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Genetic Analysis of Plant Height, Grain Yield and other Traits in Wheat (*Triticum aestivum* L.)

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ABSTRACT

A five parent diallel involving wheat varieties/lines; K-65, LU26S, Tob-66, 6544-6 and KLR-6 was evaluated to study the inheritance pattern of plant height, yield and its components. Highly significant differences were observed among genotypes for all the traits except grain yield per plant for which the differences among genotypes were simply significant. The graphical representation indicated the additive type of gene action with partial dominance for plant height, peduncle length and grain yield per plant while number of tillers per plant and 1000-grain weight were conditioned by partial dominance. No epistatic effects were found for all the traits under consideration. From these results it could be concluded that selection for all the traits under study would be effective in early generation within limits of this experiment. The genotype K-65 appeared to be promising parent for wheat breeding programme.

Key Words: Gene action; *Triticum aestivum;* Partial dominance; Additive gene action; Plant height

INTRODUCTION

Although the accomplishments made in wheat breeding are commendable, yet concerted efforts are required to further improve the yield potential to meet the increasing demands of grains. For a systematic and successful hybridization programme a thorough understanding of genetic architecture of plant yield and other important economic characters must be achieved. For genetic studies various workers had used different biometrical methods but amongst them the approach of Hayman (1954) and Jinks (1955) had been followed frequently. Genetic analysis of some economic characters showed different pattern of inheritance. Khan *et al.* (1992) reported that partial dominance with additive gene effects were important for plant height. Singh *et al.* (1988) and Chowdhry *et al.* (1989) revealed that number of tillers per plant was conditioned by partial dominance type of gene action. Iqbal *et al.* (1991) studied the gene action for peduncle length and found that it was of partial dominance with additive type. Maksimov (1988), Alam *et al.* (1990) and Chowdhry *et al.* (1992) concluded that 1000-grain weight was governed by partial dominance type of gene action. Chandrakar *et al.* (1994) and El-Hennawy (1996) reported that the grain yield per plant was conditioned by additive gene action with partial dominance.

MATERIALS AND METHODS

The present investigations were carried out in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The parental material consisted of five wheat varieties/strains; K-65, LU26S, Tob-66, 6544-6 and KLR-16. The varieties/strains were crossed in complete diallel fashion during February-March, 1997. The F_1 seeds of all crosses along with their parents were planted in the field during 1997-98 for evaluation in a randomized complete block design with three replications. Single row of 5 m length served as an experimental unit. Inter-plant and inter-row distances were 15 cm and 30 cm, respectively. All other treatments were kept constant for whole the experiment. At maturity 10 guarded plants from each row of each replication were randomly selected. The data were recorded on plant height, number of tillers per plant, peduncle length, 1000-grain weight and grain yield on individual plant basis were taken.

Means of ten plants for each of the characters were used for statistical analysis (Steel & Torrie, 1980). The significant differences allowed the use of diallel analysis technique (Hayman, 1954; Jinks, 1955).

Statistical analysis. Perusal of Table I reveals that the genotypes have highly significant differences for all the traits under consideration except grain yield per plant for which the differences among genotypes were significant.

RESULTS AND DISCUSSION

Table I. Analysis of Variance

		Mean Squares				
S.O.V.	**D.F.**	**Plant height (cm)**	**Tillers/ plant**	**Peduncle length (cm)**	**1000-grain weight (g)**	**Grain yield (g)**
Rep.	2	84.35**	0.29	10.11**	10.35	87.48**
Genotypes	24	629.78**	3.35**	68.03**	61.14**	16.98*
Error	48	11.51	1.58	1.69	10.19	8.62
Total	74					

Plant height. Fig. 1 showed that regression line cuts the Wr-axis above the origin indicating the partial dominance with additive type of gene action. As the regression line is of unit slope, it confirms the absence of epistasis. The results seems to be compatible with those of Chowdhry *et al.* (1992) and Khan *et al.* (1992). It is also apparent from the graphic illustration that variety K-65 being closest to the origin possessed most of the dominant genes while variety KLR-16 carried most of the recessive genes being farthest from the origin. The variety K-65 having maximum array mean (134.53 cm) seems to be the best general combiner while variety Tob-66 having minimum array mean (107.70 cm) indicated poor combining ability (Table II). As the character exhibits additive gene action with partial dominance in the absence of epistasis, the selection in early generations would be beneficial.

Table II. Array means for different characters

Characters	K-65	LU26S	Tob-66	6544-6	KLR-16
Plant height (cm)	134.53	110.61	107.70	113.66	113.41
Number of tillers/plant	11.37	9.09	9.90	10.25	9.70
Peduncle length (cm)	48.66	41.17	41.50	40.22	41.30
1000-grain weight (g)	47.07	50.95	44.29	46.51	44.38
Grain yield (g)	18.59	17.36	16.08	19.61	19.18

Fig. 1. Vr/Wr graph for plant height (cm)

Tillers/plant. A reference to Fig. 2 indicated that inheritance pattern for number of tillers per plant appeared to be of partial dominance, as the regression line intercepts the Wr-axis above the point of origin. The estimated regression line did not deviate significantly from unit slope, suggesting the absence of non-allelic interaction. The information obtained from the present study also confirms the earlier conclusions of Singh *et al.* (1988) and Chowdhry *et al.* (1989).

Fig. 2. Vr/Wr graph for tillers/plant

The distribution of varietal array points on the regression line suggested that variety LU26S possessed maximum dominant genes being closest to the origin whereas the variety K-65 had maximum recessive genes being farthest from the origin. The variety Tob-66 and line 6544-6 have both dominant and recessive genes while variety KLR-16 have more dominant genes than recessive genes (Fig. 2). The variety K-65 showed maximum array mean (11.37) and seemed to be the best general combiner while variety LU26S having minimum array mean (9.09) exhibited poor combining ability (Table II).

Partial dominance in the absence of epistasis suggests the possibility of obtaining transgressive segregates for this character and selection would be fruitful in early segregating generations.

Fig. 3. Vr/Wr graph for peduncle length (cm)

Peduncle length. From Vr-Wr graph for peduncle length

(Fig.3) it is evident that the regression line cuts the Wr-axis above the origin, indicating partial dominance with additive gene action. The regression line did not deviate significantly from unit slope, suggesting the absence of epistasis. The results are in agreement with the earlier findings of Iqbal *et al.* (1991). The array point distribution on regression line depicts that the variety K-65 possessed maximum dominant genes being closest to the origin whereas the line 6544-6 had maximum recessive genes being farthest from the origin. The variety K-65 having maximum array mean (48.66 cm) proved to be the best general combiner while the line 6544-6 having minimum array mean (40.22 cm) indicated poor combining ability (Table II). The absence of epistasis and presence of additive gene action with partial dominance revealed that selection may be effective in early segregating generations.

Fig. 4. Vr/Wr graph for 1000-grain weight (g)

1000-grain weight. A reference to Fig. 4 indicated that inheritance pattern for 1000-grain weight appeared to be of partial dominance, as the regression line intercepts the Wr-axis above the point of origin. The estimated regression line did not deviate significantly from unit slope, suggesting the absence of non-allelic interaction. The results are in agreement with the earlier findings of Maksimov (1988), Alam *et al.* (1990) and Chowdhry *et al.* (1992). The distribution of array point on the regression line suggested that variety LU26S possessed maximum dominant genes being closest to the origin whereas the variety Tob-66 had maximum recessive genes being farthest from the origin. The variety LU26S having maximum array mean (50.95 g) proved to be the best general combiner while the variety Tob-66 having minimum array mean (44.29 g) indicated poor combining ability (Table II). The presence of partial dominance revealed that selection may be effective in early segregating generations.

Fig. 5. Vr/Wr graph for grain yield/plant (g)

Grain yield per plant. The graphical representation for grain yield per plant revealed that partial dominance with additive gene action was present for this character as the regression line cut the Wr-axis above the origin (Fig. 5). As the regression line did not deviate from the unit slope, the absence of epistasis was concluded. The results are in conformity with those already given by Chandrakar *et al.* (1994) and El-Hennawy (1996). From the relative position of array points on the regression line it is apparent that variety K-65 showed maximum dominant genes being closest to the origin while the variety Tob-66 contained minimum dominant genes being farthest from the origin. The line 6544-6 with maximum array mean (19.61 g) appeared to be the best general combiner while variety Tob-66 due to minimum array mean (16.08 g) seemed to have poor combining ability (Table II). The presence of partial dominance with additive type of gene action suggested that selection for improved grain yield could be made in early segregating generations and K-65 proved to be good general combiner for grain yield and its components, hence a promising parent for wheat breeding programme.

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