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# GENETICS OF RATOONING ABILITY IN RICE (*ORYZA SATIVA* L.)

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ABSTRACT

**In the present investigation, 18 $F_1$ hybrids in *Oryza sativa* L. were studied for their ratooning ability. The results of scaling tests revealed the presence of epistasis. Partial dominance was prevailing in majority of the crosses. Inbreeding depression was low. Moderate to fairly high degree of heritability (50.2% to 81.2%) and genetic advance (9.3% to 29.8%) were observed. Most of the crosses showed additive (d) and additive x additive (i) types of gene effects. Thus, the ratooning ability is governed by additive gene action.**

**Key words:** Ratooning ability, heritability, additive genes, additive x additive gene action.

Crop intensification and higher yield seem to be prospective avenues to bridge the increasing gap between production and demand for food since there is meagre possibility of bringing more land under rice cultivation. Ratooning of rice crop can be evaluated as a means of making the land productive after the dry season crop in irrigated areas and after the rainy season crop in rainfed areas, since the cost of cultivation be lowered due to reduction in land preparation, seed and planting and fertilizer requirements [1]. Ratoon cropping is considered an alternative for double rice cropping [2]. It is imperative that enhanced ratoon rice crop yield is totally depending on the ratooning ability. A superior ratooning line combined with satisfactory main crop yielding ability and other important attributes is required to be identified. If the identified genotype with superior performance in both first and ratoon crops exhibit extraordinarily high combined yields, then the cost of production per unit measure can be reduced significantly. Since varieties differ greatly in ratooning ability [3], inheritance of the trait could be exploited. The ratooning ability is a complex trait, dependent on many heritable and environmental factors. The genetics of it is unclear and it may be more appropriate to consider it a composite trait. The question arises

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whether ratooning ability is a genetic trait in its own right, or a trait derived from and interaction of genotypic and environmental factors. Most of the traits contributing to yield in rice are polygenically controlled, wherein a biometrical approach would be greater value in understanding the complex interaction of genes and the environment and the resultant expressions like ratooning.

## MATERIALS AND METHODS

The study was conducted during rainy season at the Main Research Station, University of Agricultural Sciences, Hebbal, Bangalore. The material comprised parents, $F_1$, $F_2$ and backcross ($BC_1$, $BC_2$) progenies of the following crosses: between dwarf and early strains—V 20B x IR 36, V 20B x IR 46, V 20B x IR 54, V 20B x IR 15324, V 20B x IR 27315, and V 20B x ARC 11353; between semidwarf and medium duration varieties—Madhu B x IR 36, Madhu B x IR 45, Madhu B x IR 54, Madhu B x IR 15324, Madhu B x IR 27315, and Madhu B x ARC 11353; and between tall and late maturing combinations—IR 54752B x IR 36, IR 54752B x IR 46, IR 54752B x IR 54, IR 54792 B x IR 15324, IR 54752B x IR 27315, and IR 54752B x ARC 11353.

The six populations (both parents, $F_1$, $F_2$, $BC_1$, $BC_2$) were planted keeping 2 lines of each generations of the parents, $F_1$, $F_2$, $BC_1$ and $BC_2$, and six lines of each $F_2$ without replications. Twentyfive-day-old seedlings were transplanted keeping 80 plants per row at the spacing of 20 cm between rows and 10 cm between plants. The experimental plot was fertilized at the rate of 100:50:50 kg NPK/ha.

All the plants in each row were harvested after recording observations on the number of productive tillers in the main crop at physiological maturity leaving 10 to 15 cm long stubbles for the ratoon crop. The recommended dose of 50 kg N/ha was applied to the ratoon crop. The productive tillers of the ratoon crop were counted at harvest.

Ratooning ability (RA) was estimated as the ratio of productive tillers in the ratoon crop and the main crop [4]. The scaling tests of Mather [5] were applied to detect epistasis. Inbreeding depression, broad sense heritability [6], genetic advance [7], and potence ratio [8] were worked out using the standard formulae. The six-parameter model was also used to determine the nature of gene action [9, 10].

## RESULTS AND DISCUSSION

The results presented in Table 1 on the mean performance of parents, $F_1$, $F_2$ and backcross generations in the 18 crosses of rice show that the highest ratooning ability was recorded in the parent variety IR 54752B (0.81), while IR 15324 (0.58) had the poorest ratoning ability. Among the $F_1$s, the cross IR 54752B x ARC 11353 (0.87) showed maximum and V 20B x ARC 11353 (0.72) poor ratooning capacity. In $F_2$ generation, ratooning ability

**Table 1. Mean performance of the parents, $F_1$, $F_2$, $BC_1$ and $BC_2$ populations in different crosses of rice for ratooning ability**

| Cross | Female parent | Male parent | $F_1$ | $F_2$ | $BC_1$ | $BC_2$ |
|---|---|---|---|---|---|---|
| V 20B x IR 36 | 0.80 | 0.64 | 0.74 | 0.70 | 0.72 | 0.75 |
| V 20B x IR 46 | 0.80 | 0.74 | 0.78 | 0.77 | 0.85 | 0.82 |
| V 20B x IR 54 | 0.80 | 0.73 | 0.78 | 0.80 | 0.79 | 0.78 |
| V 20B x IR 15324 | 0.80 | 0.58 | 0.79 | 0.77 | 0.80 | 0.85 |
| V 20B x IR 27315 | 0.80 | 0.59 | 0.75 | 0.81 | 0.83 | 0.82 |
| V 20B x ARC 11353 | 0.80 | 0.73 | 0.72 | 0.61 | 0.80 | 0.78 |
| Madhu B x IR 36 | 0.75 | 0.64 | 0.83 | 0.75 | 0.91 | 0.85 |
| Madhu B x IR 46 | 0.75 | 0.74 | 0.84 | 0.77 | 0.82 | 0.82 |
| Madhu B x IR 54 | 0.75 | 0.73 | 0.81 | 0.80 | 0.77 | 0.86 |
| Madhu B x IR 15324 | 0.75 | 0.58 | 0.78 | 0.79 | 0.73 | 0.65 |
| Madhu B x IR 27315 | 0.75 | 0.59 | 0.77 | 0.84 | 0.80 | 0.80 |
| Madhu B x ARC 11353 | 0.75 | 0.73 | 0.75 | 0.80 | 0.82 | 0.82 |
| IR 54752B x IR 36 | 0.81 | 0.64 | 0.86 | 0.77 | 0.79 | 0.80 |
| IR 54752B x IR 46 | 0.81 | 0.74 | 0.84 | 0.75 | 0.81 | 0.93 |
| IR 54752B x IR 54 | 0.81 | 0.73 | 0.86 | 0.89 | 0.79 | 0.75 |
| IR 54752B x IR 15324 | 0.81 | 0.58 | 0.85 | 0.84 | 0.85 | 0.81 |
| IR 54752B x IR 27315 | 0.81 | 0.59 | 0.85 | 0.82 | 0.84 | 0.83 |
| IR 54752B x ARC 11353 | 0.81 | 0.73 | 0.87 | 0.79 | 0.85 | 0.79 |

Note. B lines were used instead of A line in crossing programme.

varied from 0.61 (V 20B x ARC 11353) to 0.89 (V 20B x IR 54). The ratooning ability in backcross populations ranged from 0.65 (Madhu B x IR 15324) x IR 15324) to 0.93 (IR 54752 B x IR 46) x IR 46).

As can be seen from Table 2, the scaling tests indicated epistasis in all the 18 crosses. Potence ratios (hp) were less than unity in most of the hybrids and inbreeding depression not very high, ranging from – 9.09% (Madhu B x IR 27315) to 15.28% (V 20B x ARC 11353). Most of the $F_1$ hybrids showed additive (d) and additive x additive (i) gene action.

Moderate to high heritability and genetic advance for ratooning ability observed in the present study were also reported by Chauhan et al. [4]. Therefore, single plant

**Table 2. Epistasis, potence ratio, inbreeding depression, gene effects, heritability and genetic advance for different crosses in rice**

| Cross | Test applied | Potence ratio | Inbreeding depression (%) | Gene effects | Herit-ability ($h^2$) | Genetic advance (GA) |
|---|---|---|---|---|---|---|
| V 20B x IR 36 | Epistasis | 0.25 | 5.41 | (d), (i) | 50.2 | 9.3 |
| V 20B x IR 46 | —Do— | 0.33 | 1.28 | —Do— | 65.2 | 10.3 |
| V 20B x IR 54 | —Do— | 0.32 | - 2.56 | —Do— | 79.7 | 12.5 |
| V 20B x IR 15324 | —Do— | 0.91 | 2.53 | —Do— | 70.7 | 18.5 |
| V 20B x IR 27315 | —Do— | 0.50 | - 8.00 | —Do— | 68.2 | 12.2 |
| V 20B x ARC 11353 | —Do— | - 9.67 | 15.28 | —Do— | 58.4 | 20.1 |
| Madhu B x IR 36 | —Do— | 0.60 | 9.64 | (d), (i) | 61.1 | 10.3 |
| Madhu B x IR 46 | —Do— | 0.80 | 3.32 | —Do— | 54.8 | 9.8 |
| Madhu B x IR 54 | —Do— | 0.70 | 1.23 | (d), (l) | 72.6 | 15.6 |
| Madhu B x IR 15324 | —Do— | 0.38 | - 1.28 | (d), (i) | 65.7 | 10.8 |
| Madhu B x IR 27315 | —Do— | 0.25 | - 9.09 | —Do— | 78.7 | 18.8 |
| Madhu B x ARC 11353 | —Do— | 0.35 | - 6.67 | (d), (l) | 80.7 | 19.2 |
| IR 54752B x IR 36 | —Do— | 0.63 | 10.47 | (d), (i) | 78.7 | 16.7 |
| IR 54752B x IR 46 | —Do— | 2.00 | 10.71 | —Do— | 80.2 | 18.2 |
| IR 54752B x IR 54 | —Do— | 0.25 | - 3.49 | —Do— | 81.2 | 14.8 |
| IR 54752B x IR 15324 | —Do— | 0.36 | 1.18 | —Do— | 65.7 | 29.8 |
| IR 54752B x IR 27315 | —Do— | 0.38 | 3.53 | (l) | 74.8 | 8.9 |
| IR 54752B x ARC 11353 | —Do— | 0.50 | 9.20 | —Do— | 66.9 | 18.5 |

Gene action: (d) additive, (i) additive x additive, and (l) dominance x dominance.

selection would be more effective to improve and fix this trait in the future generations.

Though Chauhan et al. [11] concluded from a similar study that both additive and nonadditive gene effects are important for the determination of this trait they, nevertheless, pointed out that additive gene effects were more important, which was also observed in the present study. Subsequently, additive and dominant gene effects were also reported to be operative in the determination of this character [12]. Ultimately, the investigation revealed that the ratooning ability is governed by additive (d) and additive x additive (i) gene actions. Hence it can be concluded that the trait ratooning ability can give ample response under selection in future generations.

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