Pak. J. Agri. Sci., Vol. 30, No. 2, 1993.

MODE OF GENE ACTION FOR SOME AGRONOMICALLY IMPORTANT CHARACTERS IN SPRING WHEAT

Muhammad Aslam Chowdhry, Muhammad Yussouf Saleem, Khurshid Alam & Ihsan Khaliq
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad

A 5 x 5 diallel cross experiment on bread wheat revealed that the genetic interactions were apparently of overdominance type for number of tillers plant^{-1} and number of grains spike^{-1}, determining delayed selection to fairly good improvement in these traits. Additive type of gene action with partial dominance and absence of non-allelic interaction was found for 1000-grain weight suggesting fruitful selection in early generations. There was also additive with partial type of dominance for grain yield but the presence of epistasis showed that selection might be more effective in later segregating generations.

INTRODUCTION

Recent research in biometrical genetics have resulted in the evolution of new and efficient techniques enabling the breeders to ascertain the nature of gene action aiming at hybridization to increase grain yield on unit basis. Diallel cross technique developed and illustrated by Hayman (1954, 1958) and Jinks (1954, 1956) provides information on genetic mechanism involved in early generations and is particularly suited to autogamous crop like wheat. These information would be helpful to keep up the tempo of our wheat improvement.

Karaivanov and Kistova (1983) in an experiment involving 16 intervarietal hybrids showed that overdominance pre-dominated in the inheritance of number of fertile tillers. Tanryver Diev (1986) in a study of some yield components in first two generations of 20 diallel hybrids of wheat grown in a single year observed over-dominance and dominance of the better parents for number of grains ear^{-1}. While Mao and Feng (1987) reported from a diallel cross of 7 cultivars that 1000-grain weight fitted the additive dominance model. Singh *et al.* (1990) reported additive effects for 1000-grain weight and grain yield plant^{-1}.

MATERIALS AND METHODS

The proposed studies for the estimation of gene action were conducted in the Experimental Area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The experimental material comprised 5 native genotypes/strains of spring wheat (*Triticum aestivum* L. em Thell) namely Pak 81, SS 5, LU 26S, K 1595 and K 1596. The genotypes were crossed in a diallel fashion including reciprocals during 1989-90.

Seeds of these F_1 crosses along with their parents were planted in the field during November, 1989 following randomized complete block design with three replications. Each replication contained 5 parents and 20 F_1's with one row of 3 m long for each genotype. The seeds were sown with dibble keeping inter-plant and inter-row distance of 15 and 30 cm, respectively. All the agronomic and plant protection practices were kept normal and equal for the entire experiment.

At maturity, 10 guarded plants were randomly selected from each genotype in each replication. The data were recorded on number of tillers plant^{-1}, number of grains spike^{-1}, 1000-grain weight and grain yield plant^{-1} and subjected to analysis of variance technique (Steel and Torrie, 1980). The traits indicating significant differences among genotypes were further analysed for genetic studies and the gene action was determined by using Hayman (1954, 1958) and Jinks (1954, 1955, 1956) methods.

RESULTS AND DISCUSSION

The analysis of variance indicated highly significant differences among wheat genotypes for all the characters. Variance and covariance graphs are depicted in Figure 1 to 4.

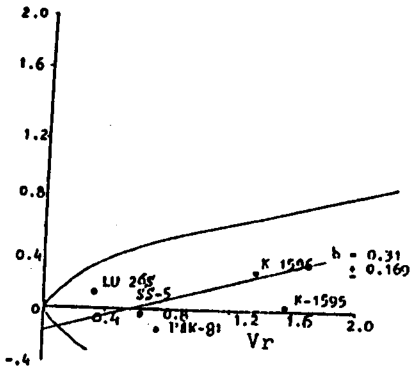

Fig. 1. Vr/Wr graph of number of fertile tillers plant^{-1}.

Number of fertile tiller plant^{-1}: The Vr/Wr graph (Fig 1) represented overdominance because the regression line cut the Wr-axis below the origin. Evidence of absence of non-additive effects was obvious because regression line did not deviate significantly from unity. Karaivanov and Kistova (1983) also reported similar results. Position of array points on the regression line indicated that LU 26S being close to origin had maximum dominant genes while K 1595 possessed maximum recessive genes being farther to origin. Genotype Pak 81 possessed higher array mean of 8.88 while genotype LU 26S was at bottom i.e. 7.92 (Table 1). Overdominance suggested delayed selection in early generations.

Number of grains spike^{-1}: Graphic representation of Vr/Wr indicated overdominant effects as the regression line cut the Wr-axis below the origin (Fig. 2). Tanryver Diev (1986) gave similar report. Estimated regression line deviated significantly from unity indicating non-allelic interaction. The distribution of array points on the regression line revealed that SS 5 possessed maximum dominant genes on account of its being nearer and LU 26S had maximum recessive genes due to its distal position from the origin. Selection would be possibly ineffective in this type of gene action in early generations. Genotype K 1995 had the higher array mean of 59.08 while SS 5 had lower array of 55.98 (Table 1).

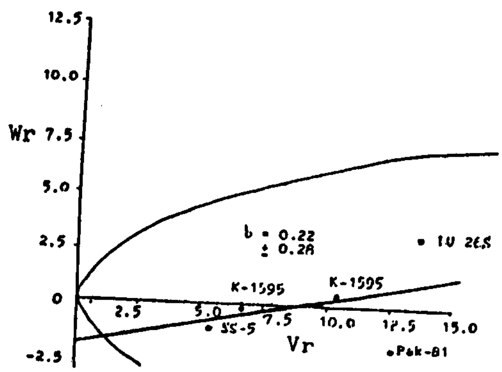

Fig. 2. Vr/Wr graph of number of grains spike^{-1}

Table 1. Array means for various characters

Character	Pak 81	SS 5	LU 26S	K 1595	K 1696
Number of fertile tillers plant^{-1}	8.88	8.36	7.92	8.55	8.79
Number of grains spike^{-1}	58.30	55.98	58.71	59.08	57.66
1000-grain weight (g)	48.57	46.71	46.34	46.77	47.48
Grain yield plant^{-1} (g)	25.27	23.94	22.89	23.36	25.55

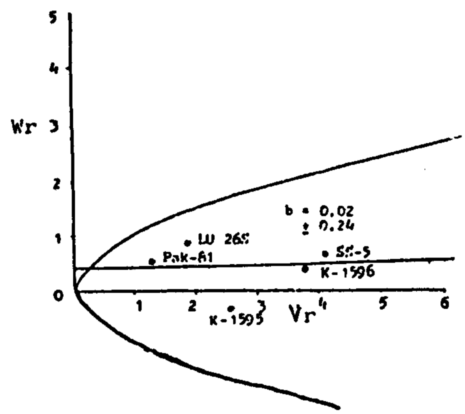

Fig. 3. Vr/Wr graph of 1000-grain weight.

1000-grain weight: Additive type of gene action with partial dominance was revealed by the Vr/Wr graph as the regression line cut the Wr-axis above the origin (Fig. 3). Similar results have already been reported by Mao and Feng (1987) and Singh *et al.* (1990). Non-significant deviation of regression line from unity suggested absence of epistasis. Position of array points on the regression line indicated that Pak 81 being closer to origin had maximum dominant genes while SS 5 possessed maximum recessive genes due to its more distant position from origin. Genotype Pak 81 possessed higher array mean of 48.57 while genotype LU 26S had lower array mean of 46.34 (Table 1). Fairly good progress in breeding for higher grain weight can be expected by using Pak 81 as one of the parent. Fixation of this character would be possible in early generations because of absence of non-allelic interaction.

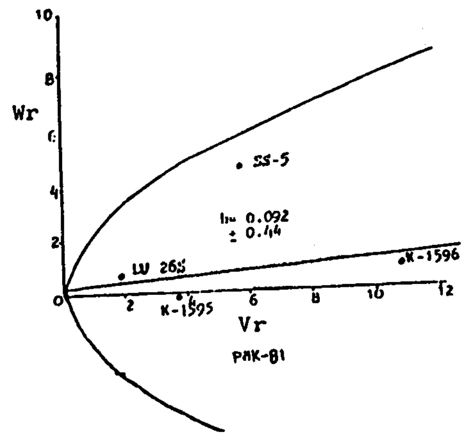

Fig. 4. Vr/Wr graph of grain yield plant^{-1}.

Grain yield plant^{-1}: Graphic representation of Vr/Wr (Fig. 4) indicated additive with partial type of dominance as the regression line cut the Wr-axis above the origin. Similar results were given by Singh *et al.* (1990). LU 26S and K 1596 had maximum dominant and recessive alleles being in vicinity and away from the origin, respectively. The SS 5 had almost equal proportion of dominant and recessive alleles because of approximately central position above the regression line within parabola. As the regression line deviated significantly from unit slope, therefore, presence of some interaction of genes was quite obvious. The genotype K 1596 had higher array mean of 25.55 whereas LU 26S had lower array mean of 22.89 (Table 1). The wheat genotype K 1596 because of higher array mean can be used as one of parent for good progress. The genetic mechanism indicated by the analysis suggested the presence of good scope for selection and improvement. However, the presence of non-allelic interaction for grain yield suggested that the selection might be more effective in later segregating generations.

REFERENCES

Hayman, B.I. 1954. The theory and analysis of diallel crosses. Genetics, 39: 789-809.

Hayman, B.I. 1958. The theory and analysis of diallel cross. II. Genetics, 43: 63-85.

Jinks, J.L. 1954. The analysis of continuous variation in diallel crosses of *Nicotiana rustica* varieties. Genetics, 39: 767-788.

Jinks, J.L. 1955. A survey of genetical basis of heterosis in a variety of diallel crosses. Heredity, 9: 233-237.

Jinks, J.L. 1956. The F_2 and backcross generation from a set of diallel crosses. Heredity, 10: 1-30.

Karaivanov, A. and L. Kistova. 1983. Inheritance of productive tillers following hybridization between spring and winter forms of bread wheat. Resteniev dni Nauki, 20 (4): 11-17. (Plant Breed. Abst. 56 (3): 1604; 1986).

Mao, S.X. and X.O. Feng. 1987. Genetic model of quantitative characters in winter wheat. Hereditas, 10 (1): 6-8.

Singh, K., G.S. Bhullar and G. Singh. 1990. Estimation of genetic parameters and prediction of properties of recombinant lines in durum wheat *(Triticum durum)*. Indian J. Agri. Sci. 60 (5): 301-306. (Plant Breed. Abst. 61 (6): 5166; 1991.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. Mc-Graw Hill Book Co. Inc., NY, USA.

Tanryver Diev, K.A. 1986. The nature of inheritance of quantitative traits in diallel hybrids of winter bread wheat. Wheat, Barley and triticale Abst. 5 (1): 126; 1988.