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Nature of Gene Action in Barley (*Hordeum vulgare* L.)

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Abstract: A 6×6 diallel cross (excluding reciprocal) of barley (*Hordeum vulgare* L.) dictated both additive and non-additive components were important but dominance components were more predominant than additive components in controlling the inheritance of all the characters under study. The asymmetric distribution of dominant and recessive alleles at loci was found for all the characters. At least 3 groups of genes were found in controlling the dominance in yield. The highest heritability (89%) in narrow sense was observed in 1000 grain weight. Vr-Wr graph indicated over dominance and genetic diversity among the parents.

Key words: Hordeum vulgare, gene action

INTRODUCTION

Barley (*Hordeum vulgare* L., 2n = 2x = 14) is an important rabi cereal crop grown throughout the temperate and tropical regions of the world. By virtue of its nature, lower cost of cultivation, wide adaptability and superior nutritional qualities, barley can be cultivated in neglected agricultural areas, particularly in problematic soils like rainfed, dry land, saline-alkaline and flood prone and marginal/coastal areas. In Bangladesh, it is grown on more than 4,000 ha, with a production of more than 3,000 tons with productivity of 7.50 q ha^{-1} (BBS, 2004). Barley is used as human food either for bread making (usually mixed with bread wheat) or traditional food recipes. The major of barley grains is in the production of malt, which is used in breweries to make beer, industrial alcohol, whisky, malted milk and vinegar.

To increase the yield of barley requires certain information regarding the nature and magnitude of gene actions involved in the expression of quantitative traits of economic importance in a hybridization program. Diallel analysis also provides a unique opportunity to obtain a rapid and over all pictures of genetical control of a set of parents in the early generation. Thus the main objective of the present study was to identify genetic architecture of different importance traits of barley for further improvement of grain yield.

MATERIALS AND METHODS

Five barley cultivars, viz., BARI barley-2, BBL-9402-43-1, BBL-9402-12-2, K-163, K-351 and IBYT/97-4 were mated in a diallel fashion excluding reciprocals during rabi 2003-04. The parents and their 15 F_1s were grown in a Randomized Block Design with three replications under normal sowing condition during rabi 2004-05 at Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. The individual plot comprised of a single row of 5 m long. The spacing between rows and that between plants in a row was 30 and 10 cm, respectively. Irrigation and other cultural operations were done as per need. Observations were recorded on ten randomly selected plants from each plot for days to maturity, Plant height (cm), tiller/plant, grain/spike, 1000 grain wt. (g) and grain yield/plant (g).

Data were processed and subjected to analysis of variance were estimated by Jones (1965) and genetic component of variance and Vr-Wr graphs were estimated by Haymen (1954a) and (1954b), Mather and Jinks (1971) as described by Sharma (1998).

RESULTS AND DISCUSSION

The additive effect (a) and dominance effect (b) were highly significant for all the characters studied indicating

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Table 1: Jones analysis of variance of half diallel table for different characters in barley

Source of variation	df	Days to maturity	Plant height (cm)	Tillers/plant	Grains/plant	1000 grain weight (g)	Yield/plant (g)
a	5	21.73**	160.84**	80.84**	162.99**	110.53**	11.76**
b	15	97.57**	48.64**	39.45**	128.61**	66.36**	11.85**
b1	1	761.93**	2.52^{ns}	337.37**	674.85**	19.10**	51.15**
b2	5	12.71**	98.04**	39.51**	145.40**	89.91**	8.75**
b3	9	70.78**	26.39**	6.32**	58.59**	58.52**	9.21**
Error	40	0.23	0.96	0.14	0.26	0.27	0.12

* and ** significant at 5 and 1 % level respectively, ns indicates non-significant

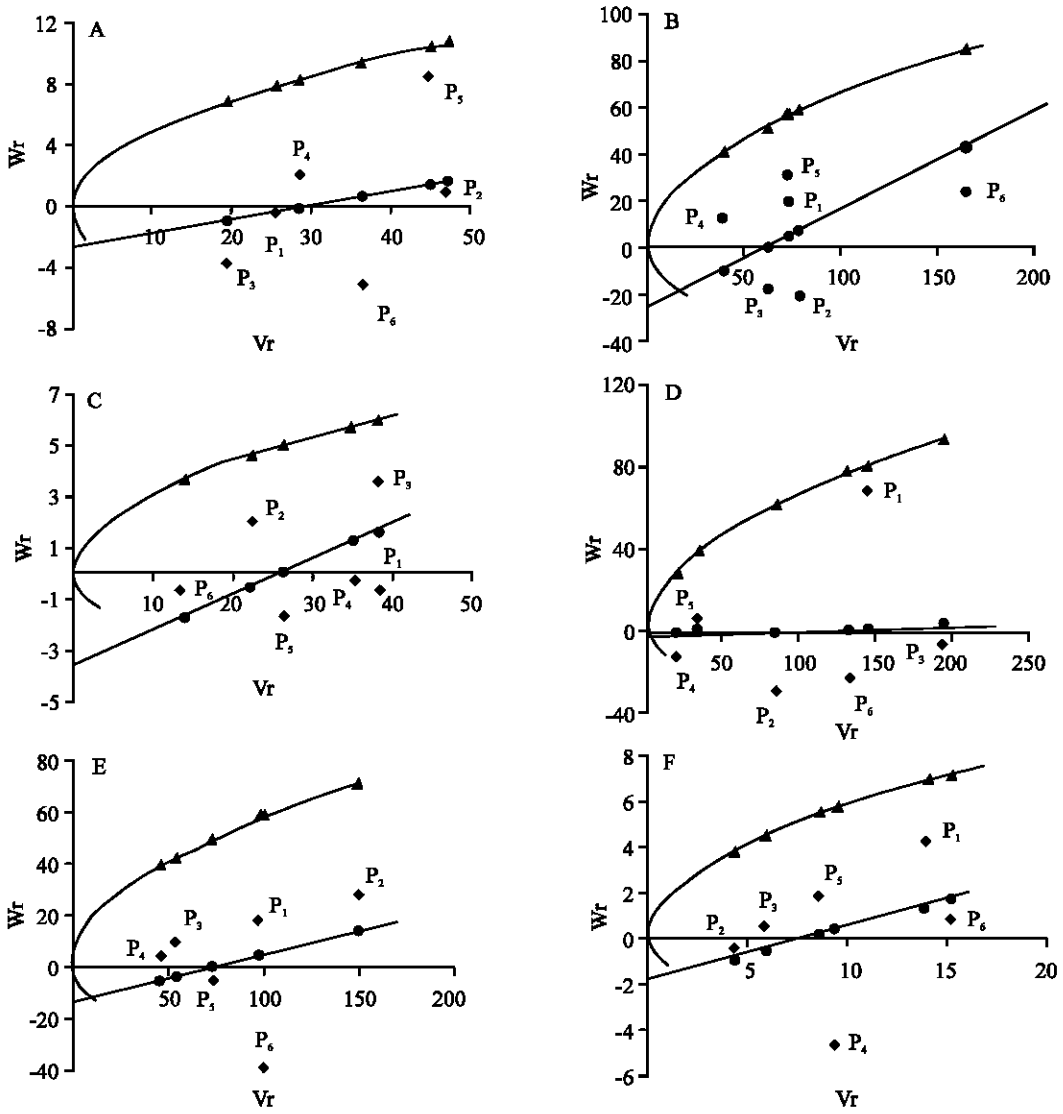

Fig. 1: Vr-Wr graph. A. Days to maturity B. Plant height C. Tillers/plant D. Grain/plant E. 1000 grain weight and F. Yield/plant

P_1 = BARI Barley-2, P_2 = BBL-9402-43-1, P_3 = BBL-9402-12-2, P_4 = K-163, P_5 = K-351, P_6 = IBYT/97-4

the importance of both additive and dominance components (Table 1). However the higher b_1 values for days to maturity, tillers/plant, grains/plants and yield/plant indicated dominance deviations of the genes are predominant in one direction. An asymmetrical distribution of dominant genes was suggested by the highly significant b_2 values for all the characters. The b_3 values were also significant for all the characters under study which indicated important contribution to the over all b values.

Table 2: Estimates of genetic components and allied genetic parameters in barley

Genetic parameter	Days to maturity	Plant height (cm)	Tillers/plant (cm)	Grains/plant	1000 grain weight (g)	Yield/plant (g)
D	2.18±0.09**	42.96±0.37**	0.82±0.08**	45.49±0.59**	33.26±0.34**	3.30±0.04**
F	3.33±0.20**	54.41±0.89**	0.17±0.19^{ns}	88.00±1.45**	15.61±0.83**	5.17±0.09**
H_1	7.84±0.22**	62.81±0.93**	25.96±0.21**	96.23±1.50**	59.28±0.87**	5.52±0.10**
H_2	126.64±0.20**	269.88±0.83**	88.70±0.19**	347.83±1.34**	309.34±0.77**	34.22±0.09**
h^2	41.02±0.13**	1.83±0.56**	27.30±0.12**	38.58±0.91**	6.37±0.52**	111.00±0.09**
E	0.24±0.03**	0.96±0.14**	0.14±0.03**	0.26±0.22^{ns}	0.27±0.13^{ns}	0.12±0.02**
$(H_1/D)^{½}$	1.90	1.21	5.62	1.45	1.33	1.29
$H_2/4H_1$	4.04	1.07	40.86	0.91	1.31	1.55
$\frac{\{(4DH_1)^{½}\}/4 + F/2}{\{(4DH_1)^{½}\}/4 - F/2}$	2.35	3.20	11.04	7.97	4.46	4.08
h^2/H_2	0.32	0.007	0.31	0.11	0.02	3.24
h^2n	0.29	0.78	0.03	0.83	0.89	0.80

* and ** significant at 5 and 1% level, respectively

The additive variance (D) and other three variance (H_1, H_2 and h^2) were highly significant for the all the characters indicated the importance of both additive and non-additive gene action in the heritance of the traits (Table 2). However, non-additive components were more predominant than additive components. Similar results were reported by Mondal *et al.* (1998), Chandramony and Nayer (1994). Positive values of F for all the characters indicated dominant alleles were excess in the genetic system controlling all the traits. Similar results were reported by Ivy *et al.* (1999).

The ratio $(H_1/D)^{½}$ measuring the mean degree of dominance for all the loci was more than unity for all the characters studied indicating the importance of over dominance of the characters and was in agreement with conclusion drawn from (Fig. 1). Over dominance as well as predominant of non-additive genetic variance was reported by Mondal *et al.* (1998) in rice, Islam and Newaz (2000) in rice, Chandramony and Nayer (1994) in sesame. $H_2/4H_1$ for all the characters was greater than 0.25 for all the characters which indicated dominating gene having increasing and decreasing effect on all the characters and also irregularly distribution of genes in the parents. The value of $[\{(4DH_1)^{½}\}/4 + F/2]/[\{(4DH_1)^{½}\}/4\text{-}F/2]$ ratio was found to be more than unity for all the characters, which also refers to excess of dominant alleles and minority of recessive alleles. The ratio of h^2/H_2 for yield was 3.24 suggesting the involvement at least 3 groups of genes having dominance. The heritability in narrow sense (h^2n) was more than 50% for all the characters except days to maturity (29%) and tillers/plant (3%) indicated major part of the phenotypic variability additive in nature; selection should be effective for improvement of these characters in barley. Further, environmental estimate (E) was positive for all the characters indicating the definite influence of environment in the expression of the characters.

Vr-Wr Graph: The VR-Wr graphs with the regression line within the limiting parabola are shown in Fig. 1. The regression line of Vr-Wr graph passed below the origin indicated over dominance for all the characters. The distribution of the array parents indicated that P_3 for days to maturity, P_4 for plant height, P_6 for tiller/plant, P_4 for grain/plant and 1000 grain weight and P_2 for yield/plant possess maximum number of dominant alleles for these traits.

It is observed from the graphical and the component of variance analysis that dominance effect was effect was involved for all the characters under study. Therefore, it may be concluded that the heterosis breeding may be advantageous to get higher production in barley.

REFERENCES

BBS, 2004. Year book of Agricultural Statistics of Bangladesh. Statistic Division, Ministry of Planning, Dhaka, Bangladesh.

Chandramony, D. and N.K. Nayer, 1994. Genetic basis of yield attributes in sesamum. Indian J. Agric. Res, 28: 214-218.

Haymen, B.I., 1954a. Analysis of variance of diallel table. Biometrics, 10: 235-244.

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

Islam, A.K.M.A. and M.A. Newaz, 2000. Gene action for seed yield and related characters in dry bean (*Phaseolus vulgaris* L.). Bangladesh J. Plant. Breed. Genet., 13: 31-34.

Ivy, N.I., M.H.S., M.A. Howlader, K. Mian and R. Rultana, 1999. Genetic analysis of economic traits in maize (*Zea mays* L.). Bangladesh J. Plant. Breed. Genet., 12: 55-61.

Jones, R.M., 1965. Analysis of variance of the half diallel table. Heridity, 20: 117-121.

Mather, K. and J.L. Jinks, 1971. Biometrical Genetics. 2nd Edn., Chapman and Hall Limited, London.

Mondal, N., K. Roy and S. Gupta, 1998. Nature of genetic control of submergence tolerance in rice. Indian J. Genet., 58: 285-290.

Sharma, J.R., 1998. Statistical and Biometrical Techniques in Plant Breeding. New Age International (P) Limited, Delhi, pp: 178-203.