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# GENETIC ANALYSIS FOR EARLINESS, PLANT HEIGHT AND KERNEL WEIGHT IN TWO BREADWHEAT CROSSES UNDER NORMAL AND SALINE SODIC SOILS

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## ABSTRACT

**A set of six populations, viz. both parents, $F_1$, $F_2$, $BC_1$ and $BC_2$, derived from the crosses Kharchia 65 x Raj 3077 and Kharchia 65 x Lok 1 of breadwheat was evaluated under normal and saline sodic soils to estimate the type of gene effects for days to flowering, days to maturity, plant height, and 100-kernel weight. In general, all these traits were predominantly governed by additive gene effects in both the crosses under normal and stress environments, though the nonadditive gene effects were also important in some of the combinations. Hence intermating in early generations followed by selection could be successfully adopted for improvement of the traits studied.**

**Key words:** Genetic analysis, breadwheat, epistasis, gene effects.

The knowledge of gene effects for different traits plays vital role before starting a breeding programme for a particular environment in which a crop is ultimately grown. Genetic studies involving a stress tolerant parent with another high yielding and widely adapted parent need more attention, because such crosses are expected to offer desirable genetic variability for a specific stress environment. Therefore, the present investigation comprising six generations each of two crosses, viz., Kharchia 65 x Raj 3077 and Kharchia 65 x Lok 1 (female parent highly salt tolerant; male parents moderately salt tolerant, high yielding and widely adapted) was carried out under normal and saline sodic soils to estimate the gene effects involved in the inheritance of days to flowering, days to maturity, plant height, and 100-kernel weight.

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## MATERIALS AND METHODS

The experimental material comprised six populations, i.e. both parents, $F_1$, $F_2$, $BC_1$ and $BC_2$ derived from each of the two crosses, namely, Kharchia 65 x Raj 3077 and Kharchia 65 x Lok 1, which were evaluated in randomized block design with three replications during rabi 1990–91 at S.K.N. College of Agricultural Farm, Jobner under normal (pH 8.4; ECe 3.5 dS/m) and saline sodic (pH 9.1; ECe 8.6 dS/m) soils. Each plot consisted of one row of the parents and $F_1$, two rows each of $BC_1$ and $BC_2$, and four rows of each $F_2$ generation. Each row was 1.5 m long, 25 cm apart with 5 cm plant-to-plant distance. Data on five competitive plants from each plot in the parents and $F_1$, 10 plants per plot in $BC_1$ and $BC_2$, and 15 plants per plot of $F_2$ were used to record four traits (Table 1).

Mather's [1] scaling tests A, B and C were first applied to judge the adequacy of the additive–dominance model. The adequacy of this model was further conformed by joint scaling test [2]. For the crosses where $\chi^2$ values of joint scaling test were significant, indicating inadequacy of the three–parameter (nonepistatic) model, the estimates of m, (d), (h), (i), (j) and (l) were calculated following the digenic epistatic model [3].

## RESULTS AND DISCUSSION

The scaling tests A, B and C indicated the presence of epistasis for all the traits as at least one scaling test was significant in both the crosses over environments, except for days to maturity in both the crosses and for plant height in the cross Kharchia 65 x Raj 3077 in saline soil; and for 100- kernel weight in Kharchia 65 x Raj 3077 in normal soil, in which none of the scaling tests was significant. However, the $\chi^2$ values of joint scaling test were significant in all the cases, indicating inadequacy of the additive–dominance model, except for 100-kernel weight in Kharchia 65 x Raj 3077 in normal soil, where the additive–dominance model fitted well. This suggested that digenic nonallelic interactions were responsible for the inheritance of all the traits studied in normal as well as saline sodic soils.

The estimates of m, (d), (h), (i), (j) and (l) obtained on the best-fit model for the traits studied are presented in Table 1. The additive gene effects for all the traits were significant in both the crosses over environments, except for days to flowering in Kharchia 65 x Raj 3077 in saline soil. The dominance gene effects were significant for days to flowering in Kharchia 65 x Lok 1 in saline soil, and for days to maturity in both crosses in normal soil; for plant height in Kharchia 65 x Raj 3077 in saline soil; and for 100- kernel weight in Kharchia 65 x Raj 3077 in normal soil and Kharchia 65 x Lok 1 in saline soil. Additive x additive (i) type of epistatic effects were significant for days to flowering in both crosses over environments, except Kharchia 65 x Lok 1 in normal soil; for days to maturity in both crosses in normal soil; and for plant height in Kharchia 65 x Raj 3077 over both environments. The

**Table 1. Estimates of genetic parameters on the best-fit model for four characters in two crosses of breadwheat under normal and saline sodic soils**

| Cross | Environment (soil type) | Estimates of genetic parameters | | | | | | Epistasis |
|---|---|---|---|---|---|---|---|---|
| | | m | (d) | (h) | (i) | (j) | (l) | |
| | | | | **Days to flowering** | | | | |
| Kharchia 65 x Raj 3077 | Normal | 73.9 ± 2.7 | 1.7** ± 0.2 | 1.70 ± 6.31 | 6.20* ± 2.74 | 0.26 ± 1.42 | 1.80 ± 3.68 | — |
| | Saline | 81.9 ± 1.6 | 0.40 ± 0.24 | 2.91 ± 3.91 | 3.42** ± 1.58 | − 1.74 ± 1.09 | − 0.22 ± 2.42 | — |
| Kharchia 65 x Lok 1 | Normal | 72.7 ± 3.6 | 5.50** ± 0.23 | − 0.01 ± 8.16 | 2.58 ± 3.61 | − 5.54** ± 1.72 | 3.62 ± 4.66 | — |
| | Saline | 78.9 ± 1.6 | 3.50** ± 0.21 | 9.45** ± 3.98 | 3.58* ± 1.59 | − 3.66** ± 1.11 | − 5.50* ± 2.51 | Duplicate |
| | | | | **Days to maturity** | | | | |
| Kharchia 65 x Raj 3077 | Normal | 113.7 ± 1.6 | 1.37** ± 0.24 | 26.17** ± 3.84 | 11.20** ± 1.55 | − 0.34 ± 0.96 | − 15.14** ± 2.42 | Duplicate |
| | Saline | 120.7 ± 1.2 | 1.14** ± 0.19 | − 0.78 ± 2.95 | 0.54 ± 1.19 | − 0.01 ± 0.82 | 1.05 ± 1.85 | — |
| Kharchia 65 x Lok 1 | Normal | 126.7 ± 1.6 | 4.04** ± 0.24 | − 14.49** ± 4.11 | − 3.72* ± 1.62 | − 3.47** ± 1.17 | 8.27** ± 2.57 | Duplicate |
| | Saline | 119.2 ± 1.2 | 3.54** ± 0.19 | 1.71 ± 3.03 | − 0.08 ± 1.18 | − 2.35** ± 0.89 | 0.01 ± 1.94 | — |
| | | | | **Plant height** | | | | |
| Kharchia 65 x Raj 3077 | Normal | 81.6 ± 6.0 | 13.93** ± 0.89 | 25.00 ± 14.59 | 12.20* ± 5.98 | − 8.98* ± 3.91 | 3.60 ± 9.04 | — |
| | Saline | 78.0 ± 5.5 | 4.63** ± 1.18 | − 27.79* ± 13.14 | − 13.08* ± 5.38 | 1.34 ± 3.70 | 14.94 ± 8.59 | — |
| Kharchia 65 x Lok 1 | Normal | 86.8 ± 6.8 | 16.27** ± 1.10 | − 13.97 ± 16.46 | − 2.76 ± 6.73 | 2.06 ± 4.45 | 22.54* ± 10.54 | — |
| | Saline | 65.7 ± 5.6 | 3.35** ± 0.86 | − 11.17 ± 13.78 | − 2.48 ± 5.51 | 3.54 ± 3.89 | 11.62 ± 8.61 | — |
| | | | | **100-kernel weight** | | | | |
| Kharchia 65 x Raj 3077 | Normal | 4.8 ± 0.0 | − 0.13** ± 0.04 | 0.50** ± 0.07 | — | — | — | — |
| | Saline | 4.1 ± 0.3 | 0.34** ± 0.04 | − 0.10 ± 0.87 | − 0.44 ± 0.33 | 0.13 ± 0.25 | − 0.19 ± 0.57 | — |
| Kharchia 65 x Lok 1 | Normal | 5.4 ± 0.4 | − 0.50** ± 0.05 | − 0.18 ± 0.91 | 0.04 ± 0.38 | − 0.20 ± 0.23 | 0.56 ± 0.54 | — |
| | Saline | 5.2 ± 0.4 | − 0.35** ± 0.05 | − 2.37* ± 1.10 | − 0.86 ± 0.44 | 0.43 ± 0.29 | 1.75** ± 0.67 | Duplicate |

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

additive x dominance (j) type of digenic interactions were significant for days to flowering and maturity in the cross Kharchia 65 x Lok 1 in both soil types; and for plant height in Kharchia 65 x Raj 3077 in normal soil. The dominance x dominance (l) type interallelic interaction effects were significant for days to flowering in the cross Kharchia 65 x Lok 1 in saline soil; for days to maturity in both crosses in normal soil; for plant height in Kharchia 65 x Lok 1 in normal soil; and for 100-kernel weight in Kharchia 65 x Lok 1 in saline soil.

The gene effects worked out for these traits by various workers indicated the importance of additive and dominance [4] as well as epistatic effects [5] for days to flowering; additive and dominance effects for days to maturity [6, 7]; additive [8] and epistatic effects [9, 10] for plant height, and additive gene effect for 100-kernel weight [11].

The signs of (h) and (l) estimates were opposite for days to flowering in the cross Kharchia 65 x Lok 1 in saline soil; for days to maturity in both the crosses in normal soil; and for 100-kernel weight in Kharchia 65 x Lok 1 in saline soil (Table 1). This indicates duplicate type gene action which would hinder progress in selection.

In most of all the character combinations, additive gene effect was highly significant, indicating its predominant role in the inheritance of the characters studied. However, simple pedigree breeding will not be able to fix superior lines in early generations, because nonfixable gene effects (h), (j) and (l) were also significant in some of the character combinations. Under such a situation intermating in early generations followed by selection may help in exploiting both types of gene effects [12, 13]. The $\chi^2$ values were significant for most of the cases, indicating that the digenic epistatic model fits well. However, in some cases none of the digenic interaction effects was significant. This may be due to the presence of higher order interactions, linkage, or large sampling error.

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