GAU Res. J. 1996. 21 (2) : 8-12

Genetics of Plant Height and Flag Leaf Area in Bread Wheat (*Triticum aestivum* L. em. Thell) Under Normal and Salinity Conditions

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ABSTRACT

A diallel cross analysis involving 8 varieties of bread wheat and their 28 F_1 hybrids (excluding reciprocals) was attempted under normal, sodic and saline sodic soils to study the nature and magnitude to gene action for plant height and flag leaf area. The additive genetic component (D) was highly significant and in general greater in magnitude than the respective non-additive components (H_1 and H_2) for both the traits over environments. This indicated preponderance of additive gene action in inheritance of both the traits under different environments. Estimates of degree of dominance showed partial dominance for both the traits over environments, except for flag leaf area in normal soil where it showed over-dominance, variance-covariance graphs confirmed most of these results. Heritability estimates were observed to be high for plant height and moderate for flag leaf area. A simple selection would be effective to improve both the traits under study.

(Received on 22nd April, 1994)

INTRODUCTION

Genetic information of quantitative characters provides a guide line to breeder informulating an appropriate breeding method to bring about desired improvement in the crop. For detailed study of genetic architecture of characters, component and graphical analyses (Jinks and Hayman, 1953, and Hayman, 1954) seems to be more important. Plant height and flag leaf area are considered to be important yield related traits in bread wheat. Very little information is available on genetics of these two attributes under salinity stress conditions where this crop is also extensively grown. The present study was, therefore, carried out to get some information on genetics of plant height and flag leaf area in wheat under normal and salinity conditions.

MATERIALS AND METHODS

Genetically diverse 8 varieties of bread wheat (K 8565, HD 2009, CPAN 1992, Kharchia 65, Raj 1972, Raj 3077, Lok 1 and HW 452) and their 28 half diallel crosses were grown in randomized block design with three replications under sodic (ECe 3.6 ds/ and pH 9.3), normal (EC 3.5 ds/m and pH 8.4) and saline sodic (ECe 8.6 ds/m and pH 9.1) soils at College Farm, S. K. N. College of Agriculture, Jobner. The experiment on sodic soil was conducted during *rabi* 1989-90, while on other two environments it was grown during *rabi* 1990-91. Each plot consisted of 1.5 m long

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single row, which were spaced at 25 cm apart. A plant-to-plant distance of 5 cm was maintained in each row.

Data were recorded on 5 randomly selected plants from each treatment in each replication for plant height (cm) and flag leaf area (cm^2). The procedure of Jinks and Hayman (1953) and Hayman (1954) was adopted for component and graphical analysis. Heritability estimates in narrow sense were computed following Crumpacker and Allard (1962).

RESULTS AND DISCUSSION

The slope of regression line (b) in the variance covariance graphs (Fig. 1 and 2) deviated significantly from zero but not from unity, indicating the adequacy of additive - dominance model for both the traits over environments. The rusults of components and their different ratios are presented in Table 1. Estimates of additive genetic variance (D) were highly significant and greater in magnitude in most of the cases than the respective non- additive components (H_1 and H_2) for both the traits over environments. While H_1 was significant for plant height in sodic soil and flag leaf area in sodic and saline sodic soils. The component H_2 was observed to be significant only for flag leaf area across the environments. This results indicated the preponderance of additive type of gene action for the inheritance of both characters under normal and salinity stress enviroments. The findings of Singh *et al.* (1985) and Yadav *et al.* (1988) for plant height and Prabhu and Sharma (1984) for flag leaf area were also akin to the results of the present study. The values of F for plant height and flag leaf area under three environments indicated higher frequency of recessive and dominant alleles in the parents for the inheritance of both the traits, respectively. These results were further confirmed by the ratio of dominant and recessive genes in the presents, as it was less than one for plant height and greater than one for flag leaf area over environments. The values of $H_2/4H_1$ for both the traits over environments were less than 0.23 which suggested asymmetrical distribution of genes with positive and negative effects in the parent. The degree of dominance indicated partial dominance for both the traits, except flag leaf area in normal soil where it was observed to be over-dominance. Most of these results were in confirmation with the results obtained in V_r, W_r graphs (Fig. 1 and 2). The h^2/H_2 ratio suggested that one gene or gene group operated uniformly the inheritance of both traits under different environments.

Estimated heritability in the narrow sense was consistantly high for plant height and moderate for flag leaf area over environments. It showed simple nature of its inheritance. Similar findings for plant height (Prakash *et al.* 1981 and Sharma *et al.* 1984) and flag leaf area (Joshi and Sharma, 1984 and Singh *et al.* 1986) have been reported by various wheat workers. In case of self-pollinated crop like wheat, simple selection would be desirable for effective improvement of traits having preponderance of additive gene action with moderate to high heritability estimates.

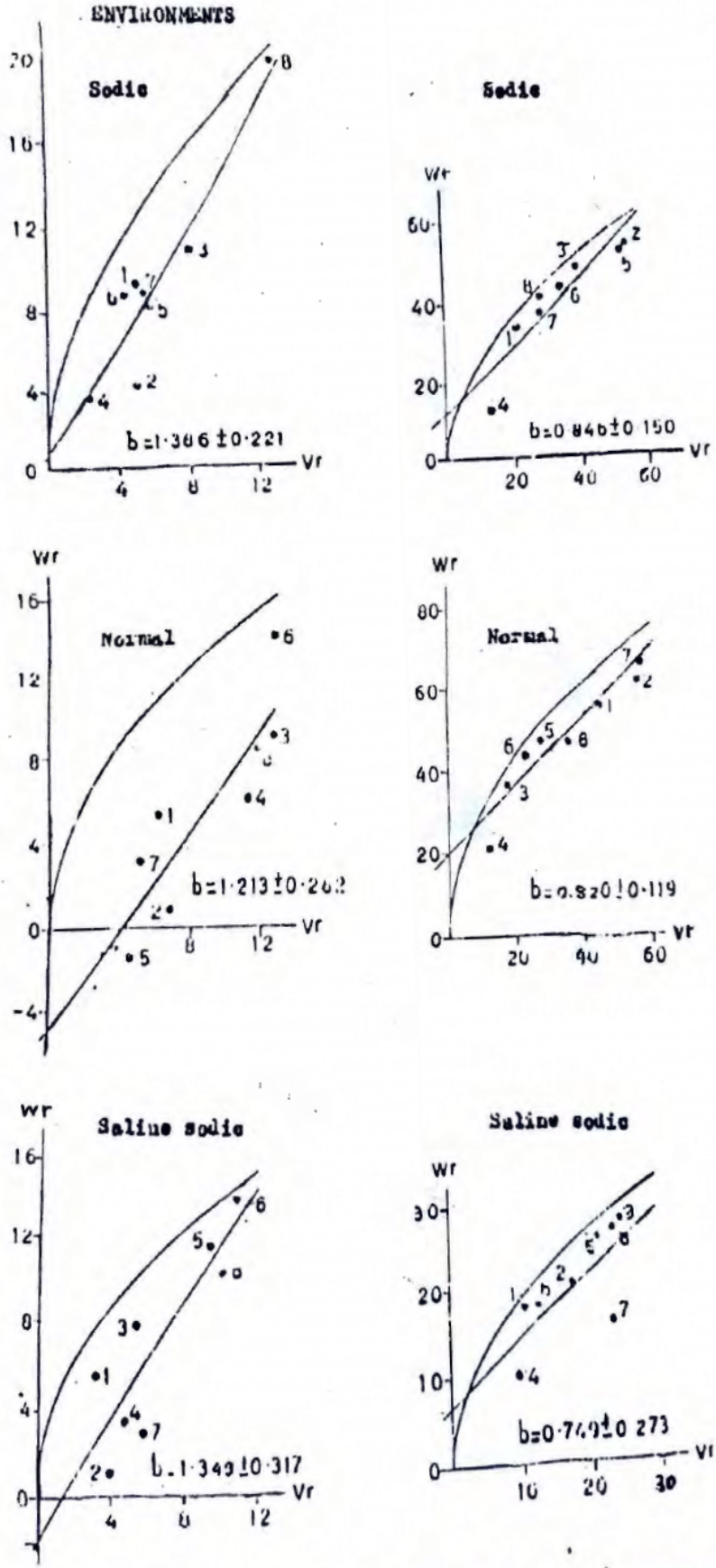
The V_r, W_r graphs (Fig. 1) for plant height reveal that, array point of parent Kharchia 65 was relatively nearer to the point of origin in all the environments indicating more proportion of dominant alleles for this

TABLE 1

Components of genetic variation and their ratios for plant height and flag leaf area in wheat under saline (S), Normal (N) and saline sodic (SS) conditions.

Components / raios	Plant height			Flag leaf area		
	S	N	SS	S	N	SS
D	63.584** ± 4.363	88.544** ± 4.299	33.091** ± 3.319	30.156** ± 1.598	16.307** ± 3.333	17.059** ± 1.873
H_1	24.044* ± 10.029	20.659 ± 9.884	17.978 ± 7.631	13.427** ± 3.674	24.078 ± 7.663	12.115* ± 4.305
H_2	15.890 ± 8.725	19.126 ± 8.599	13.726 ± 6.639	8.872* ± 3.196	19.598* ± 6.667	9.628* ± 3.746
h^2	22.062** ± 5.851	17.909* ± 5.767	— 0.572 ± 4.452	11.521** ± 2.143	7.206 ± 4.471	6.618* ± 2.512
F	— 34.189* ± 10.308	— 10.333 ± 10.159	— 14.769 ± 7.843	24.222** ± 3.776	11.504 ± 7.876	7.282 ± 4.425
E	4.247* ± 1.454	6.709** ± 1.433	3.667* ± 1.106	2.284** ± 0.533	3.251* ± 1.111	2.080* ± 0.624
$(H_1 / D)^{0.5}$	0.652	0.483	0.737	0.667	1.215	0.843
$H_2/4H_1$	0.147	0.231	0.191	0.165	0.203	0.199
$\frac{(4\,DH_1)^{0.5} + F}{(4\,DH_1)^{0.5} - F}$	0.416	0.784	0.535	4.023	1.818	1.678
h^2/H_2	1.388	0.936	0.042	1.298	0.368	0.687
Heritability	86.837	81.375	78.589	53.809	36.284	57.746

*,** Significant at 5 % and 1 % level respectively.



1= K 8565, 2= HD 2009, 3= CPAN 1992, 4= Kharchia 65,
5= Raj 1972, 6= Raj 3077, 7= Lok 1, 8= HW 452

Fig. 1: Vr. Wr graphs for plant height under three environments.

Fig. 2 : Vr, Wr, graphs for flag leaf area under three environments.

trait. While for flag leaf area (Fig. 2), parental points of HW 452 over environments and Raj 3077 in normal and saline sodic soils were located far away from the point of origin suggesting that both parents possessed more recessive genes. For plant height narrow scattering of parental arrays along the regression line indicated less diversity among the parents. Whereas opposite results were obtained for flag leaf area. However, relative changing position of most of parent arrays in different environments suggested the influence of environment in the expression of these traits.

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