Asian Journal of
Plant Sciences

Study of Gene Action for Yield and Yield Components in *Gossypium hirsutum* L.

[1]Muhammas Aslam Khan, [2]Abdul Sattar Larik and [2]Zahoor Ahmed Soomro

[1]Agriculture Extension Kasur, Punjab, Pakistan

[2]Department of Plant Breeding and Genetics, Sindh Agriculture University, Tandojam 70060, Sindh, Pakistan

Abstract: A diallel cross experiment was conducted in Randomized Complete Block Design involving Stone-Ville-213, HG-6-1-N, Fregobract-83 and AG-*hirsutum*-87 upland cotton cultivars to ascertain the type of gene action for different quantitative traits. Data was collected on ginning out turn percentage, seed index and seed cotton yield/plant. The genotypes were highly (P≥ 0.01) significant. Results demonstrated that GOT% and seed index were controlled by over dominant type of gene action, whereas seed cotton yield/plant was governed by partial dominance type of gene action. The variety Stone-ville-213 is good general combiner for GOT% and seed cotton yield/plant whereas AG-*hirsutum*-87 is best general combiner for the character seed index. The crosses Stone-ville-213 x Fregobract-83, Stone-ville-213 x HG-6-1-N and Stone-ville-213 x AG-*hirsutum*-83 were the best specific combiner for GOT%, seed cotton yield/plant and seed index, respectively.

Key words: Gene action, combining ability, *Gossypium hirsutum* L.

Introduction

Pakistan is an agricultural country and cotton crop is the backbone for earning foreign exchange of the country. However, per acre production is low as compared to the other cotton growing countries. Now major dilemma faced by the cotton breeders is how to increase the decling yield level. This can be possible if existing scarce genetic sources are properly utilized. Therefore, it is a dried need to fix the desirable genes in such a manner that homozygous lines may be obtained to improve the cotton genotypes. Genetic improvement of cotton plant will ultimately lead to the enhanced productivity. Larik *et al.* (1999, 2000) have assessed the efficiency and effectiveness of selection for superior genotypes based on the estimation of gene action and other genetic parameters.

Therefore, the research work was designed to determine gene action and relative performance with respect to general as well as specific combining ability for yield and yield components.

Materials and Methods

The experiment was conducted in Randomized Complete Block Design (RCBD) at the Department of Plant Breeding and Genetics, Agricultural University Faisalabad during 1998-99. The direct and reciprocal crosses were made of four upland cotton varieties viz. Stone ville-213, HG-6-1-N, Fregobract-83 and AG-*hirsutum*-87. Data was collected for the characters, GOT%, Seed index and Seed cotton yield/plant, and was statistically analyzed through analysis of variance technique (Steel and Torrie, 1960) to determine the difference among F₁ hybrids and parents. For further genetic analysis diallel cross technique developed by Jinks (1955; 1956) was used. The information on gene action was inferred by plotting the variance (Vr) of each array against its covariance (Wr).

Results and Discussions

The mean performance of parents and F₁ hybrids is presented in Table 1 to 3. The mean square values of the characters are presented in Table 4, which showed that the differences between genotypes were highly (P≥ 0.01) significant indicating the existence of genetic variability among genotype for the traits studied.

Ginning out turn percentage: The analysis of variance for ginning out turn percentage (Table 4) indicated that the differences among the genotypes were significant. The values of variance and covariance graph shown in Fig. 1, also display that the regression line cuts the Wr axis below the origin. This signifies the over dominance type of gene action. As the regression line deviates significantly from a unit slop the expression appeared to be contaminated with non-allelic interaction. From the position of array points on the regression line it was shown that AG-*hirsutum*-87 being the most proximate to the origin had most dominant genes while the HG-6-1-N possesses the recessive genes for this character. It is clear from Table 1, that Stone ville-213 displayed 35.65 ginning
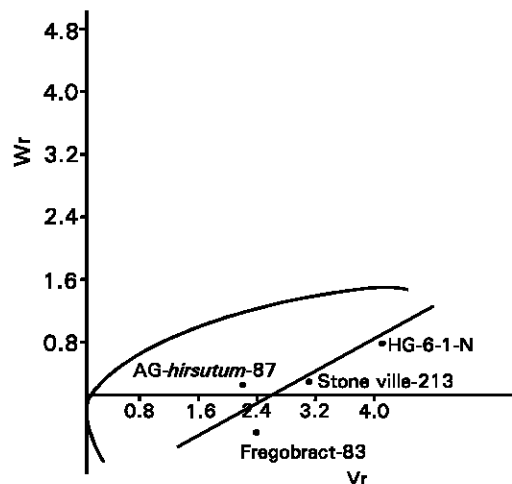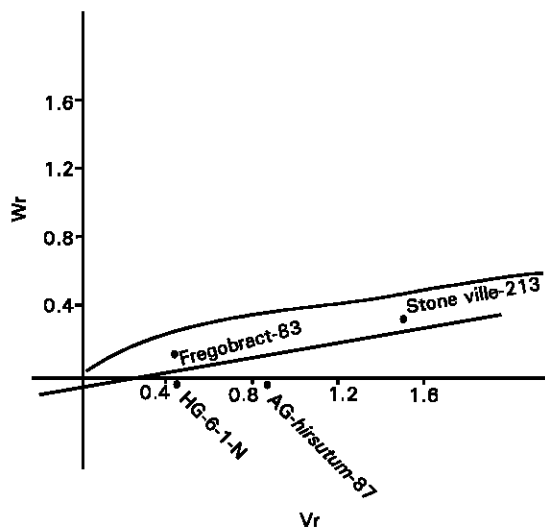

Fig. 1: Wr/Vr graph for ginning outtrun percentage
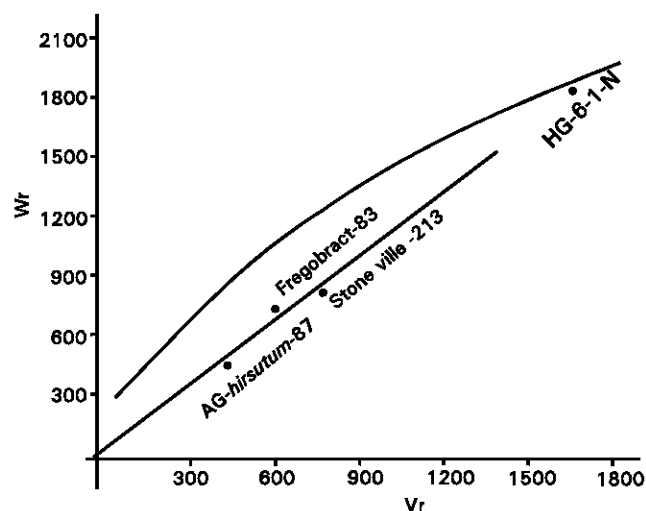

Fig. 2: Wr/Vr graph for seed index

Fig. 3: Wr/Vr graph for yield of seed cotton

Table 1: Diallel for ginning out turn percentage

	Stone ville-213	HG-6-1-N	AG-*hirsutum*-87	Fregobract-83
Stone ville-213	35.65	39.22	38.88	39.84
HG-6-1-N	39.22	34.55	37.75	38.20
AG-*hirsutum*87	38.88	35.75	35.43	37.56
Fragobract-83	39.84	38.20	37.56	36.09
Total	153.59	149.72	149.62	151.69
Array mean	38.39	37.43	37.40	37.92

Table 2: Diallel for seed index (g)

	Stone ville-213	HG-6-1-N	AG-*hirsutum*-87	Fregobract-83
Stone ville-213	5.45	7.22	8.28	6.21
HG-6-1-N	7.20	6.2	7.73	7.43
AG-*hirsutum*87	8.28	7.73	6.1	7.52
Fragobract-83	6.21	7.43	7.12	6.2
Total	27.16	28.58	29.23	26.95
Array mean	6.7	7.14	7.30	6.73

Table 3: Diallel for seed cotton yield/plant (g)

	Stone ville-213	HG-6-1-N	AG-*hirsutum*-87	Fregobract-83
Stone ville-213	134.86	127.07	81.61	87.22
HG-6-1-N	127.7	37.14	55.16	45.87
AG- *hirsuthum*87	81.61	56.16	43.19	84.7
Fragobract-83	87.22	46.87	84.7	39.81
Total	430.76	267.24	263.76	258.6
Array mean	107.69	66.81	65.94	64.65

Table 4: Mean squares for GOT %, seed index and seed cotton yield/plant

S.O.V	d.f	GOT %	Seed index	Seed cotton yield/Plant
Varieties	3	0.92	0.856	854.57
Genotypes	15	12.99**	2.998**	4925.46**
Error	45	1.13	0.66	1195.12

** = Significant at 0.01 level

out turn percentage but showing the highest array mean value (38.39) suggesting that Stone ville-213 was good general combiner and within the array the cross Stone ville-213 x Fragobract-83 showed highest value (39.84) which exhibited that this cross is best specific combiner for this trait. The results of variance and covariance are in accordance with the results of BingTang *et al.* (1993). They reported over dominance type of gene action whereas, Singh *et al.* (1982) and Keerio *et al.* (1995) explained additive type of gene action with partial dominance for this character.

Seed index: The analysis of variance for seed index is presented in Table 4, which indicates that the difference among the genotypes were significant. The variance and covariance graph for the character seed index is depicted in Fig. 2, which showed that the regression line intercepted the Wr axis below the origin, indicating the over dominance type of gene action. As the regression line deviates significantly from unit slop there appears some non-allelic interactions in this respect. The variety Fregobract is close to the origin which showed maximum dominant genes, whereas the Stone ville-213 have maximum recessive genes.

In Table 2, the variety AG-*hirsutum*-87 showed the mean 6.1 g but in the array it carries the highest mean (7.30 g) value which showed that it is good general combiner for this trait. Within the array the cross of Stone ville-213 x AG-*hirsutum*-87 had the highest value (8.28g) suggesting that the cross is specific combiner in this respect. The results are in conformity with the results of Larik *et al.* (1997), whereas, the Singh *et al.* (1982) reported additive type of gene action.

Seed cotton yield/plant: The analysis of variance for seed cotton yield/plant is presented in Table 4, indicates that the differences among the genotypes were highly significant. The Fig. 3 showed that the regression line passes the Wr axis above the origin which revealed the additive type of gene action with partial dominance. As the regression line deviates significantly from a unit slope there appears some interaction of nonallelic genes in this respect. The variety AG-*hirsutum*-87 is nearer to the origin indicating the presence of maximum dominant genes whereas, HG-6-1-N is far from the origin demonstrating that this variety has maximum recessive genes for this character. Results further (Table 3) showed that Stone ville-213 had highest array mean value (107.69) which suggested that Stone ville-213 is good general combiner for this trait and the cross. Stone ville-213 and HG-6-1-N had the highest value (127.07), thus it indicates that it is better specific combiner as compared to other crosses. Azhar *et al.* (1983) and Nadre *et al.* (1984) have also reported similar results from their studies. However, Keerio *et al.* (1995) reported over dominance type of gene action.

References

Azhar, F. M., M. D. Khan and M. A. Khan, 1983. Combining ability and diallel crosses of some *hirsutum* cultivars. The Pak Cotton, 27: 259-265.

BingTang, J. N. Jenkins, J. C. McCarty and C. E. Watson, 1993. F_2 hybrids of host plant germplasm and cotton cultivars. II. Heterosis and combining ability for fibre properties. Crop Sci., 33: 706-710.

Jinks, J. L., 1955. A survey of genetical basis of heterosis in a variety of diallel crosses. Heredity, 9: 223-227.

Jinks, J. L., 1956. The F_2 and back cross generations from a set of diallel crosses. Herdity, 10: 1-30.

Keerio, M. D., M. S. Kalwar, M. I. Memon and Z. A. Soomro, 1995. Genetics of seed cotton yield and its primary components in *G. hirsutum* L. Pak. J. Bot., 27: 425-429.

Larik, A. S., S. R. Ansari and M. B. Kumbhar, 1997. Heritability analysis of yield and quality components in *G. hirsutum* L. Pak. J. Bot., 29: 97-101.

Larik, A. S., A. R. Mahar, A. A. Kakar and M. A. Sheikh, 1999. Heterosis, inbreeding depression and combining ability in *Triticum aestivum*. Pak. J. Agric. Sci., 36: 39-44.

Larik, A. S., S. I. Malik, A. A. Kakar and M. A. Naz, 2000. Assessment of heritability and genetic advance for yield and yield components in *Gossypium hirsutum* L. Scientific Khyber, 13: 39-44.

Nadre, K. R., V. K. Shinde and V. G. Reddy, 1984. Diallel analysis of yield in desi cotton. J. Maharashtra Agric. Univ., 9: 29-31.

Singh, H. G., S. S. Malhi and G. S. Chahal, 1982. Single tester analysis for seed and fibre characters in upland cotton. Crop Improve., 9: 164-166.

Steel, R. G. D. and J. H. Torrie, 1960. Principles and procedures of statistics, McGraw Hill Publishing Co. Inc. New York, pp: 481.