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Short Communication

Inheritance of grain yield and some quantitative traits in six rowed barley (*Hordeum vulgare* L.)

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Generation mean was undertaken to estimate the different non-allelic gene actions operating in the inheritance of grain yield and its components traits in six rowed barley (*Hordeum vulgare* L.). Six generations, P_1, P_2, F_1, F_2, BC_1 and BC_2 of two crosses namely, BL-2 × RD 2433 and RD 2407 × RD 2433 were raised in a randomized block design with three replications. Ten randomly selected plants each of P_1, P_2 and F_1, 20 plants of BC_1 and BC_2 and 30 plants of F_2 generations were used for recording observations, on days to maturity, plant height, flag leaf area, tillers per plant, grains per spike and grain yield per plant. Scaling tests A, B and C were first applied to detect the presence of epistasis as suggested by Mather's [1]. The estimates of gene effects of six parameter model were calculated as per Hayman [2]. Potance ratio [3], heritability [ns] as per Mather's [1] and genetic advance [4] were also calculated accordingly.

Two out of three scaling tests, differed significantly from zero for all the characters in both the crosses (table not given) suggesting the influence of non-allelic interaction in the inheritance of these characters.

The results of six parameter model (Table 1) revealed that among the main effects, additive (d) was found significant in the cross RD 2407 × RD 2433 for plant height, and grains per spike and in BL-2 × RD 2433 for tillers per plant. Dominance (h) effect was found significant in the cross B-2 × RD 2433 for grains per spike and grain yield per plant. Both additive (d) and dominance (h) effects were found significant in the cross BL-2 × RD 2433 for days to maturity, plant height and flag leaf area and in the cross RD 2407 × RD 2433 for tillers per plant, flag leaf area and grain yield per plant. On overall basis the relative magnitudes of dominance (h) effects were higher then the additive (d) effects. The importance of both the main effects (d, h) in the inheritance of these traits in barley had also reported by [5].

All the interaction effects (i, j and l) were found significant in the cross BL 2 × RD 2433 for plant height and flag leaf area, whereas, for days to maturity, tillers per plant and flag leaf area these were significant in the cross RD 2407 × RD 2433. Additive × additive (i) interaction was found significant only for days to maturity in both the crosses; additive × dominance (j) was found significant for grain yield per plant only in the cross RD 2407 × RD 2433. Screening of (h) and (l) revealed presence of duplicate epistasis for all the traits except number of grains per spike in cross BL-2 × RD 2433 where complementary epistasis was present.

The results of potence ratio, inbreeding depression, heritability (ns) and genetic advance (Table 2) revealed that potence ratio for grain yield per plant indicated over dominance for both the crosses and partial dominance for flag leaf area. Again for plant height in the cross BL-2 × RD 2433 there was over-dominance and partial dominance in the cross RD 2407 × RD 2433. The results of inbreeding depression exhibited low to medium inbreeding depression for all the traits studied, means these traits can be fixed in the segregating generations. Heritability and GA both were low, suggesting the complex inheritance and non-additive gene action.

A perusal of the above results suggested that non-fixable gene effects (h), (j) and (l) were higher than the fixable gene effects (d) and (i) in both the crosses for all the characters. Therefore, normal breeding methods would not be fruitful and some forms of recurrent selection namely, diallel selective mating or biparental matings in early segregating generations might prove to be an effective approach for exploiting both additive and non-additive type of gene actions.

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Table 1. Estimates of gene effects and type of epistasis for different traits in barley

Cross	m	d	h	i	j	i	Type of epistasis
Days to maturity							
BL-2 × RD 2433	107.66±0.88	2.34**±0.66	13.34**±3.79	8.68**±3.76	0.005±0.74	−4.01±4.51	
RD 2407 × RD 2433	108.66±0.88	0.33±0.66	17.18**±3.81	14.08**±3.76	−3.49**±0.8	−18.37**±4.56	D
Plant height							
BL-2 × RD 2433	62.4±0.56	7.04**±1.76	−26.68**±4.17	−24.00**±4.17	5.84*±2.04	61.36**±8.06	
RD 2407 × RD 2433	68.4±1.23	−7.57**±1.25	−4.84±5.79	−5.14±5.53	−9.1**±1.48	6.6±7.81	D
Tillers/plant							
BL-2 × RD 2433	3.80±0.40	−0.60**±0.16	−2.07±1.68	−3.08±1.64	−0.16±0.27	6.95**±1.86	
RD 2407 × RD 2433	3.26±0.03	−0.7**±0.16	7.19**±10.46	5.68**±0.35	−1.01**±10.32	−4.39**±0.70	D
Flag leaf area							
BL-2 × RD 2433	17.05±0.53	−2.47**±0.72	24.95**±2.61	25.82**±2.58	−7.88**±0.76	−24.96**±3.69	D
RD 2407 × RD 2433	15.84±0.51	−3.08**±0.61	31.24**±2.53	28.68**±2.40	−4.06**±0.73	−41.61**±2.44	D
Grains/spike							
BL-2 × RD 2433	46.83±0.61	−3.44**±0.79	6.87*±3.02	−1.0±2.93	−2.24±0.91	27.34**±4.26	C
RD 2407 × RD 2433	49.56±0.39	−8.23**±0.71	3.71±2.28	0.62±2.12	−11.07±0.78	19.78**±3.67	
Grain yield/plant							
BL-2 × RD 2433	7.55±0.18	0.47±0.45	−7.82**±1.54	−6.72**±1.17	−0.34±0.76	14.98**±2.81	D
RD 2407 × RD 2433	5.97±0.16	1.27**±0.33	−2.55*±1.10	0.42±0.94	−1.97**±0.63	1.19±1.87	

*,** Significant at 5 per cent and 1 per cent level respectively.D = Duplicate, C = Complementary

Table 2. Potence ratio, inbreeding depression, heritability and genetic advance for different characters in barley

Cross	Potence ratio	Inbreeding depression (%)	Heritability (ns)	Genetic advance (GA)
Day to maturity				
BL-2 × RD 2433	1.94	5.00	53.10	4.44
RD 2407 × RD 2433	1.00	3.55	51.28	4.44
Plant height				
BL-2 × RD 2433	−2.16	3.10	45.63	3.72
RD 2407 × RD 2433	0.19	−1.13	21.96	6.59
Tillers/plant				
BL-2 × RD 2433	−2.34	15.55	57.20	0.23
RD 2407 × RD 2433	4.75	43.40	24.76	0.00
Flag leaf area				
BL-2 × RD 2433	0.29	30.46	83.40	1.43
RD 2407 × RD 2433	0.59	24.78	14.75	1.48
Grains/spike				
BL-2 × RD 2433	−6.55	17.98	30.79	1.06
RD 2407 × RD 2433	1.08	12.06	24.68	1.62
Grain yield/plant				
BL-2 × RD 2433	−1.34	−2.16	10.82	0.87
RD 2407 × RD 2433	−4.18	−29.22	15.50	0.09

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