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Genetic Determination for Some Drought Related Leaf Traits in Bread Wheat

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Abstract: Mode of gene action was studied in a 5 x 5 diallel cross of bread wheat involving five genotypes namely 8073, 8177, 6039-4, Pb-96 and MH-97. Highly significant differences were observed for all the traits studied. Over-dominance was observed in hygrophilic colloids and stomata size. Flag leaf area, leaf venation and stomatal frequency were governed by partial dominance with additive gene action. Epidermal cell size was controlled by partial dominance. Non-allelic interactions were observed in flag leaf area and stomata size.

Key words: Traits, stomatal frequency, leaf venation, bread wheat

Introduction

Wheat (*Triticum aestivum* L. em. Thell) is the main rabi crop and the most important cereal as it is the major human consumable commodity in most of the areas of the world including Pakistan. On world basis, wheat ranks after rice, providing protein and caloric requirements to one third of the population. It is widely grown in the areas subjected to frequent drought stress. So the need arises to evolve varieties having mechanism efficient enough to escape, avoid or better tolerate the drought conditions. Therefore, the genetic information on plant and some drought related characters is of great importance in the selection of desirable parents and populations to develop and launch effective breeding programme to evolve high yielding varieties.

The diallel analysis developed by Hayman (1954) and Jinks (1955) provides reliable information about the nature of gene action involved in the expression of complex genetic characters.

Chaudhry *et al.* (2001) reported partial dominance with additive gene action for leaf venation, epidermal cell size and flag leaf area, while over-dominance was shown for stomata size. Tahir *et al.* (1995) showed partial dominance for stomatal frequency. Over-dominance was shown by Munir (1997) for hygrophilic colloids.

Materials and Methods

The experiment was conducted in the experimental area of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The experimental material comprised of five varieties/lines viz., 8073, 8177, 6039-4, Pb-96 and MH-97. These genotypes were crossed in a diallel fashion during February-March, 2000.

The hybrid seeds of these crosses along with their parents were planted in the field in a randomized complete block design with three replications using inter-plant and inter-row distance of 15 and 30 cm, respectively. The experimental unit comprised a single row of 5 meter length. All other treatments were kept constant for the entire experiment. At maturity, ten guarded plants from each plot were taken randomly and data were recorded on flag leaf area (cm^2), leaf venation, stomata size (μ^2), stomatal frequency, epidermal cell size (μ^2) and hygrophilic colloids on individual plant basis.

The data thus collected were subjected to analysis of variance technique (Steel and Torrie, 1984). Plant traits showing significant differences among genotypes were further analyzed using diallel technique developed by Hayman (1954) and Jinks (1955).

Results and Discussion

Analysis of variance showed highly significant differences among the genotypes for all the traits (Table 1).

Flag leaf area: The inheritance pattern for flag leaf area was found to be partial dominance with additive type of gene action, as the regression line intercepted the Wr-axis above the origin (Fig.1). These results were in accordance with those of Alam *et al.* (1990) and Chaudhry *et al.* (2001). Additive genetic effects were shown by Subhani and Chowdhry (2000). Whereas over-dominance was reported by Chowdhry *et al.* (1997) for flag leaf area. Non-additive gene action was shown by Chowdhry *et al.* (1992).

The regression line significantly deviated from the unity thus indicating the presence of non-allelic interaction. Due to non-allelic interaction, selection would be difficult in segregation generations. The genotype 8073 being in proximity to the point of origin possessed most of the dominant genes for flag leaf area, whereas the genotype 6039-4, being away from the origin, carried most recessive genes.

Leaf venation: This trait was found to be controlled by partial dominance with additive type of gene action as the regression line intercepted the Wr-axis above the point of origin (Fig. 2).

The deviation of the regression line from the unity was not significant which indicated the absence of epistasis. Similar conclusions were illustrated by Chaudhry *et al.* (2001). Additive genetic effects were reported by Subhani and Chowdhry (2000).

Maximum dominant genes were carried by the genotype 8073 for leaf venation as it is located nearest to the origin whereas the genotype Pb-96 which lies far away from the origin possessed maximum recessive genes for this trait.

The selection in early generations would be effective because of the presence of partial dominance with additive gene action accompanied by the absence of epistasis.

Stomata size: Stomata size is governed by over-dominance as the regression line cuts the Wr-axis below the origin (Fig. 3). The results derived from this study are in accordance with those of Chaudhry *et al.* (2001).

The manner in which array points are displayed in the graph, it is clear that the genotype Pb-96 being closest to the origin is having most of the dominant genes for the trait in question, while the genotype 6039-4 which is farthest from the origin possessed most of the recessive genes for stomata size. Significant deviation of estimated regression line from the unity indicates presence of non-allelic interaction.

The presence of over-dominance coupled with epistasis shows that the selection would be rather difficult.

Stomatal frequency: Array points (Fig. 4) showed that the genotype MH-97 carries maximum dominant genes for stomatal frequency as it holds the position closest to the origin. On the other hand maximum recessive genes for this trait were found in the genotype 6039-4 as its position is far away from the origin.

Partial dominance with additive gene action was found for this trait as the graph showed that the regression line intercepted the Wr-axis above the point of origin. Epistasis is absent due to non-significant deviation of regression line from unit slope. Tahir *et al.* (1995) showed partial dominance for stomatal frequency, whereas additive genetic effects were reported by Subhani and Chowdhry (2000).

The conclusive results suggest that selection in early generations would be helpful due to the absence of epistasis and presence of partial dominance with additive gene action.

Epidermal cell size: The Vr/Wr graph (Fig. 5) showed that the regression line cuts the Wr-axis above the origin showing the presence of partial dominance for this trait. Chaudhry *et al.* (2001) also showed partial dominance with additive gene action for this trait. While over-dominance was reported by Tahir *et al.* (1995).

No existence of non-allelic interaction was noticed as the regression line does not deviate significantly from the unit slope. Array distribution showed that

Table 1: Analysis of variance (mean squares) for some drought related leaf traits in bread wheat

S.O.V	d.f	Flag leaf area	Leaf venation	Stomata size	Stomatal frequency	Epidermal cell size	Hygrophilic colloids
Replication	2	142.565	0.018	6554.350	16.530	26064.334	0.426
Genotypes	24	108.896**	0.122**	10763.705**	108.811**	103385.826**	5.050**
Error	48	19.431	0.026	3379.674	18.755	45481.905	0.258

** Highly significant

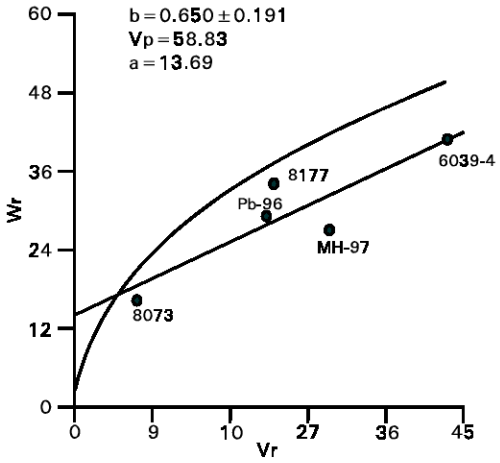

Fig. 1: Vr/Wr graph for flag leaf area

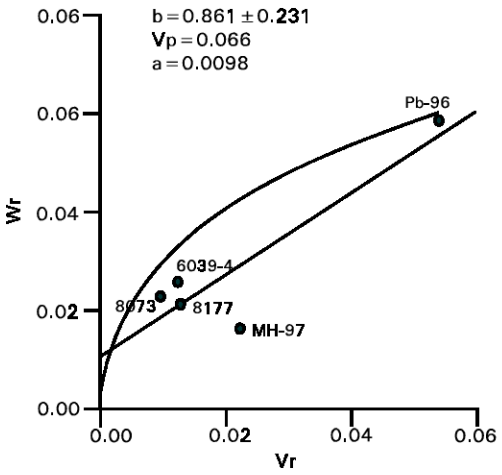

Fig. 2: Vr/Wr graph for leaf venation.

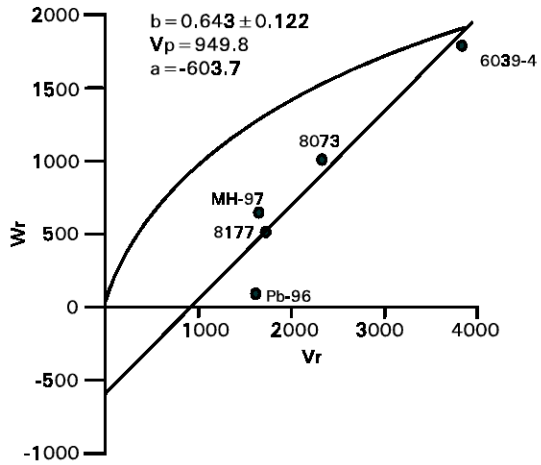

Fig. 3: Vr/Wr graph for stomata size.

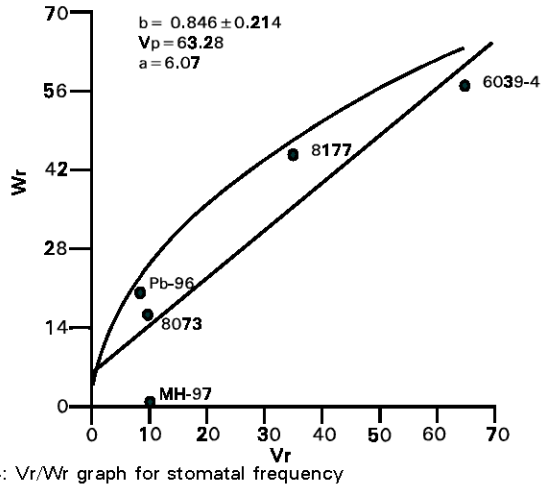

Fig. 4: Vr/Wr graph for stomatal frequency

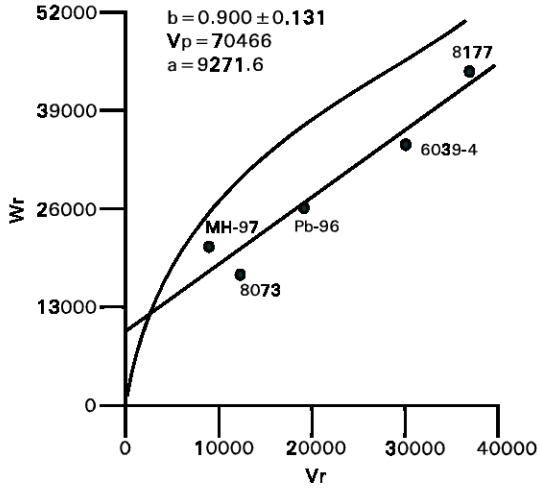

Fig. 5: Vr/Wr graph for epidermal cell size

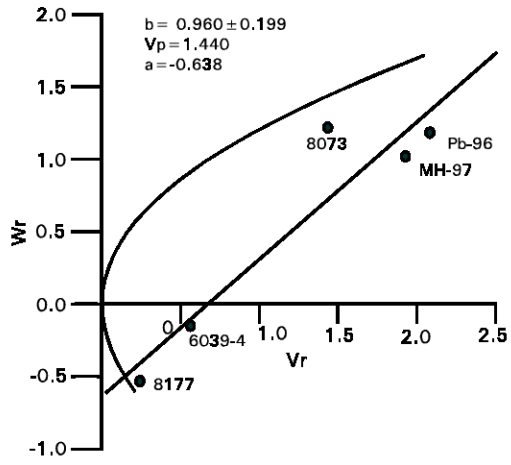

Fig. 6: Vr/Wr graph for hygrophllic colloids

most of the dominant genes were carried by the genotype 8073 as it holds proximal position to the origin. While the genotype 8177 which is farthest from the origin possessed most of the recessive genes for epidermal cell size. The selection in the early generations would be beneficial due to the absence of non-allelic interaction and the presence of partial dominance.

Hygrophilic colloids: The regression line intercepted the Wr-axis below the point of origin depicting that hygrophilic colloids were governed by over-dominance type of gene action. The findings were similar to those of Munir (1997). The deviation of regression line was not significant from unity which indicates absence of epistasis. The array points displayed at the Vr/Wr graph (Fig. 6) showed that the genotype 6039-4 being proximal to origin has most of the dominant genes for this trait, whereas most of the recessive genes are present in the genotype Pb-96 as it is away from the point of origin. The present results suggest that the selection in early generations would be difficult due to the presence of over-dominance type of gene action.

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