followed by AENB-18/87 (2193 kg ha^{-1}) and had the high regression coefficient (b = 1.106 and 1.108, respectively) and deviation from regression (S^2d) value (1551.305 and 2759.45, respectively) showed specific adaptation to poor environments. NIAB-78 with comparatively better yield had b value close to unity and lowest (S^2d) value indicating wide adaptability over the environments. The data indicated that AENB-10/87 followed by AENS-18/87 produced significantly higher seed cotton yield than AEH-2/90 and Rehmani at 3 out of four sites and ranked 1st and 2nd, respectively when averaged over all sites. AENB-10/87 also produced significantly higher number of bolls/plant, seed cotton yield/plant and ginning outturn percentage (GOT%) than the commercial varieties, whereas, it was at par with NIAB-78 in case of boll weight and staple length.

Key words: Cotton, seed cotton yield, stability analysis, adaptation

Introduction

Cotton (*Gossypium hirsutum* L.) is the major cash crop of Pakistan, that contributes about 60% of the total foreign exchange earnings and is considered to be the backbone of Pakistan's economy. Cotton is grown over an area of about 2.98 million hectares in Pakistan, among which Sindh shares 0.63 million hectares (Anonymous, 2000). However, the yield per unit area is much lower than the major cotton growing countries of the world. Improvement in seed cotton yield is the top most priority among the cotton breeding objectives. The availability of desirable variability through cross breeding depends upon the genetic diversity of the parents involved. This mutagenesis of cultivar or in combination with hybridization proved to be suitable techniques for enhancing further genetic variability in cotton (Al-Didi, 1965; Kuliev, 1983).

The yielding ability of a genotype is the results of its interaction with the environment. Consequently, the release of potential varieties with continuous yield performance over an array of environments is very essential to achieve maximum yield in a particular region (Abou-El-Fittouh *et al.*, 1969). Genotype x environment interaction can be result of genotype rank changes from one environment to another, difference in scale among environments, or a combination of these phenomena (Cornelius *et al.*, 1993). It has been observed that genotypes differ widely in their response to environment, some genotypes exhibit a highly specific response to a particular environment, others are uniform in performance over a range of environments (Bilboro and Ray, 1976; Baloch *et al.*, 1997; Baloch, 2001; Sial *et al.*, 2000; Sial *et al.*, 2001). Many statistical methods have been extensively used since long time to analyse the genotype x environment (GxE) interactions like joint regression analysis (Yates and Cochran, 1938; Finlay and Wilkinson, 1963; Eberhart and Russell, 1996, Zhang and Geng, 1986). To obtain a better understanding of GxE interactions, multi variate methods (cluster analysis) have been used (Zobel *et al.*, 1988). In recent years, AMMI (analysis additive main effect and multiplicative interaction) has come up as a very important method in explaining GxE studies (Yau, 1995).

The main objective of the present study was to evaluate the performance of the early maturing and higher yielding cotton strains developed through induced mutation and hybridization under different agroclimates in Sindh province.

Materials and Methods

The pure and homogeneous seeds of NIAB-78 and sarmast were irradiated each with different doses of gamma rays (250 and 300 Gy) from ^{60}CO source. The variants with early maturity and good plant type were selected from each M_2-irradiated population of both varieties. The two mutants each from NIAB-78-300 Gy γ-rays were isolated and confirmed in M_3 generation. Theses two early maturing mutant strains (AENB-10/87 and AENS-18/87) along with one early maturing hybrid strain AEH-2/90 and commercial varieties NIAB-78 and Rehmani were evaluated in zonal varietal trials at four different sites viz. Tandojam, Mirpur Khas, Sakrand and Hala during 1995-96. The experiment at each site was laid out in a randomized complete block design (RCBD) with 4 replications. The plot size was 36 m^2 (6 x 6m^2) with 8 rows, 75 cm distance between rows, 30 cm between plant to plant. Data for seed cotton yield (kg $plot^{-1}$) at each site and converted into kg ha^{-1}. The data for other yield contributing characters viz. seed cotton yield per plant (g), boll weight (g), number of balls per plant, ginning outturn (%) and staple length (mm) were recorded at Nuclear Institute of Agriculture (NIA), Tandojam site. Seed cotton yield (kg/plot) data were analyzed and significant differences between mean values were compared by using Duncan's Multiple Range Test (DMR) followed Gomez and Gomez (1983). In order to study the stability of yield performance of cotton strains, the parameters viz. mean seed cotton yield over all sites (mean), linear regression co-efficient (b), S.E(b) and deviation from regression coefficient (S^2d) were computed according to regression techniques proposed by Finlay and Wilkinson (1963) and Eberhart and Russell (1966).

Results and Discussion

The mutant strain AENB-10/87 produced significantly ($P \leq 0.05$) higher seed cotton yield than NIAB-78 (commercial variety) at three sites except Raja farm, Hala. It also produced significantly ($P \leq 0.05$) higher yield than other commercial varieties, Rehmani and NIAB 78 overall sites. AENB-10/87 exceeded in yield (2270 kg ha^{-1}), when averaged over all sites and ranked first. The second strain AENS-18/87 produced significantly ($P \leq 0.05$) higher yield of seed cotton at three sites except Hala site, where it was found at par in yield with commercial variety NIAB-78 (Table 1). Similarly, Kuleiv (1983) and Iqbal *et al.* (1991) reported higher seed cotton yield in mutants derived through gamma rays in cotton (*Gossypium hirsutum* L.).

The mean yield over all genotypes at each site was used as "site mean yield" (environmental mean). The site mean yields ranged from 1804.8 kg ha^{-1} at Raja Farm, Hala (low yielding site) to 2726.8 kg ha^{-1} at NIA, Tandojam (high yielding site). The regression coefficient (b) value on environmental index ranged from 0.795 in Rehmani to 1.108 in AENS-18/87 (Table 2). The regression coefficient (b) is close to unity in AEH-2/90 and NIAB-78 (0.993 and 0.999), whereas, it was lower ($b \leq 0.795$) in Rehmani. Genotypes AENB-10/87 and AENS-18/87, with higher mean yields

Table 1: Mean seed cotton yield (kg ha^{-1}) of cotton strains tested over different sites in Sindh

Strains/Varieties	Tandojam	Mirpurkhas	Sakrand	Raja Farm, Hala	Mean
AENS-18/87	2873a	2105b	1988b	1813a	2193b
AEH-2/90	2681b	1988c	1772cd	1820a	2064c
AENB-10/87	2935a	2225a	2060a	1856a	2270a
NIAB-78	2703b	1985c	1832c	1808a	2083c
Rehmani	2442c	1894d	1746d	1727b	1952d
Mean	2726.8	2039.4	1879.6	1804.8	

Means followed by different letters are significantly different from each other at $P \leq 0.05$

Table 2: Stability parameters of cotton stains/ varieties tested in zonal varietal trials in Sindh

Strains/Varieties	Over all mean yield (kg ha^{-1})	Regression coefficient b + S.E.(b)	Variance due to deviation from regression (S^2d)
AENS-18/87	2193	1.108±0.064	2759.445
AEH-2/90	2064	0.993±0.084	1214.860
AENB-10/87	2270	1.106±0.093	1551.305
NIAB-78	2083	0.999±0.044.	341.980
Rehmani	1952	0.795±0.028	112.150

Table 3: Mean values of different yield components of cotton strains

Strains/varieties	Seed cotton yield/plant	Boll weight (g)	No. of bolls/plant	Ginning outturn (%)	Staple length (mm)
AENS-18/87	89.7b	3.42a	27.2b	36.4b	27.4ab
AEH-2/90	87.7b	3.39a	26.7b	34.6c	27.8a
AENB-10/87	95.5a	3.35b	29.7a	37.4a	26.8cd
NIAB-78	86.8b	3.37a	26.3bc	34.6c	26.6d
Rehmani	83.5c	3.39a	25.3c	33.5d	27.1bc

Means followed by different letters are significantly different from each other at $P \leq 0.05$

(2270 and 2193 kg ha^{-1}, respectively) of seed cotton yield had higher b values (1.106 to 1.108, respectively) and S^2d (1551.305 and 2759.443, respectively) value suggesting specific adaptation to low yielding or poor environments. The commercial variety NIAB-78 produced comparatively better yield (2083 kg ha^{-1}) with regression coefficient (b= 0.999) close to unity and the lowest variance due to regression coefficient (S^2d=341.98) indicating wide stability over all the environments. Rehmani with low seed cotton yield had low b (0.795) and S^2d (112.15) value than all other entries suggesting specific adaptability and stability particularly in favorable environments.

The results of other measured yield associated characters indicated that the strain AENB-10/87 gave significantly ($P \leq 0.05$) higher seed cotton yield/plant (g), number of bolls per plant and GOT% (Table 3). The higher yield per plot in this genotype may be attributed to the significant increase in boll numbers/plant as compared to the commercial varieties. The strain AENS-18/87 followed by AEH-2/90 showed significantly ($P \leq 0.05$) higher seed cotton yield/plant (g) and boll numbers than Rehmani and were found at par in boll numbers and seed cotton yield/ plant (g) as compared with NIAB-78. The results are in agreement with Mukhov (1986), Mamedov and Shamaev (1987). In case of GOT%, the strain AENB-10/87 gave significantly higher lint percentage (37.4%) followed by AENS-18/87 (36.4%), whereas the strain AEH-2/90 produced GOT% at par (34.6%) with NIAB-78 and was better than Rehmani. The staple length was significantly longer (27.8mm) in strain AEH-2/90 than both NIAB-78 and Rehmani varieties (26.6 and 27.1 mm respectively).

In conclusion, this study has provided an evaluation of the environmental and agronomic performance of a set of cotton advanced strains/lines. Stability analysis has demonstrated the performance of a genotype over a range of environments. Genotypes AENB-10/87 and AENB-18/87 produced the highest seed cotton yield over all environments and had the high regression value and S^2d value showed specific adaptation to low yielding environments. The strain AENS-18/87 and AEH-2/90 showed significantly higher seed cotton yield/plant and boll numbers than check variety Rehmani and were found at par in boll numbers and seed cotton yield/ plant as compared with NIAB-78. GxE interaction studies, therefore can lead to better evaluation of new cotton strains/lines for stability in yield performance across the locations.

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