Genetic Mechanism For Some Spike Characteristics and Grain Yield In Bread Wheat

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Abstract
Five wheat varieties/lines viz; HABA-4, HABA-12, Ptic-62, Pak-81 and LU26S were crossed in a diallel fashion to determine the mode of inheritance of some important spike characteristics. Number of spikes per plant, number of grains per spike and grain yield per plant were governed by over dominance type of gene action. Number of spikelets per spike, spike length and 1000-grain weight were ruled by partial dominance with additive type of gene action except spike length in which additive type of gene action was observed. Epistasis was absent for all the traits studied.

Introduction
Wheat, the major food crop of Pakistan has always been an object of extensive research, wheat productivity can be maximized through the development of improved varieties from crosses. To evolve new wheat varieties, a plant breeder has to deal with hundreds of new crosses and thousands of progenies to pick up a desired combination. Thus he is in dire need of such techniques that will help him in the selection of suitable parents and screening of his breeding material in early generations. The diallel cross technique as advocated by Hayman (1954, 1958) and Jinks (1954, 1955) offers a method especially in self fertilized crops like wheat to assess the crosses right in the F1 generation and provides the necessary genetic information on the plant characters to determine the right breeding approach. Hussain et al. (1986) crossed six wheat varieties and showed that additive type of gene action was operative with partial dominance for number of spikelets per spike while for number of grains per spike and grain yield per plant over dominance type of gene action was present. Khan et al. (1992) analysed 6 x 6 complete diallel cross of spring wheat varieties and found additive gene action with some degree of partial dominance for spike length. Chowdhry et al. (1993) reported that the genetic interactions were apparently of over dominance type for number of spikes per plant and number of grains per spike while additive type of gene action with partial dominance and absence of non allelic interaction was found for 1000-grain weight. Bhatta et al. (1994) investigated from a 4 x 4 diallel cross in wheat that the grain yield per plant was controlled by non-additive type of gene action with over dominance. The present study was conducted to ascertain the type of genetic mechanisms involved in the expression of certain spike characteristics and grain yield of wheat in a five parental complete diallel cross. Such information would be helpful to keep up the tempo of our wheat improvement.

Materials and Methods
The present research work was carried out in the experimental area of the Department of Plant Breeding & Genetics, University of Agriculture, Faisalabad. The material comprised five different varieties/lines of wheat namely HABA-4, HABA-12, Ptic-62, Pak-81 and LU26S and were crossed in a complete diallel fashion during March, 1993. The F1s including the reciprocals and parents were sown in the field following replicated randomised complete block design during the year 1997-98. Four rows of plants were sown in the experimental unit with plant plant and row to row distance of 15 cm and 30 cm respectively. Sowing was done by dibbling method. Ten seeds per hole were sown and later after germination thinned to one seedling per site. Ten guarded plants were randomly selected at maturity from each genotype in each replication. The data were recorded on individual plants on number of spikes per plant, spike length, number of spikelets per spike, number of grains per spike, 1000-grain weight and grain yield per plant. The analysis of variance technique developed by Steel and Torrie (1980) was applied to estimate the significance of mean differences and when the differences were significant, the data were further subjected to diallel analysis technique advocated by Hayman (1954, 1958) and Jinks (1954, 1955).

Results and Discussion
Analysis of variance for important spike characteristics and grain yield exhibited highly significant differences among genotypes (Table 1) from which it was evident that diversity for these traits existed among the parents which could be utilized for wheat improvement programs.

Number of spikes per plant: The Vr/Wr gene representation revealed that regression line intercepted the Wr-axis below the origin indicating over dominance type of gene action (Fig.1). Similar results were reported by Chowdhry et al. (1993). Epistasis was absent as the regression line did not deviate significantly from unity. The distribution of varietal array points on regression
Asif et al.: Bread wheat, genotypes, cross breeding, spike characteristics, grain yield, Pakistan.

![Graph 1](image1.png)

**Figure 1:** \( \frac{Vr}{Wr} \) graph for number of spikes per plant.

![Graph 2](image2.png)

**Figure 2:** \( \frac{Vr}{Wr} \) graph for spike length.

![Graph 3](image3.png)

**Figure 3:** \( \frac{Vr}{ Wr} \) graph for number of spikelets per spike.

![Graph 4](image4.png)

**Figure 4:** \( \frac{Vr}{Wr} \) graph for grains per spike.

![Graph 5](image5.png)

**Figure 5:** \( \frac{Vr}{Wr} \) graph for 1000-grain weight.

![Graph 6](image6.png)

**Figure 6:** \( \frac{Vr}{Wr} \) graph for grain yield per plant.

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Table 1. Analysis of variance for spike characteristics and grain yield per plant in a 5 x 5 diallel cross of wheat.

<table>
<thead>
<tr>
<th>S.O.V.</th>
<th>df</th>
<th>Number of spikes per plant</th>
<th>Number of spikelets per spike</th>
<th>Number of grains per spike</th>
<th>1000-grain weight</th>
<th>Grain yield per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replications</td>
<td>2</td>
<td>4.79</td>
<td>0.45</td>
<td>1.38</td>
<td>0.03</td>
<td>3.20</td>
</tr>
<tr>
<td>Genotypes</td>
<td>24</td>
<td>3.19**</td>
<td>1.46**</td>
<td>3.14**</td>
<td>46.19**</td>
<td>53.22**</td>
</tr>
<tr>
<td>Error</td>
<td>48</td>
<td>0.61</td>
<td>0.24</td>
<td>0.48</td>
<td>1.21</td>
<td>1.31</td>
</tr>
</tbody>
</table>

** = Highly significant

Dominant genes being closest to the origin whereas the revealed that the line HABA-4 possessed maximum variety Pak-81 had maximum recessive genes being farthest from the origin. The selection in early generations would be difficult because of the over-dominance type of gene action.

Spike length (cm.): From the Fig. 2 it is evident that this trait exhibited partial dominance as the regression line cut wr-axis just above the point of origin. Khan et al. (1992) reported partial dominance with additive type of gene action for this trait. The distribution of array points on regression line indicated that the line HABA-12 being closer to the origin carried maximum dominant genes while the variety Pitic-62 being farthest from the origin carried maximum recessive genes. As the regression line was of unit slope, it confirmed the absence of epistasis. The selection would be effective in later generation for spike length which was controlled by partial dominance with non additive type of gene action in the absence of epistasis.

Number of spikelets per spike: Fig. 3 showed that inheritance pattern for number of spikelets per spike appeared to be additive with partial dominance, as the regression line intercepted the Wr-axis above the point of origin. These results were in agreement with the findings of Hussain et al. (1986). The estimated regression line deviated non significantly from unit slope, suggesting the absence of non allelic interactions. The distribution of varietal array points on the regression line suggested that the line HABA-12 possessed maximum dominant genes being closest to the origin while the variety Pitic-62 being farthest from the origin obtained maximum recessive genes. As this character exhibited additive type of gene action with partial dominance in the absence of epistasis, the selection in early generation would be beneficial.

Number of grains per spike: The graphical illustration of Vr/Wr indicated the over dominance type of gene action for number of grains per spike, as the regression line cut the Wr-axis below the point of origin (Fig. 4). Similar results were reported by Hussain et al. (1986) and Chowdhry et al. (1993). The regression line did not deviate significantly from unit slope the variety Pak-81 being closest to the origin had maximum dominant genes while the variety Pitic-62 carried the maximum recessive genes being farthest from the point of origin. Selection would be difficult in earlier generations for number of grains per spike due to the over dominance type of gene action.

1000-grain weight (g): The graphic representation of Vr/Wr indicated that additive with partial dominance type of gene action governed the expression of 1000-grain weight, the regression line cut the Wr-axis above the point of origin (Fig. 5). Similar results were found by Chowdhry et al. (1993). There was no non allelic interaction because the regression line did not deviate from the unit slope. The distribution of varietal array points on the regression line indicated that the variety LU26S possessed the maximum dominant genes being closest to the point of origin while the line HABA-4 being farthest from the origin carried maximum recessive genes. Additive type of gene action with partial dominance in the absence of epistasis for 1000-grain weight suggested that selection in early generations would be very effective for this trait.

Grain yield per plant (g): The values of Vr/Wr graph for grain yield per plant illustrated the over dominance type of gene action as the regression line intercepted the Wr-axis below the point of origin (Fig. 6). These results were in agreement with those of obtained by Hussain et al. (1986) and Bhatta et al. (1994). Since the estimated regression line deviated non significantly from unit slope, so the epistasis was absent. The distribution of varietal array points on the regression line indicated that the variety Pitic-62 being closest to the origin had maximum dominant genes while the variety Pak-81 carried maximum recessive genes being farthest from the origin. Due to the over dominance type of gene action for grain yield per plant, the effective selection in early generations would be some what difficult.

References
