INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2005/07–6–1015–1018
http://www.ijab.org

Inheritance Pattern of Plant Height, Grain Yield and Some Leaf Characteristics of Spring Wheat

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ABSTRACT

Studies were conducted to estimate the inheritance pattern of some quantitative characters in a 5×5 diallel cross involving five wheat verities / lines viz., Fsd. 83, Fsd. 85, Pb. 96, 9244 and 9247 during crop season 2004-2005. Plant height, specific flag leaf area, specific flag leaf weight and grain yield per plant were controlled by the over dominance type of gene action; whereas, flag leaf area and flag leaf weight seemed to be determined by the additive type of gene action with partial dominance. Epistasis was found absent for all the characters studied. For the traits like plant height, specific flag leaf area, specific flag leaf weight and grain yield per plant, delayed selection will be fruitful while, for flag leaf area and flag leaf weight, selection in the early segregating generations will be most effective.

Key Words: Inheritance; Quantitative characters; Spring wheat; Pakistan
Abbreviations: Fsd. Faisalabad; Pb. Punjab

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a high rank cereal all over the world, occupying 17% of the total cultivated land in the world and is staple food for 35% of the world's population providing more calories and protein in the human diet than any other crop (CIMMYT, 2000).

Evolution of the new genotypes by continuous genetic recombination is the need of today. Inheritance studies are of great importance to start an effective breeding program to gain the useful information about the hybrids in terms of the performance of their parents and to attain the maximum genetic gain with minimum resources.

Diallel technique developed and illustrated by Hayman (1954) and Jinks (1954) provides very important information about the genetic mechanism in the segregating generations.

In most of the diallel studies of wheat, plant height seemed to be controlled by the over dominance type of gene action (Iqbal *et al*., 1991; Uma & Sharma 1997; Chowdhry *et al*., 2002). Similarly, Mahmood and Chowdhry (2000) from a diallel cross of wheat observed over dominance type of gene action for specific flag leaf area and specific flag leaf weight, while they reported additive gene action with partial dominance for flag leaf weight. Over dominance was also noted for grain yield per plant by Chowdhry *et al*. (2001) and Chowdhry *et al*. (2002). Srivasta and Nema (1993), Awaad (1996), Chowdhry *et al*. (1999) and Kashif and Khaliq (2003) studied partial dominance with additive gene action for flag leaf area.

The main objective of this study was to obtain the information about inheritance pattern of some traits as plant height, grain yield and some leaf characteristics in a 5×5 diallel cross of wheat. This information would be of great importance in the selection of desirable parents for an effective breeding program to evolve new varieties of economic importance.

MATERIALS AND METHODS

The present research work was conducted in the field area of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during crop season 2004-2005. The experimental material comprised of five spring wheat varieties / lines of diverse genetic background viz., Fsd. 83, Fsd. 85, Pb. 96, 9244 and 9247. These genotypes were crossed in a diallel fashion.

Seeds of above F_1 crosses along with their parents were planted in the field using randomized complete block design with three replications. Two seeds per hole were sown with the help of a dibble and latter thinned to one seedling per site after germination. Other cultural and agronomic practices were kept uniform for whole experiment. Ten guarded plants from each parent and hybrid were selected randomly and data were recorded for plant height (cm), flag leaf area (cm^2), flag leaf weight (mg), specific flag leaf area, specific flag leaf weight and grain yield per plant (g) on individual plant basis. The data thus collected were subjected to analysis of variance technique (Steel & Torrie, 1980). The characters showing significant differences among genotypes were further analyzed by Hayman (1954) and Jinks (1954) techniques.

RESULTS AND DISCUSSION

The analysis of variance showed highly significant

differences among the genotypes for all the traits under consideration. (Table I).

Plant height. Graphical analysis (Fig. 1) indicated that regression line intercepted Wr-axis on the negative side below the point of origin indicating that plant height was governed by the over dominance type of gene action. Epistasis was found absent as the regression line did not deviate significantly from the unit slope. Similar results have been reported by Uma and Sharma (1997), Chowdhry *et al.* (2002) and Arshad and Chowdhry (2003). Distribution of array points along the regression line (Fig. 1) revealed that Fsd. 83 contained maximum dominant genes being closest to the origin while 9247, which was located farthest possessed most recessive genes for plant height. These results suggest that selection would be difficult in the early generations for plant height due to over dominance type of gene action.

Flag leaf area. The Vr / Wr graph (Fig. 2) showed that regression line intercepted Wr-axis above the point of origin suggesting that flag leaf area was governed by the additive gene action with partial dominance. Absence of non-allelic interaction was also found. Chowdhry *et al*. (1999), Mahmood and Chowdhry (2000) and Kashif and Khaliq (2003) also reported the same results. From these results it is noted that selection would be effective in the early generations for flag leaf area due to additive type of gene action with partial dominance. Distribution of array points along the regression line (Fig. 2) revealed that 9247 contained maximum dominant genes being closest to the origin followed by 9244 while Pb. 96 being farthest possessed most recessive genes for flag leaf area.

Flag leaf weight. Graphical analysis (Fig. 3) revealed that regression line cuts Wr-axis above the point of origin, therefore, flag leaf weight were controlled by the additive gene action with partial dominance. Regression line did not deviate significantly from the unit slope suggesting that non-allelic interaction was found absent. Additive gene action with partial dominance gives the idea of selection in the early generations. These results are in agreement with Mahmood and Chowdhry (2000). In Fig. 3, distribution of array points along the regression line showed that Fsd. 85 contained maximum dominant genes being closest to the origin while 9247, which was located farthest possessed most recessive genes for flag leaf weight.

Specific flag leaf area. Graphical analysis (Fig. 4) revealed that regression line intercepted Wr-axis below the point of origin indicating that flag leaf area was governed by the over dominance type of gene action. Epistasis was found absent as the b value did not deviate significantly from the unity. These results suggest that selection would not be effective in the early segregating generations. Graph also revealed that Fsd. 83 had maximum dominant genes for the specific flag leaf area being closest to the point of origin followed by Fsd. 85, while 9244 had maximum recessive genes due to its distant position from the point of origin (Fig. 4). Mahmood and Chowdhry (2000) also reported the over dominance type of gene action for the specific flag leaf area.

Table I. Mean squares of some quantitative traits in a 5 x 5 diallel cross of wheat

SOV	df	Plant height	Flag leaf area	Flag leaf weight	Specific flag leaf area	Specific flag leaf weight	Grain yield per plant
Replication	2	16.48^{*}	3.48^{ns}	47.65^{ns}	0.00016^{ns}	0.24^{ns}	2.38^{ns}
Genotypes	24	18.41^{**}	29.97^{**}	3824.02	0.00212^{**}	2.99^{**}	17.67^{**}
Error	48	3.88	2.58	162.40	0.00032	0.37	1.61

ns = Non-significant * = Significant **= Highly significant

Fig. 1. Vr/Wr graph for plant height

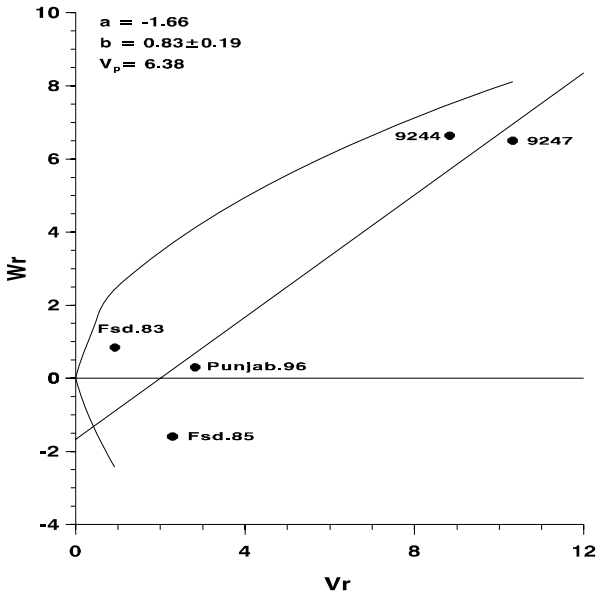


Fig. 2. Vr/Wr graph for flag leaf area

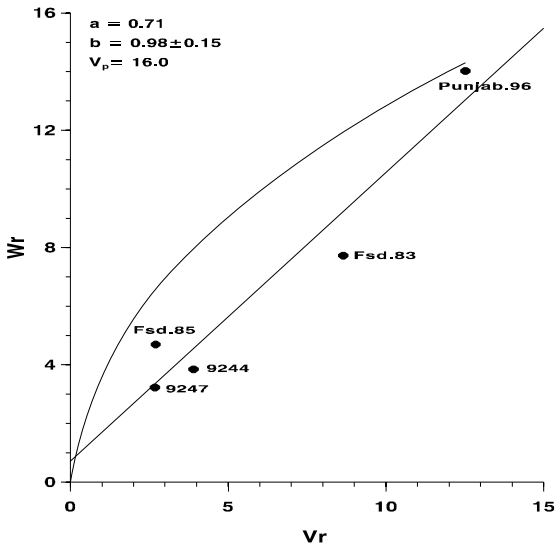


Fig. 3. Vr/Wr graph for flag leaf weight

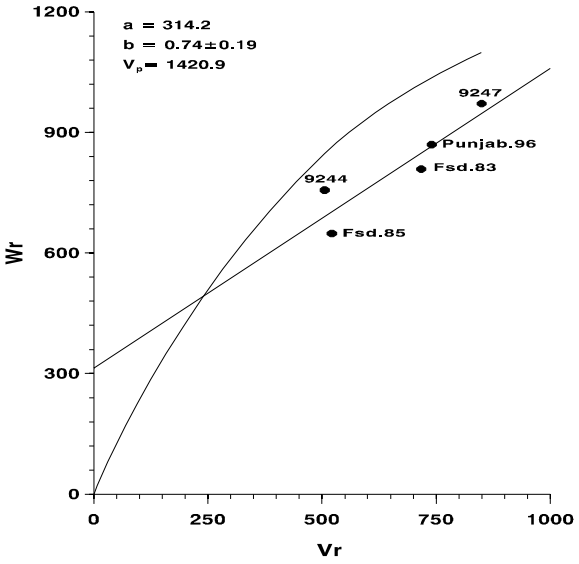
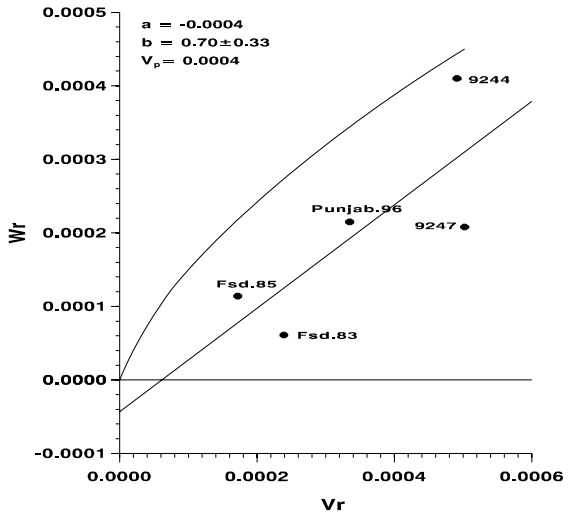


Fig. 4. Vr/Wr graph for specific flag leaf area



Specific flag leaf weight. A study of Fig. 5 indicates that regression line intercepted Wr-axis below the point of origin suggesting that specific flag leaf weight was governed by the over dominance type of gene action. As the regression line did not deviate significantly from the unit slope, therefore, non-allelic interaction was found absent. These results are similar to those of Mahmood and Chowdhry (2000). Placement of array points along the regression line (Fig. 5) depicted that Fsd. 85 contained maximum dominant genes being closest to the origin, while 9247 which was located farthest possessed most recessive genes for the specific flag leaf weight. From these observations it is clear that selection would be effective in the later generations for this trait due to over dominance type of gene action.

Grain yield per plant. The Vr / Wr graphical representation (Fig. 6) indicated that regression line intercepted Wr-axis below the point of origin indicating that grain yield per plant was controlled by the over dominance type of gene action. Epistasis was found absent as the regression line did not deviate significantly from the unit slope. Distribution of array points along the regression line (Fig. 6) revealed that 9247 contained maximum dominant genes being closest to the origin while Fsd. 85, which was located farthest possessed most recessive genes for the grain yield per plant. These results suggest that selection would be difficult in the early generations for grain yield per plant due to over dominance type of gene action. Similar results have earlier been reported by Chowdhry *et al.* (2001) and (2002).

These studies concluded that the traits like plant

Fig. 5. Vr/Wr graph for specific flag leaf weight

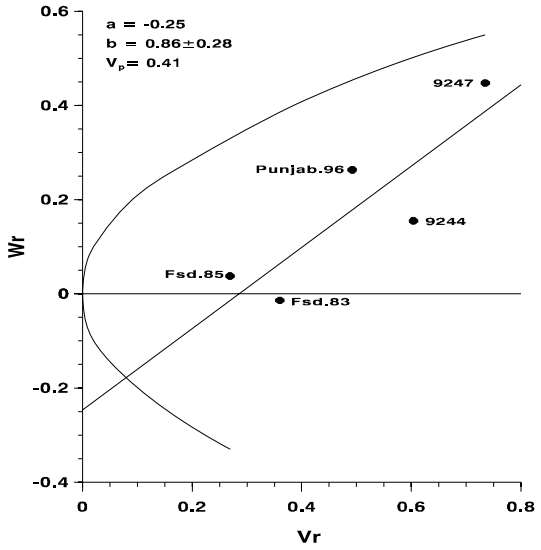
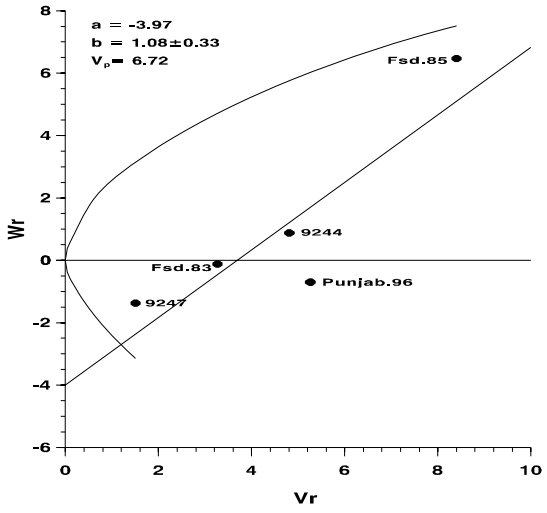


Fig. 6. Vr/Wr graph for grain yield per plant



height, specific flag leaf area, specific flag leaf weight and grain yield per plant were controlled by the over dominance type of gene action, therefore, selection for these traits can be done in the latter segregating generations; whereas, flag leaf area and flag leaf weight showed additive type of gene action with partial dominance suggesting the selection in early generations.

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(Received 10 August 2005; Accepted 18 September 2005)