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Genetic Control of Some Yield Attributes in Bread Wheat

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Abstract: Five wheat varieties/lines viz., Shahkar-95, Chakwal-86, Fsd-85, Rawal-87 and Pasban-90 were crossed in a diallel fashion to determine the genetic mechanism controlling yield and its components. Spike length, number of spikelet per spike, 1000-grain weight and grain yield per plant were governed by over dominance type of gene action. Number of tillers per plant and number of grains per spike were controlled by additive type of gene action with partial dominance. Epistasis was absent for all the traits studied.

Key words: Diallel, gene action, allelic interaction, genotypes, yield

Introduction

Wheat (*Triticum aestivum* L.) is the staple food for most of the people in the world. The production of wheat needs to be increased annually to maintain supply for the increasing consumer population. So in bread wheat, breeding based on economic traits had been receiving maximum attention for a long time. Hence an estimate of gene action is important in launching successful breeding programme.

The diallel analysis developed by Hayman (1954) and Jinks (1955) provide a fairly reliable mechanism to properly understand the genetic system and gene action involved in the expression of important traits.

Hussain *et al.* (1986) and Khan *et al.* (1992) reported that number of spikelets per spike was conditioned by over dominance type of gene action. Similar results have also been reported by Khan *et al.* (1984) and Iqbal *et al.* (1991) for spike length. Regarding 1000-grain weight and grain yield per plant, similar findings were observed by Zia and Chowdhry (1980) and Chowdhry *et al.* (1989) while additive gene action with partial dominance was reported by Khan *et al.* (1982) and Iqbal *et al.* (1989) for number of tillers per plant. Chowdhry *et al.* (1982) and Chowdhry *et al.* (1995) reported additive type of gene action with partial dominance for number of grains per spike.

Materials and Methods

The present research was conducted in the experimental area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The experimental material consisted of five wheat varieties/strains viz., Shahkar-95, Chakwal-86, Fsd-85, Rawal-87 and Pasban-90. The varieties/strains were crossed in a complete diallel fashion during cross season 1998-99. Seed of all crosses along with their parents were planted in the field during 2nd week of Nov. 1999-2000 in a randomized complete block design with three replications. Single row of 5 meter length served as an experimental unit. Inter-plant and inter-row distances were 15 and 30 cm, respectively. All other treatments were kept constant for whole the experiment. At maturity ten guarded plants from each row of each replication were randomly selected. The data were recorded on the number of tillers per plant, number of spikelets per spike, spike length (cm), 1000-grain weight (g), number of grains per spike and grain yield per plant (g) on individual plant basis.

Mean of ten plants for each character were used for statistical analysis. The data recorded were subjected to analysis of variance technique (Steel and Torrie, 1980) and where the differences were found significant, means were subjected to diallel analysis techniques developed by Hayman (1954) and Jinks (1955).

Results and Discussion

The analysis of variance indicated highly significant differences for all the traits under consideration except number of tillers per plant and number of spikelets per spike for which the differences among genotypes were significant (Table 1).

Number of tillers per plant: The Fig. 1 showed that regression line cuts the Wr-axis above the origin indicating the additive type of gene action with partial dominance. As regression line is of unit slope it confirms the absence of epistasis. The results are in agreement with the findings of Khan *et al.* (1982) and Iqbal *et al.* (1989). The position of array points on the regression line indicated that genotype Chakwal 86 had maximum dominant genes being closest to the origin, whereas variety Pasban 90 being farthest from origin contained maximum recessive genes. As the character exhibits additive gene action with partial dominance in the absence of epistasis, selection in early generation will be beneficial.

Spike length: The Vr/Wr graph shows that regression line intercepts the Wr-axis below the origin indicating non additive gene action with over dominance. The deviation of regression line was not significant from unity. This indicates that there was no non-allelic interaction. Similar results were also reported by Khan *et al.* (1984) and Iqbal *et al.* (1991). Array points (Fig. 2) showed that variety Chakwal 86 being nearest to the origin had most of the dominant genes while Pasban 90 was the farthest from origin so it carried most of the recessive genes. The present study showed the non-additive type of

Table 1: Analysis of variance for yield characteristics in a 5 x 5 diallel cross of wheat.

S.O.V.	df	Mean Squares					
		Number of tillers per plant	Spike length	Number of spikelets per spike	Number of grains per spike	1000-grain weight	Grain yield per plant
Replication	2	1.1283	2.8078	0.778	4.963783	1.162	2.826
Genotypes	24	13.1808*	30.4900**	87.559*	241.4938**	145.660**	54.735**
Error	48	13.6184	21.329	94.880	49.30183	96.527	59.101

** = Highly Significant * = Significant

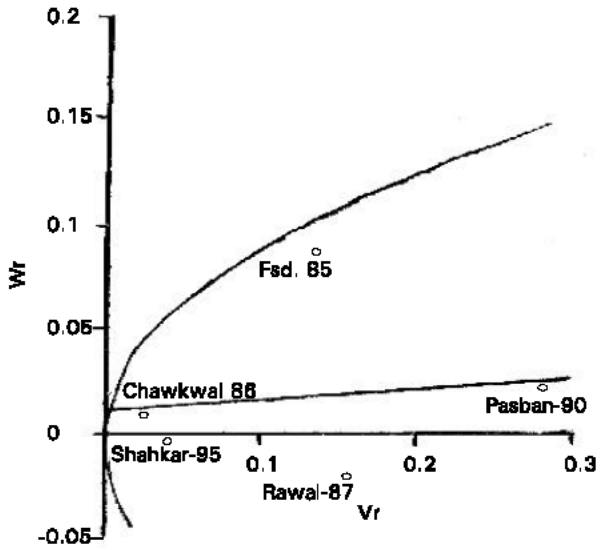

Fig. 1: Vr/Wr graph for number of tillers per plant

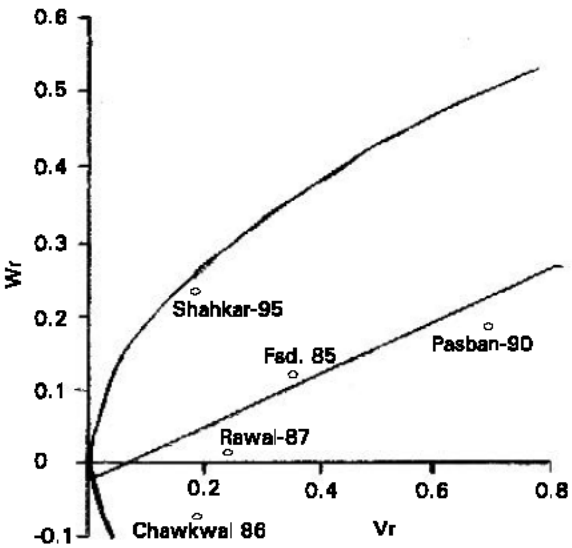

Fig. 2: Vr/Wr graph for spike length

gene action, so selection in early generation would be difficult.

Number of spikelets per spike: The regression line cuts Wr-axis below origin indicating non additive and over dominance type of gene action. Similar results have also been reported by Hussain *et al.* (1986) and Khan *et al.* (1992). The estimated regression line was not deviated from unit slope. This suggests the absence of non allelic interaction. The distribution of varietal array points on the regression line indicated that variety Pasban 90 possessed the maximum dominant genes being closest to the point of origin while variety Chakwal 86 being farthest from the origin carried maximum recessive genes (Fig. 3). Non-additive type of gene action suggests that selection in early generation would be difficult for this trait.

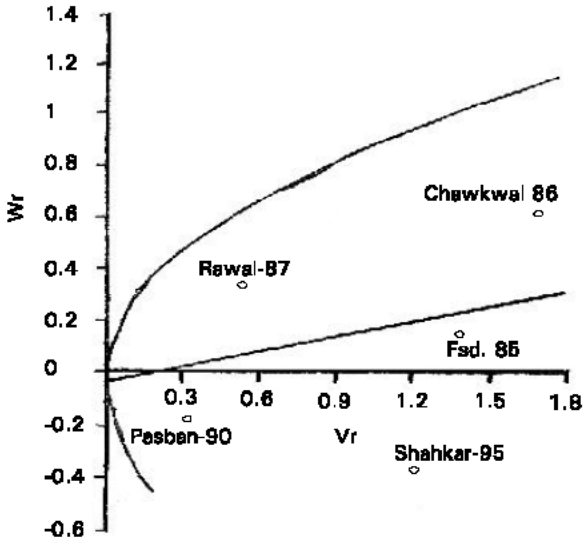

Fig. 3: Vr/Wr graph for number of spikelets per spike.

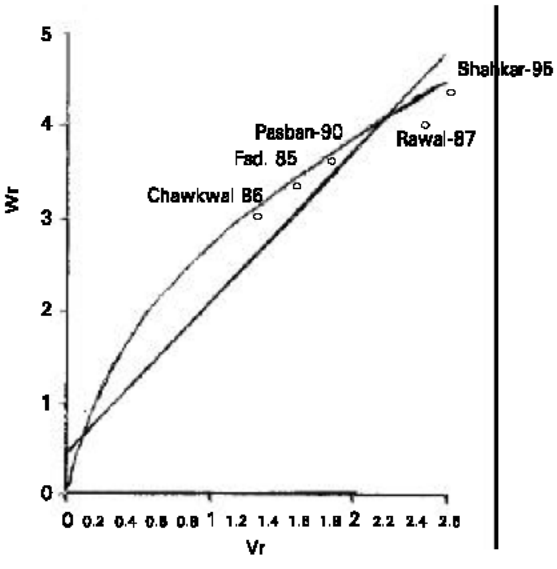

Fig. 4: Vr/Wr graph for number of grains per spike.

Number of grains per spike: From Fig. 4, it is evident that this trait showed additive type of gene action with partial dominance as the regression line intercepts Wr-axis just above the point of origin indicating additive type of gene action Adnan and Bhutta (1994) and Tahir *et al.* (1995) reported partial dominance with additive type of gene action for this trait. It is apparent from the graphic illustration that variety Chakwal 86 being closest to the origin carried maximum dominant genes. Whereas genotype Shahkar 95 contained maximum recessive gene being farthest from the point of origin. The selection in early generation would be effective because of additive gene action with partial dominance.

1000-grain weight: The inheritance pattern for 1000-grain weight appeared to be non additive type of gene action as

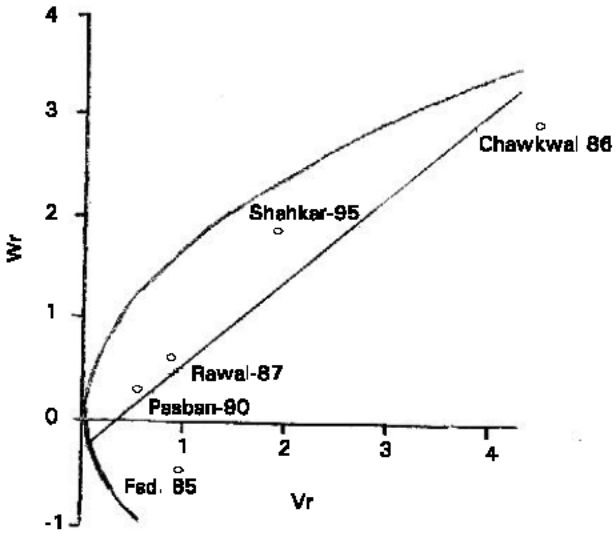

Fig. 5: Vr/Wr graph for 1000-grain weight

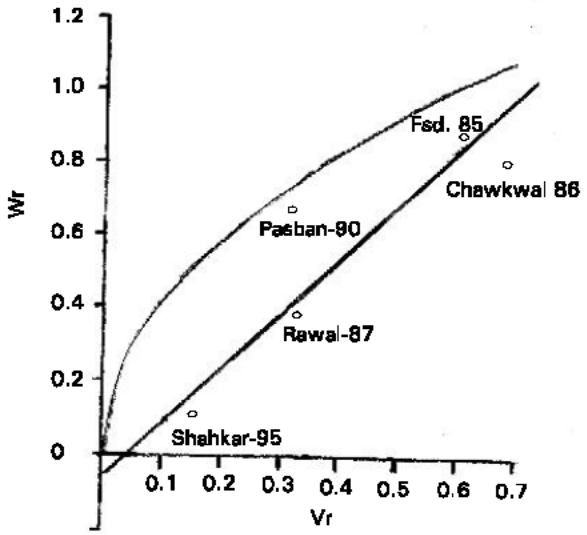

Fig. 6: Vr/Wr graph for grain yield per plant.

regression line cuts the Wr-axis below the origin (Fig. 5). The array points revealed that Pasban 90 was nearest to the origin, so it contained maximum dominant genes and variety Chakwal 86 being farthest from the origin possessed maximum recessive genes. The results derived from the present study are in accordance with those of Zia and Chowdhry (1980), Lonts (1984) and Iqbal *et al.* (1991). There was no non-allelic interaction as the regression line did not deviate from unit slope. Due to over dominance type of gene action for 1000-grain weight the selection would be difficult in early generation.

Grain yield per plant: The graphical representation of Vr/Wr indicated the over dominance type of gene action for yield per plant as the regression line cut the Wr-axis below the point of origin (Fig. 6). These results were in agreement with those of Zia and Chowdhry (1980). The estimated regression line deviated non-significantly from unit slope suggesting the absence of non-allelic interactions.

The distribution of array points on regression line indicated that variety Shahkar 95 being closer to the origin carried maximum dominant genes while variety Fsd 85 being farthest from the origin possessed maximum recessive gene. The selection would be difficult in later generation for grain yield per plant which was controlled by non additive gene action in the absence of epistasis.

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