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Short Communication

Genetic architecture of yield and its component traits in bread wheat (*Triticum aestivum* L.) grown under saline and normal environments

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In view of limited information on the genetics of yield and related traits and their inheritance in bread wheat under normal and salinity conditions, the present investigation was conducted to generate informations on the relative magnitude of additive and dominance components in the genetic control of characters in planning suitable, economic and efficient breeding strategies to develop high yielding varieties with reasonably good productivity potential and quality.

Ten genetically diverse varieties of wheat (*Triticum aestivum* L.) namely; PBW-343, UP-2338, Job-666, WH-542, HD-2687, Raj-3777, KRL 1-4, Lok-1, K-65 and Raj-3077, selected on the basis of salt tolerance and ecogeographic origin, were crossed in diallel fashion (excluding reciprocals) during *rabi* 1998-99. Few F_1 seeds were planted to develop sufficient quantity of F_2 seed during *rabi* 1999-2000. Parents, F_1s and F_2s were evaluated following randomized block design with three replications in normal (pH-8.00, ECe 1.04 dSm^{-1}) and saline fields (pH-8.50, ECe 6.40 dSm^{-1}) during *rabi* 2000-01. At each location, in each replication, each of the homogeneous generations i.e. parents and F_1s were sown in a plot of 2 rows of 2 m length spaced 25 cm apart, while the segregating generation i.e. F_2 was sown in a plot of 4 rows of 2m in length spaced 25 cm apart. 10 cm distance between plant to plant was maintained in each plot. Non experimental rows were planted all around the experimental material to avoid any possible boarder effects. The observations were recorded on days to ear emergence (taken on whole plot basis), plant height (cm), number of productive tillers/plant, number of grains/ear, grain weight/ear (g), grain yield/plant (g) and 1000 grain weight (g) were recorded on a sample of 10 plants/plot in each parent/F_1 and 20 plants in F_2/replication/ environment. The mean values were used for the analysis of variance. The analysis of variance was done following standard statistical methods [4,7].

A simple genetic explanation of the data on additive dominance model was sought after testing it for epistasis and non-random distribution of the genes among parents. The linear regression of Wr on Vr was tested for significance (b = 0) and for deviation from unity (b = 1) by usual t-test indicating the presence of epistasis for most of the characters under normal condition except days to ear emergence in F_2 generation and 1000 grain weight in both the generations. It must also be pointed out that under normal condition the gene dispersion and association may cause the graph to deviate from a straight line of linear regression in characteristic ways that have superficial similarities to the effect of complementry and duplicate interactions (2). However, under salinity, the additive dominance model fitted for all the characters except number of grains/ear. The change in the gene action from normal to saline environment may be due to the result of the large environmental variance and genotype × environmental interactions within the environment [1] and partly due to the suppression of genetic variability under stress condition [5]. Estimation of components of variation (D, H_1, H_2, h^2, F and E) and various ratios based on these components are presented in Table 1. The estimates of additive (D) and dominance (H_1 and H_2) components were significant for almost all the characters under study indicating the importance of both additive as well as non-additive gene effects. However, the magnitude of dominant component were higher than additive components indicating the preponderance of non-additive gene effects for the inheritance of these traits except days to ear emergence in both the environments.

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Table 1. Estimates of components of genetic variance for different morphological characters in wheat grown under (n) and saline (S) environments

Components/ ratios	Days to ear emergence			Plant height		No. of prod. Tillers/plant		Grain weight/ear		Grain yield/plant		1000 grain weight			
	N	S		S		S		S		S		N		S	
	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
D	18.76**	23.52**	22.65**	113.35**	112.86**	1.46**	1.48**	0.10*	0.10	11.33**	11.44**	31.82**	31.73**	31.18**	31.17**
H_1	7.52**	6.16**	22.74**	134.72**	187.74**	1.71**	2.33**	0.36**	0.43**	19.98**	26.02**	38.65**	37.05**	40.29**	36.55**
H_2	5.79**	5.37**	13.27**	105.96**	160.05**	1.52**	1.86**	0.28**	0.34**	16.86**	20.38**	32.37**	34.19**	35.48**	32.44**
h^2	14.01**	1.24	0.63	13.81	6.91	2.31**	1.06**	0.04	0.00	13.00**	4.92*	6.37	0.58	25.94**	5..96
F	5.76**	4.72*	2.42	58.63**	–19.05	–0.36	–0.05**	0.03	0.01	–2.15	–8.00	20.45*	14.64*	3.92	4.53
E	0.62*	0.51*	1.38	1.09	1.58	0.04	0.02	0.00	0.00	0.22	0.09	0.03	0.12	0.22	0.23
$(H_1/D)^{1/2}$	0.63	0.51	1.00	1.09	1.29	1.08	1.25	1.93	2.12	1.33	1.51	1.10	1.08	1.14	1.08
$H^2/4H_1$	0.19	0.22	0.15	0.20	0.21	0.22	0.20	0.20	0.20	0.21	0.20	0.21	0.23	0.22	0.22
$(4DH_1)^{1/2}+F$	1.64	1.49	1.11	1.62	0.88	0.80	0.56	1.20	1.07	0.87	0.62	1.82	1.54	1.12	1.14
h^2/H_2	2.42	0.23	0.05	0.13	0.04	1.52	0.57	0.14	0.00	0.77	0.24	0.20	0.02	0.73	0.18

* and ** significant at 5% and 1% level of significance, respectively.

The average degree of dominance $(H_1/D)^{1/2}$ indicated over dominance for almost all the characters under both the environments except days to ear emergence which showed partial (F_2-normal environment and F_1-saline environment) and complete dominance (F_2-saline environment). Over dominance as observed in the present study of component analysis is in the line with similar results obtained by Dubey [3] particularly for saline environments. Even in normal environments such reports are common.

The value of $H_2/4H_1$ was less than 0.25 for all the characters studied indicating the asymmetrical distribution of positive and negative alleles in the parents.

The positive F value caused the ratio $[(4DH_1)^{1/2} + F/(4DH_1)^{1/2}\text{-}F]$ to be greater than unity for almost all the traits (except number of productive tillers/plant, grain yield/plant and plant height in F_2 generation) indicating that these characters were controlled by more of dominant genes in the parent. The low value of h^2/H_2 in all the characters studied indicated that there was atleast one gene group controlled the inheritance of the trait however, for days to ear emergence in F_2 generation normal environment, three groups of genes and for number of productive tillers/plant in F_1 generation saline environment, two groups of genes were observed.

The heritability estimates in narrow sense was high for days to ear emergence, plant height and 1000 grain weight over generations and environments and moderate in number of productive tillers/plant and grain yield in both the generations under saline environment indicating the greater role of additive genetic components. Hence, it is expected that selection of these characters in early generations would be effective for the improvement of grain yield in wheat. The heritability estimates were low for rest of the characters emphasizing the greater role of non-additive genetic components. The results are in close agreement with the findings of Mann and Sharma [6].

In the light of these results it seems that epistasis appear to be of minor importance under saline environment for most of the characters and this could be of practical significance under salinity condition.

Considering the preponderance of additive and partial dominance for days to ear emergence, simple selection procedure would be effective. However, the prevalence of both additive and non-additive gene effects for rest of the characters non conventional breeding methods such as biparental mating followed by recurrent selection, diallel selective mating in addition to conventional breeding methods are suggested for amelioration of grain yield through its component traits.

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