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Diallel Analysis for Yield and Yield Contributing Characters in *Gossypium hirsutum* L.

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Abstract: A diallel cross experiment was conducted on 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. The genotypes were highly ($P \geq 0.01$) significant. Plant height and boll weight were controlled by over dominant type of gene action, whereas seed cotton yield per plant was governed by partial dominance type of gene action. The variety stone-ville-213 seemed good general combiner for plant height, number of bolls and seed cotton yield per plant whereas AG-*hirsutum*-87 was best general combiner for boll weight. The cross stone-ville-213 x fregobract-83 and stone-ville-213 x HG-6-1-N were the best specific combiner for number of bolls and seed cotton yield per plant respectively.

Key Words: Gene Action, Combining Ability, *Gossypium hirsutum*, Diallel

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 dilema 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 dire 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 and 2000) workout 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 research was conducted at the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The direct and reciprocal crosses were made on four American cotton varieties, viz. stone-ville-213, HG-6-1-N, fregobract-83 and AG-Hirsutum-87. Data collected were statistically analysed through the procedure of Steel and Torrie, (1960), to determine the difference among F_1 hybrids and parents. For detailed 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 Discussion

Plant Height: The analysis of variance for plant height (Table 1) indicated that differences among genotypes were highly significant ($P<0.01$). The values of variance and covariance (Fig. 1) revealed that the regression line intercepted the Wr axis just below the origin indicating the over dominance type of gene action. As the regression line deviates significantly from a unit slope some sort of interaction is controlling the phenotypic manifestation for this character. From the position of array points on the regression line it was shown that stone-ville-213 had the maximum dominant genes while HG-6-1-N had maximum recessive genes, (Table 2) suggested that the variety stone-ville-213 had highest array mean (159.80) which shows the good general combiner for this trait. The cross AG-Hirsutum-87x Stone-ville-213 had the highest value(167.08) which indicates the best specific combiner for the character plant height. Present results are in confirmity with the results of Sanyari *et al.,* (1982), Mirza and Khan (1984) and Keeroi *et al.,* (1995), all reported over dominance type of gene action.

Number of Bolls Per Plant: The analysis of variance for number of bolls/plant (Table 1) shows the difference among the genotype were highly significant. The variance and covariance (Fig. 2) indicating that the regression line cuts the Wr axis above the origin and signifies additive type of genes with partial dominance. The regression line deviated significantly from a unit slope showing some non-allelic interaction in this trait. Further it shows that variety AG-Hirsutum-87 is nearer to the origin having maximum dominant genes whereas the variety stone-ville-213 is farther to the origin having maximum recessive genes for this trait. The stone-ville-213 had maximum array mean (43.99) which indicates that stone-ville-213 is good general combiner, whereas cross stone-ville-213 x HG-6-1-N had highest value (47.2) which indicates the good specific combiner for this trait (Table 3). Haq (1982), BingTang *et al.,* (1993) and Shah *et al.,* (1993) got the same results by reporting additive type of genes with partial dominance.

Boll Weight: The analysis of variance for boll weight (Table 1) indicated that the differences among the genotypes were highly significant. Fig. 3 indicates that the regression line intercepted the Wr axis below the origin showing overdominance type of gene action. The regression line deviates significantly from a unit slope therefore presence of some interaction of genes in this regard. Further it shows that the variety HG-6-1-N possess maximum dominant genes being closer to

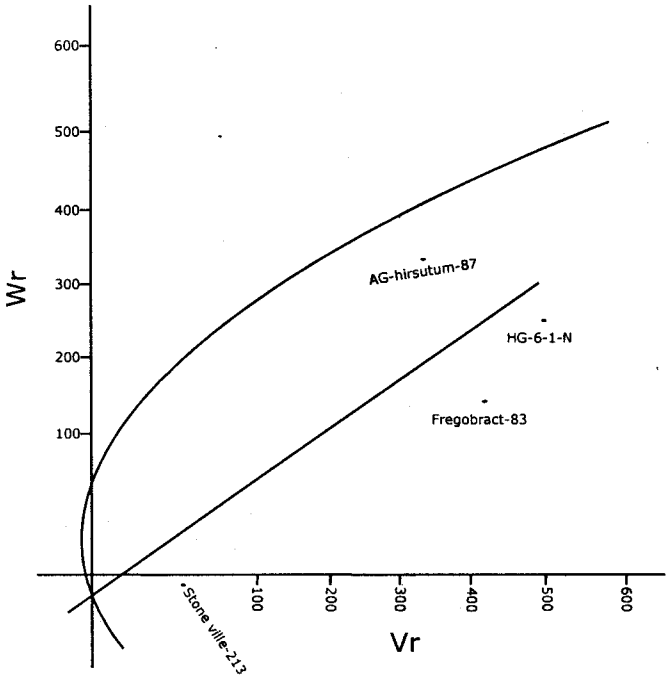

Fig .1: Wr/Vr Graph for Plant Height

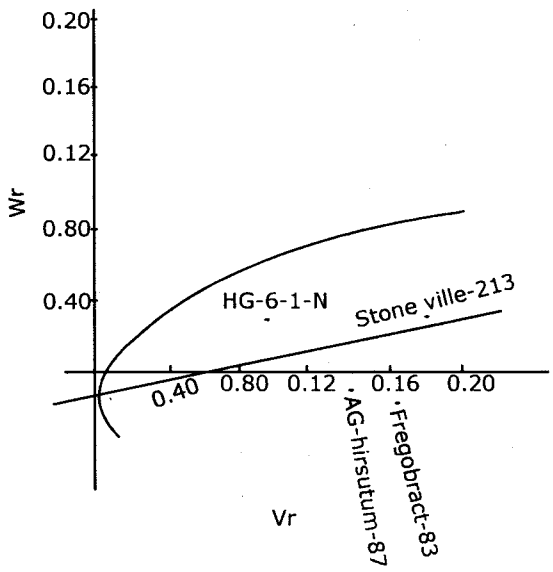

Fig .3: Wr/Vr Graph for Bolls Wight

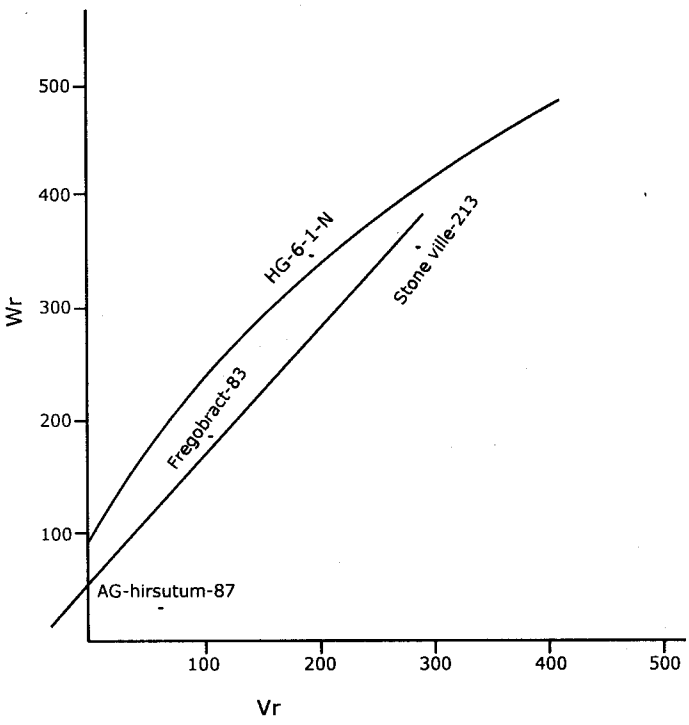

Fig .2: Wr/Vr Graph for Number of Bolls/Plant

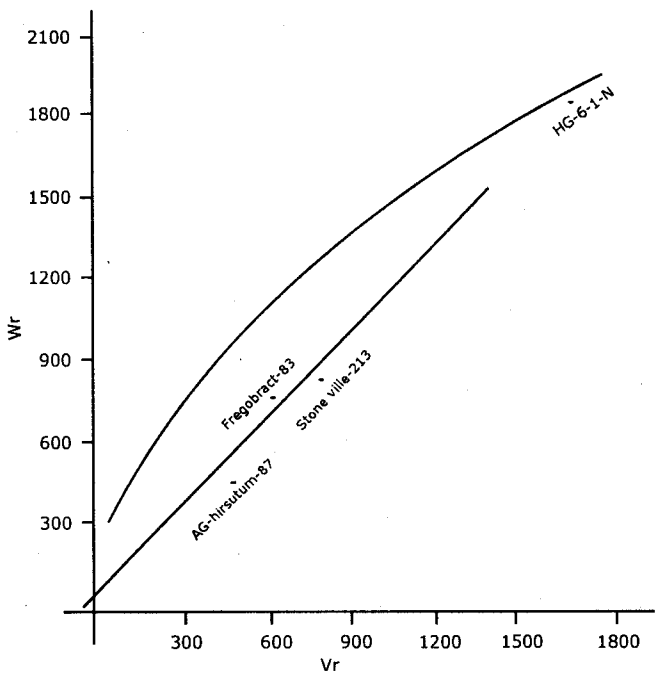

Fig .4: Wr/Vr Graph for Yield of Seed Cotton

Table 1: Mean Squares for Yield and Yield Contributing Characters of *Gossypium hirsutum* L.

Source of variation	D.F	Plant height	No. of boll/ plant	Boll weight	Seed cotton yield/ Plant
Varieties	3	358.52	58.76	0.046	854.57
Genotypes	15	1329.48**	840.62**	0.376**	4925.46**
Error	45	317.78	193.58	0.03	1195.12

** P< 0.01

Table 2: Diallel Analysis of Different Varieties of Cotton for Plant Height

Varieties	Stone ville-213	HG-6-1-N	AG-*hirsutum*-87	Fregobract-83
Stone ville-213	150.76	155.12	167.08	166.19
HG-6-1-N	155.12	105.82	127.91	144.37
AG-*hirsutum*87	167.08	127.91	147.91	135.49
Fragobract-83	166.19	144.37	135.49	118.17
Total	639.15	533.22	578.39	564.82
Array mean	159.80	133.3	144.5	141.2

Table 3: Diallel Analysis of Different Varieties of Cotton for Number of Bolls/plant

Varieties	Stone ville-213	HG-6-1-N	AG-*hirsutum*-87	Fregobract-83
Stone ville-213	66.75	47.2	27.27	34.75
HG-6-1-N	47.2	18.25	21.35	19.07
AG-*hirsutum*87	27.27	21.35	20.15	31.17
Fragobract-83	34.75	19.7	31.17	16.75
Total	175.97	106.57	99.94	101.74
Array mean	43.99	26.64	24.98	25.43

Table 4: Diallel Analysis of Different Varieties of Cotton for Boll Weight

Varieties	Stone ville-213	HG-6-1-N	AG-*hirsutum*-87	Fregobract-83
Stone ville-213	2.03	2.19	2.99	2.68
HG-6-1-N	2.69	1.99	2.6	2.52
AG-*hirsutum*87	2.99	2.6	2.14	2.64
Fragobract-83	2.68	2.82	2.64	2.43
Total	10.38	9.8	10.38	10.27
Array mean	2.6	2.45	2.6	2.56

Table 5: Diallel Analysis of Different Varieties of Cotton for Seed Cotton yield/plant (g)

Varieties	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-*hirsutum*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

the origin and variety stone-ville-213 had maximum recessive genes for this trait.

AG-*Hirsutum*-87 had highest array mean (2.6) showing better general combining ability, the cross AG-*Hirsutum*-87 x Stone-ville-213 had highest value (2.99), which exhibited better specific combining ability in this respect (Table 4). The results obtained from this research are same as results obtained from Singh *et al.*, (1982), Shah *et al.*, (1993) and Larik *et al.*, (1997), who reported over dominance type of gene action.

Seed Cotton Yield Per Plant: The analysis of variance for seed cotton yield per plant (Table 1) revealed that the differences among the genotypes were highly significant. The Wr Vr graph Fig. 4 showed that the regression line passes the Wr axis above the origin, which indicated 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 (Table 5) showed that stone ville-213 had highest array mean zvalue (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), which 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, Deshpande *et al.,* (1984) and Keerio *et al.,* (1995) reported over dominance type of gene action.

It was concluded that variety stone-ville-213 is god general combiner for seed cotton yield and other yield contributing characters like plant height and number of bolls per plant and this variety could be exploited (for producing hybrid cotton) in breeding programme for higher yield.

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