Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences
Volume 1 Number 3: 235-237, 2002

Genetic Control of Some Polygenic Traits in *Aestivum* Species

Muhammad Aslam Chowdhry, Ashi Ambreen and Ihsan Khaliq
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan

Abstract: Five wheat genotypes viz., 8073, 8177, 6039-4, Pb-96 and MH-97 were crossed in a diallel fashion to ascertain the genetic control of some polygenic traits. The analysis of variance revealed that the differences among genotypes for all the traits studied, were highly significant. The parameters like number of tillers per plant, plant height, number of grains per spike, 1000-grain weight and grain yield per plant were controlled by over-dominance type of gene action. Spike length was governed by partial dominance with additive gene action. Number of spikelets per spike was under control of partial dominance. Epistasis was present in plant height, spike length and 1000-grain weight.

Key words: Diallel fashion, polygenic traits, epistasis

Introduction

Wheat (*Triticum aestivum* L. em. Thell) is the most important cereal crop of the world. It is the main staple food of the rapidly increasing population of Pakistan that is why it occupies a prominent position in the cropping pattern of the country. In order to fulfil the demands of rapidly increasing population, we need to increase the grain production per unit area by using available resources. Therefore, it is necessary to evolve wheat cultivars, having wider genetic base capable of producing better yield under a wide range of agro-climatic conditions to enhance the grain yield. Dependable biometrical techniques which deal with the genetic analysis of important traits have been expound in recent past which has greatly helped the plant breeders in tailoring better genotypes. The diallel cross technique developed and illustrated by Hayman (1954) and Jinks (1955) provides information on genetic mechanisms involved in early generations and are particularly suited to autogamous crops like wheat.

Chowdhry *et al.* (1991) reported additive type of gene action with partial dominance for plant height. Over-dominance was reported by Chowdhry *et al.* (1995) for number of tillers per plant. Partial dominance with additive type of gene action was shown by Asif *et al.* (1999) and Chowdhry *et al.* (1999) for spike length. Ternovskaya (1994) and Shahzad *et al.* (1998) showed over-dominance for grains per spike. Similar results have been reported by Walia *et al.* (1993), Subhani and Chowdhry (2000) and Chowdhry *et al.* (2001) for grain yield per plant, and by Chowdhry *et al.* (1997) and Chowdhry *et al.* (2001) for 1000-grain weight. Partial dominance with additive gene action was reported by Asif *et al.* (1999) and Ali *et al.* (1999) for number of spikelets per spike.

Materials and Methods

The present experiment was conducted in the experimental area of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Five genotypes viz., 8073, 8177, 6039-4, Pb-96 and MH-97 were crossed in all possible combinations during February-March, 2000. Seeds of all crosses along with their parents were planted in the field during the crop season on December 2, 2000, in a Randomized Complete Block Design. Single row of 5 meter length served as an experimental unit. Within and between rows distances were kept at 15 and 30 cm, respectively. At maturity 10 guarded plants from each treatment were selected randomly and data on plant height (cm), number of tillers per plant, spike length (cm), number of spikelets per spike, number of grains per spike, 1000-grain weight (g) and grain yield per plant (g) on individual plant basis were taken. The data recorded were subjected to analysis of variance technique (Steel and Torrie, 1984) and the parameters showing significant differences were subjected to diallel analysis techniques developed and illustrated by Hayman (1954) and Jinks (1955).

Results and Discussion

Differences among genotypes were highly significant for all the parameters under study (Table 1).

Plant height: The Vr/Wr graph (Fig.1) shows that plant height was governed by over-dominance type of gene action as the regression line intercepted the Wr-axis below the point of origin. Chowdhry *et al.* (1991) showed additive with partial dominance type of gene action for plant height.

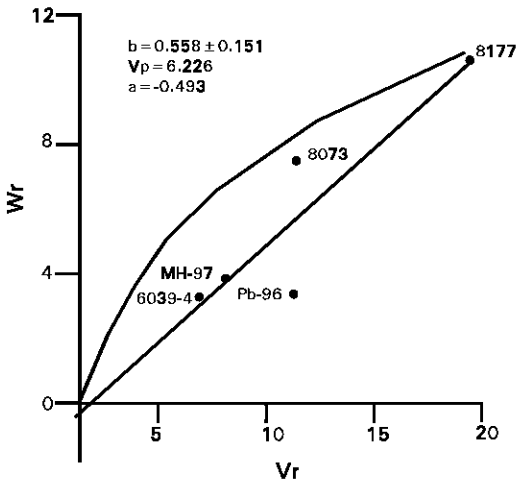

Fig.1: Vr/Wr graph for plant height

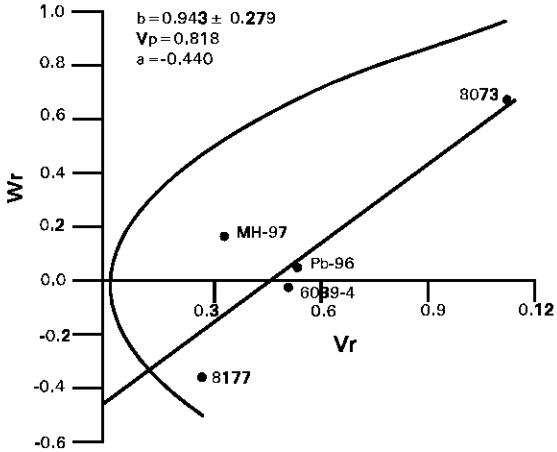

Fig. 2: Vr/Wr graph for number of tillers per plant

Epistasis was found to be present as the regression line significantly deviates from the unit slope. The genotype 6039-4 contained maximum dominant genes being closest to the origin, while the genotype 8177 possessed most recessive genes, being farthest from the origin for plant height. In view of over-dominance and the presence of epistasis, selection in segregating generations would be difficult.

Number of tillers per plant: The regression line intercepted the Wr-axis on the negative side of the origin indicating over-dominance type of gene action

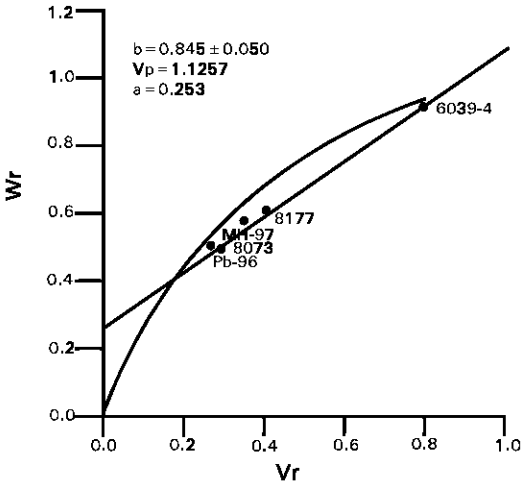

Fig.3: Vr/Wr graph for spike length

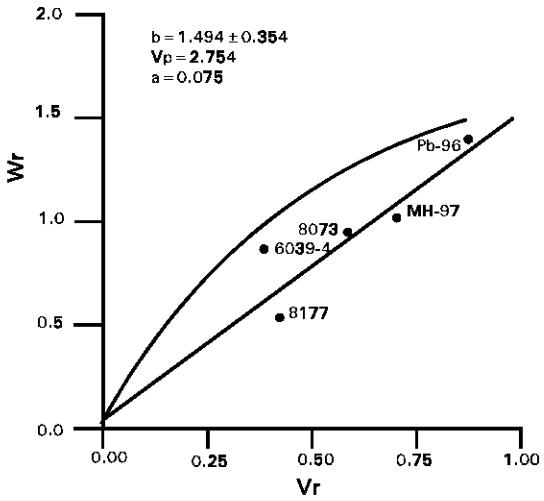

Fig. 4: Vr/Wr graph for spikelets per spike

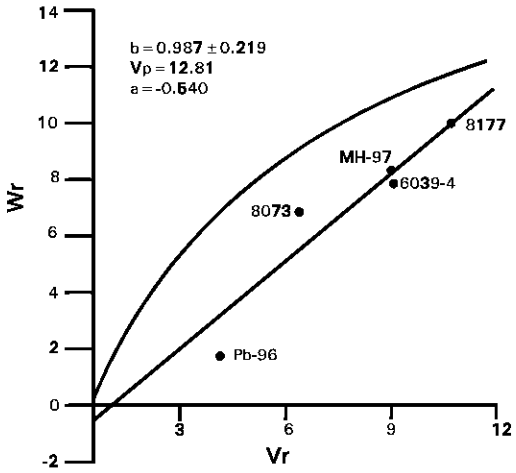

Fig. 5: Vr/Wr graph for grains per spike

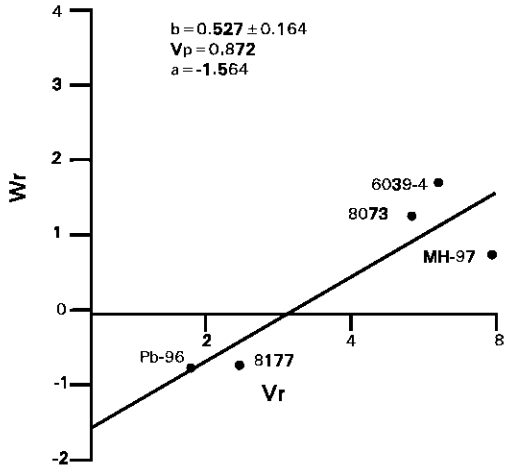

Fig. 6: Vr/Wr graph for 1000-grain weight

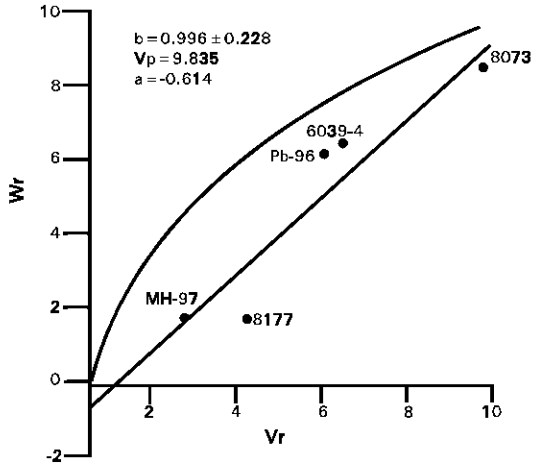

Fig. 7: Vr/Wr graph for grain yield per plant

(Fig. 2). Absence of epistasis was noticed as the estimated regression line was not found to be deviating significantly from the unit slope. The position of array points on the regression line (Fig. 2) indicated that the genotype MH-97 had maximum dominant genes for number of tillers per plant being nearest to origin. While 8073 which is farthest from origin possessed most of the recessive genes. The present findings suggest that the selection would possibly be ineffective in such type of gene action in early generations.

Spike length: The trait was controlled by additive gene action with partial dominance as shown by the graphical representation where the regression line intercepted the Wr-axis above the point of origin (Fig.3). The results corroborated the findings of Asif *et al.* (1999) and Chowdhry *et al.* (1999). The array distribution showed that the variety Pb-96 was closest to the origin, which indicated that most of the dominant genes were present in it. While the genotype 6039-4 being away from the origin carried most of the recessive genes for spike length. Non-allelic interactions were found to be present because the regression line significantly deviated from unit slope in Vr/Wr graph. The present study showed that the selection would be difficult due to presence of non-allelic interactions.

Number of spikelets per spike: Partial dominance was indicated for this trait by the Vr/Wr graph as the regression line cuts the Wr-axis slightly above the origin. Whereas Ali *et al.* (1999) and Asif *et al.* (1999) reported partial dominance with additive gene action. Additive type of gene action with partial dominance was shown by Chowdhry *et al.* (1991) for number of

Table 1: Analysis of variance mean squares for some polygenic traits in *Aestivum* spp.

SOV	d.f.	Plant height	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	1.068	0.721	0.262	0.724	1.405	1.878	1.629
Genotypes	24	43.476**	2.017**	0.052**	3.410**	40.129**	11.890**	24.889**
Error	48	7.607	0.736	0.339	0.702	3.142	2.182	1.595

** Highly significant

spikelets per spike. The estimated regression line did not deviate significantly from the unit slope showing no existence of non-allelic interaction. Maximum dominant genes for spikelets per spike are present in the genotype 8177 as it is nearest to the point of origin (Fig. 4). However, the genotype Pb-96 which is farthest from the origin possesses maximum recessive genes for this trait. Due to the presence of partial dominance accompanied with absence of epistasis, the selection in early generations will be fruitful.

Number of grains per spike: From the graphical representation, it is evident that the regression line intercepts the Wr-axis below the point of origin, thus revealing over-dominance type of gene action. The findings agreed with those of Ternovskaya (1994) and Shahzad *et al*. (1998). Non-allelic interaction was not found as the regression line did not deviate significantly from the unity (Fig.5). From the position of array points at the Vr/Wr graph it is clear that the genotype Pb-96 possessed maximum dominant genes for number of grains per spike as it holds the position proximal to the origin. While the genotype 8177, being away from the origin, depicts that it carried maximum recessive genes for this trait. In early generations selection would be difficult due to the presence of over-dominance.

1000-grain weight: This trait was found to be under control of over-dominance type of gene action as the regression line cuts the Wr-axis below the point of origin (Fig. 6). Similar results have also been reported by Chowdhry *et al*. (1997) and Chowdhry *et al*. (2001) for this trait. Epistasis was found to be present as the estimated regression line deviated significantly from the unity. The graph Vr/Wr shows the array distribution which revealed that maximum dominant genes for 1000-grain weight were carried by the genotype Pb-96 being closest to the origin, while the genotype MH-97 being farthest from the point of origin carried maximum recessive genes. Presence of epistasis and over-dominance indicates that the selection would be difficult in segregating generations.

Grain yield per plant: The inheritance pattern for this trait was found to be over-dominance type of gene action, as the regression line in the Vr/Wr graph (Fig.7) intercepts the Wr-axis below the origin. Deviation of the estimated regression line from the unity was not significant thus indicating the absence of non-allelic interaction. These results are in agreement with the findings of Walia *et al*. (1993), Subhani and Chowdhry (2000) and Chowdhry *et al*. (2001) for grain yield per plant. Variety MH-97 contained most of the dominant genes for grain yield per plant as it is nearest to the origin whereas the genotype 8073 which is away from origin carried maximum recessive genes for this trait. The results show that the selection in the early generations would be difficult due to the existence of over-dominance.

References

Ali, Z. A.S. Khan and T.M. Khan, 1999. Gene action for plant height, grain yield and its components in spring wheat. Pak. J. Biol. Sci., 2: 1561-1563.

Asif, M., I. Khaliq, M.A. Chowdhry and A. Salam, 1999. Genetic mechanism for some spike characteristics and grain yield in bread wheat. Pak. J. Biol. Sci., 2: 948-951.

Chowdhry, M.A., S. Z. A. Shah, S.S. Mehdi and M. Adnan, 1995. Biometrical analysis of some metric traits in a 4 x 4 diallel cross of spring wheat. Gomal Univ. J. Res., 15: 107-114.

Chowdhry, M.A., I. Rasool, I. Khaliq, T. Mahmood and M.M. Gilani, 1999. Genetics of some metric traits in spring wheat under normal and drought environments. RACHIS, 18: 34-39.

Chowdhry, M.A., M.T. Arshad, G.M. Subhani and I. Khaliq, 1997. Inheritance of polygenic traits in hexaploid spring wheat. JAPS ,7: 77-79.

Chowdhry, M.A., M.A. Chaudhry, S. M. M. Gilani and M. Ahsan, 2001. Genetic control of some yield attributes in bread wheat. Pak. J. Biol. Sci., 4: 980-982.

Chowdhry, M.A., A. Karim, K. Alam and M. Iqbal 1991. Genetic determination of some quantitative characters of bread wheat (*Triticum aestivum* L. em. Thell.). Sarhad J. Agric., 7: 491-494.

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

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

Shahzad, K., Z. M. Din, M.A. Chowdhry and D. Hussain, 1998. Genetic analysis for some yield traits in *Triticum aestivum* L. Pak. J. Biol. Sci., 1: 237-240.

Steel, R. G. D. and J. H. Torrie., 1984. Principles and Procedures of Statistics - A Biometrical Approach. McGraw Hill Book Co., New York, USA.

Subhani, G.M. and M.A. Chowdhry, 2000. Genetic studies in bread wheat under irrigated and drought stress conditions. Pak. J. Biol. Sci., 3: 1793-1798.

Ternovskaya, T.K., 1994. Genome D. in bread wheat. Diallel analysis of metrical characters of the ear in wheat plants. Tsitologiya I Genetika, 28: 36-42.

Walia, D.P., T. Dawa, P. Plaha and H.K. Chaudhary, 1993. Gene action and heterosis in bread wheat. Crop Improve. Society of India, pp: 84-85