Indian J. Genet., **65**(2): 96-98 (2005)

Early generation testing and response to selection in three crosses of rice (*Oryza sativa* L.)

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(Received: October 2004; Revised: June 2005; Accepted: June 2005)

Abstract

One hundred and fifty seven F_4 progenies from three Basmati × non-Basmati crosses, selected on the basis of high yield/plant and harvest index in the genetic background of fine grain quality characteristics from 498 F_3 progenies were evaluated in the augmented randomized block design under two environments i.e. 120 kg N/ha (E-I) and 160 kg N/ha (E-II). Estimates of correlation coefficients between selected F_3 progenies and corresponding F_4 lines were highly significant and positive with respect to grain yield/plant, biological yield/ plant and 1000-seed weight. At lowest selection intensity, standardized selection differential was the highest for all traits. Standardized response to selection at such low selection intensity was the highest for all traits in E-II and equally good in E-I. Realized heritability for grain yield/plant was high at 5%, 10% and 15% selection intensities in E-II. For 1000-grain weight the estimated realized heritability was high in all cases.

Key words: Basmati × non-Basmati crosses, standardized selection differential, standardized response to selection, early generation testing, realized heritability.

The early generation testing is the one of the best options to reduce the amount of material to be handled in the segregating generations and at the same time retain the good recombinant lines for the traits under improvement. Whân *et al.* [1] suggested that selection for grain yield in early generation need to be done at many sites simultaneously at an early growth stage. In the present investigation, selection and evaluation of genotypes were carried out in two environments to get the information on response to early generation selection and realized heritability for adopting efficient selection strategies in Basmati × non-Basmati derived gene pool of rice for yield improvement in the background of fine grain quality.

Materials and methods

One hundred and fifty seven F_4 progenies of three Basmati × non-Basmati crosses namely, Taraori Basmati × PR106, Pusa Basmati-1 × PR 106 and Basmati 386 × PR 106 selected, on the basis of high grain yield and fine grain quality from 498 F_3 progenies, were evaluated along with five checks *viz.*, Pusa Basmati 1, Taraori Basmati, Basmati 386, PR 106 and Pusa 44 in the augmented randomized block design in five blocks in under two environments created by applying two doses of nitrogen i.e. 120 kg/ha (E-I) and 160 kg/ha. (E-II).

The initial fertility status of two environments with respect to available N, P and K was similar. Plot size consisted of single row of 1.5 m length with row to row and plant to plant spacing of 20 cm and 15 cm respectively. Standard agronomic practices were adopted to raise the crop. The data were recorded on five randomly chosen plants from each plot on grain yield/plant (g), biological yield/plant(g), harvest index and 1000-grain weight (g). The analysis of variance for design used was carried out as per Federer [2]. Simple correlation coefficients were computed for early generation testing and standardized selection differential, response to selection and realized heritability were estimated as per Falconer [3].

Results and discussion

The results obtained with respect to correlation of different traits between F_3 and F_4 generations are given in Table 1. The correlation of seed yield/plant, biological yield/plant, harvest index and 1000-grain weight between F_3 and F_4 generation was significant and positive in both the environments indicating that grain yield, biological yield, harvest index and 1000-grain weight of

Table 1. Estimates of correlation coefficients between F_3 and F_4 generation for seed yield/plant(g), biological yield/plant(g), harvest index and 1000-seed weight in two environments

Traits	Correlation coefficients	
	E-I	E-II
Seed yield/plant(g)	0.78*	0.84*
Biological yield/plant(g)	0.74*	0.70*
Harvest index	0.69*	0.66*
1000-seed weight(g)	0.88*	0.93*

*Significant at 5% level of significance

Table 2. Estimates of standard selection differential, standardized response to selection and realized heritability for different traits in two environments under different selection intensities

Parameters → / Trait and selection ↓ intensities	Population mean	No. of selected lines	Mean of selected lines	Standardized selection response (S/σ p)	Progeny mean		Standardized selection differential (R/σ p)		Realized heritability (R/S)	
					E-I	E-II	E-I	E-II	E-I	E-II
Seed yield/plant (g)	15.08									
Selection intensity										
5%		30	30.12	4.86	28.09	29.26	4.24	4.59	0.87	0.94
10%		60	27.31	3.96	25.10	25.86	3.01	3.49	0.76	0.88
15%		90	24.56	3.06	23.18	24.01	2.62	2.89	0.86	0.94
22.5%		135	20.95	1.90	18.98	18.80	1.26	1.20	0.66	0.63
Harvest index(%)	41.10									
Selection intensity										
5%		30	55.17	1.41	51.59	51.20	1.05	1.01	0.74	0.72
10%		60	52.81	1.11	50.67	50.40	0.96	0.93	0.86	0.83
15%		90	50.02	0.90	48.00	48.13	0.69	0.71	0.76	0.79
22.5%		135	48.60	0.75	47.50	46.80	0.64	0.57	0.85	0.76
1000-seed weight (g)	21.69									
Selection intensity										
5%		30	29.59	11.13	28.00	28.10	8.89	9.03	0.80	0.81
10%		60	27.91	8.76	27.40	27.20	8.04	7.76	0.92	0.88
15%		90	26.02	6.10	25.00	24.61	4.66	4.11	0.76	0.67
22.5%		135	25.00	4.66	23.50	24.00	2.55	3.25	0.55	0.70

Phehotypic standard deviations i) grain yield/plant = 3.09; harvest index = 9.96; iii) 1000-grain weight = 0.71

F_3 derived lines in F_4 generation would be predictable on the basis of yield test in F_3 generation and selection for such lines having high harvest index along with fine grain quality characteristics would be fruitful in F_3 generation itself [4, 5]. Deviation in the estimates of correlation coefficients between two different environments are expected due to genotype × environment interactions.

Weiss *et al.*, [6] reported that selection among lines after F_3 generation for grain yield is fruitful. Hanson and Weber [7] have also indicated that grain weight on F_2 plant basis is essentially equivalent to selection for grain yield in F_3. Thorne [8] and Luedders *et al.*, [9] reported significant positive correlation coefficient of F_3 derived lines with F_5 derived lines. Boerma and Cooper [10] reported that selection within highly heterogeneous lines isolated by early testing of F_2 derived lines in F_3, and subsequent generations can improve yield. Sneep [11] and Cooper [12] emphasized the use of early testing in F_2 and subsequent generations for yield.

The high order positive and significant correlation between F_3 and F_4 generations in this study are indicative of likely response to selection. As the selected F_2 derived lines were evaluated in F_4 generation in two environments and response to selection under different selection intensities, results would be useful for better prediction of the improvement in a breeding programme. The results (Table 2) revealed that at 5% selection intensity, standardized selection differential was the highest for all the traits studied and it was followed by 10%, 15% and 22.5% selection intensities. Standardized response to selection at 5% selection intensity was observed to be the highest for all traits in E-II and equally good in E-I. Estimated value of response to selection at different selection intensities were higher in E-II. Some variation in estimated response to selection between environments could be due to differences in the nature and magnitude in the correspondence between genetic and non-genetic effects. The realized heritability for seed yield/plant was high at 5%, 10% and 15% selection intensities in E-II, but moderate at all the selection intensities in E-I. The realized heritability for harvest index was high at 5% selection intensity and moderate at 10% and 22.5% selection intensities in E-II. At 5% and 10 % selection intensities it was moderate in E-I. However, realized heritability was low at 15% selection intensity in both the environments than that at 22.5% selection intensity in E-I. For 1000-grain weight, realized heritability was observed to be high in all the cases. The difference between two environments for the estimates of realized heritability could be due to the fact that heritability is a property not only of a character but also of the population, the environment and the circumstances to which genotypes are subjected to [13,14], its ultimate value depends upon the magnitude of all the components of variance. The influence of environments on the estimates of "R" for grain yield as obtained in the present study was also reported by Whan *et al.*, [1]. According to Fasoulas [15], high intensity of selection maximized genetic advance as has also been observed in the present study.

Shebeshki [16] suggested that for the identification of the most desirable gene combinations even in the heterozygote, the essential point of view is that the proportion of the plants with most desirable combination of genes decreases rapidly with the advancing generations and if these were not selected in the early generations even if heterozygote, these would be lost. The present results favour the suggestion of Shebeshki [16] as higher number of superior lines were recovered when early selection in F_2 was practiced.

Present study thus concluded usefulness of selection in early generation. The findings may have greater impact on breeding programme of rice therefore, it would be desirable to look further at this aspect on the basis of the present information with respect to grain yield/plant, biological yield/plant, harvest index and 1000-grain weight.

References

1. **Whan B. R., Knight R. and Rathjan A. J.** 1982. Response to selection for grain yield and harvest index in F_2, F_3 and F_4 derived lines of two wheat crosses. Euphytica, **31**: 139-150.
2. **Federer W. T.** 1955. Augmented (or koonulaku) designs. Hawiar Planters Records., **55**: 191-208.
3. **Falconer D. S.** 1989. Introduction to Quantitative Genetics. 3rd edn. Longman, Burnt Mill.
4. **Mishra S. K., Maurya D. M. and Vishwakarma D. N.** 1992. Efficiency of individual ranking for early generation selection in two rice crosses. New Botanist, **19**: 90-95.
5. **Roumen E.** 1996. Response to selection for high and low resistance to leaf blast in F_2 population of three rice crosses. Euphytica, **89**: 243-248.
6. **Weiss M. C., Weber R. and Kelton R.** 1947. Early generation testing in soybean. J. Am. Soc. Agron., **39**: 791-811.
7. **Hanson W. D. and Weber C. R.** 1962. Analysis of genetic variability from generation of plant progeny lines in soybean. Crop Sci., **2**: 63-67.
8. **Thorne J. C.** 1974. Early generation testing and selection in soybean. Association of yield in F_3 and F_5 derived lines. Crop Sci., **14**: 898-900.
9. **Luedders V. D., Duclos L. A. and Matson A. L.** 1973. Bulk, pedigree and early generation testing breeding methods compared in soybean. Crop Sci., **13**: 363-364.
10. **Boerma H. R. and Cooper R. L.** 1975. Comparison of three selection procedures for yield in soybean. Crop Sci., **15**: 225-229.
11. **Sneep J.** 1977. Selection for yield in early generations of self fertilizing crops. Euphytica, **26**: 27-30.
12. **Cooper R. L.** 1981. Development of short statured soybean cultivers. Crop Sci., **21**: 127-131.
13. **Rodroquez R. E. S., Rangel P. H. N., Morais O. P. de. and Morais O. P.** 1998. Estimate of genetic parameters and response to selection in the irrigated rice population CNA I-Pesquissa-Agropecuaria-Brasileira, **35**: 685-691.
14. **Verma S. K. and Mani S. C.** 2000. Selection method and response to selection in rice. Indian J. Genet., **60**: 477-481.
15. **Fasoules A.** 1981. Principles and methods of Plant Breeding. Pub. No. 11. Aristotelian University of Thessaloniki, Greece.
16. **Shebeshki L. H.** 1967. Wheat Breeding. Proceedings of the Canadian Centennial Wheat Symposium Modern Press, Saskatoon, Saskatchewan, Canada, pp. 253.