Indian J. Genet., **60**(4): 477-481 (2000)

SELECTION METHODS AND RESPONSE TO SELECTION IN RICE

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(Received: July, 1999; accepted: September, 2000)

ABSTRACT

The F_2 plants of the cross UPR 83-34/Sita were planted at four different plant spacing viz. 15 × 10, 20 × 10, 20 × 15 and 20 × 20 cm and subjected to biased and random selection followed by the estimation of selection differential for number of tillers per plant, panicle length (cm), number of grains per panicle, 1000-grain weight (g) and grain yield per plant (g). The resulting F_3 progenies were also evaluated for the same traits to find out the realized selection response. Biased selection gave higher means than the random selection in F_2, but differences got dissipated in the next generation. The estimates of selection differential were, in general, positive and high for biased selections than for corresponding random selections. On the other hand, the realized selection responses were mostly negative for biased selections and positive for random selections.

Key Words : Rice, selection differential, realized selection response, selection methods

Plant improvement by selection must take one of the two forms: selection among existing population for desirable traits or selection within population which may have descended from an experimental cross of the most desirable parents. Selection response can be maximised either by selecting the best genotype available in the population or by increasing the rigour of selection. A very rigorous selection may not be desirable as it can eliminate some promising genotypes. However, the identification of promising homozygous plants in the early segregating generations is equally difficult. With this objective in view an attempt was made to study the realized selection response at different plant spacing in segregating populations of rice.

MATERIALS AND METHODS

The experimental material comprised F_2 population of cross UPR 83-34/Sita. The F_2 generation of this cross was transplanted at four different plant spacings viz. 15 × 10 cm, 20 × 10 cm, 20 × 15 cm and 20 × 20 cm, row- to-row and palnt-to-plant, respectively, in a well puddled field at the Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, during *kharif* (wet) season of 1992. Single seedling hill^{-1} was transplanted. The crop was grown under irrigated conditions and normal fertility (120 kg N: 60 kg P_2O_5: 40 kg K_2O). Other agronomic practices were followed as and when required. At each spacing a minimum of 2000 plants were maintained. These were further divided into two equal parts, each having 1000 plants. Out of these 1000 plants from each spacing, 200 plants were selected randomly before flowering and subsequent selection was done on the basis of their grain yield at maturity.

During *kharif* 1993, the F_3 progenies of 35 random and 35 top yielding biased plants from each spacing (a total of 280 plant progenies) were evaluated alongwith the parents, F_1 hybrid and a local check (Pant Dhan 10) in a randomized complete block design with two replications. Each F_3 progeny was grown in a single row of 5m length with a spacing of 20 × 15 cm from row-to-row and plant-to-plant, respectively. At the time of maturity, five plants from each progeny were selected on the basis of their phenotypic performance for detailed study. Data were recorded on number of tillers/plant, panicle length (cm), number of grains/panicle, 1000-grain weight (g) and grain yield/plant (g) during both the years. Realized selection responses were calculated as per Falconer[1].

RESULTS AND DISCUSSION

The means of the plants selected in F_2 generation by the two methods of selection and the means of their F_3 progenies are given in Table 1. The results indicated that biased selection gave higher grain yield/plant at all the spacings than random selection at the respective spacing. The means of component characters were also higher in biased selection as compared to the random selection. However, these differences got dissipated in the next generation as mean of the F_3 progenies derived through the two methods of selection were very close to each other at all the spacing. This highlights the need for progeny testing in the selection programmes. The mean number of tillers/plant and panicle length in the random selection and 1000 grain weight in both the methods of selection showed slight increase in the F_3 progenies which could be a result of favorable climatic conditions. The mean grain yield/plant and other components decreased in F_3 progenies.

Estimates of realized selection response in random and biased groups of populations at different plant spacings given in Table 2 indicated that the estimates of selection differential at different plant spacings were higher in the biased selection than the random selection for number of tillers/plant. However, the realized selection responses were higher in random selection, especially at wider spacings. At closer

Table 1. Mean performance of various characters in F_2 and F_3 generations of rice cross UPR 83-84/Sita

Selection methods	Plant spacing (cm)	Characters									
		F_2 generation					F_3 generation				
		Number of tillers/ plant	Panicle length (cm)	Number of grains/ panicle	1000 grain weight (g)	Grain yield/ plant (g)	Number of tillers/ plant	Panicle length (cm)	Number of grains/ panicle	1000 grain weight (g)	Grain yield/ plant (g)
Biased	15×10	13.2± 0.53	27.4± 0.19	157.7± 5.70	22.9± 2.06	34.9± 1.15	13.1± 0.29	24.6± 0.19	156.9± 2.06	24.1± 0.27	15.0± 0.57
	20×10	17.0± 0.72	27.0± 0.38	201.7± 6.90	21.8± 0.25	27.7± 0.88	12.8± 0.24	24.7± 0.14	157.1± 2.53	23.7± 0.23	14.8± 0.71
	20×15	13.7± 0.44	23.9± 0.54	175.0 ± 4.60	23.5± 0.19	37.7± 0.99	13.0± 0.35	24.2± 0.18	160.7± 2.57	23.0± 0.19	14.2± 0.53
	20×20	18.5± 0.72	28.3± 0.44	185.3± 4.30	22.1± 0.23	31.2± 1.01	12.9± 0.26	23.9± 0.23	154.0± 2.08	23.6+ 0.24	15.7± 0.64
	Mean	15.6	26.6	179.9	22.6	32.9	12.9	24.4	157.2	23.6	14.9
Random	15×10	12.5± 0.70	25.8± 0.48	158.3± 5.70	19.1± 0.26	12.3± 0.97	12.6± 0.24	24.0± 0.19	154.0± 2.22	23.3± 0.30	13.5± 0.64
	20×10	10.8± 0.49	23.5± 0.51	149.0± 4.10	18.8± 0.24	14.0± 1.07	14.0± 0.28	24.4± 0.24	154.5± 2.24	23.4± 0.27	13.5± 0.60
	20×15	10.9± 0.42	26.5± 0.33	143.9± 3.20	20.1± 0.34	15.5± 1.13	13.9± 0.28	24.4± 0.21	151.5± 2.12	23.3± 0.23	13.0± 0.67
	20×20	12.3± 0.54	26.5± 0.37	159.6± 4.80	21.1± 0.33	19.8± 1.06	13.2± 0.20	24.5± 0.20	157.1± 2.23	23.4± 0.27	13.8± 0.58
	Mean	11.6	25.6	152.7	19.8	15.4	13.4	24.3	154.3	23.4	13.5

plant spacing of 15 × 10 cm, where competition between plants was maximum, the estimates of realized response to selection were higher in biased selection (1.90). Both, negative and positive estimates of realized selection response have been reported by different workers in early segregating generations of rice [2, 3].

Though, biased selection for panicle length at closer spacing (15 × 10 and 20 × 10 cm) gave higher selection differential, both the methods of selection by and large resulted in negative realized selection response at almost all the plant spacings, except for the randomly selected population at 20 × 10 cm.

The biased selection for number of grains/panicle at all the spacings, except 20 × 15 cm gave very high selection differential, but the realized selection responses were negative, except at a spacing of 15 × 10 cm. On the other hand, random selection at optimum spacings (20 × 10 and 20 × 15 cm) resulted in negative selection differential, but the selection responses at too close (15 × 10 cm) or too wide spacings (20 × 20 cm) were negative. This indicated that phenotypic selection for characters which have been reported to be governed by polygenes[4] and with low heritability[5] could be misleading.

The estimates of realized selection responses for 1000-grain weight were positive, irrespective of plant spacing or the method of selection. In both the selection methods, the realized responses were maximum in the population which were selected at lower plant spacing of 15 × 10 cm. The realized selection response was positive inspite of negative selection differential at some of the spacings in the random selections.

All the progenies derived from the biased selection gave very high selection differential but the realized selection responses were negative for grain yield/plant, which again indicated that the phenotypic selection could be misleading and unstable. The realized selection responses were also negative at most of the spacings in the progenies derived from random selection.

Table 2. Selection differential and realized selection response in rice at different plant spacings for various characters

Selection methods	Plant spacing (cm)	Selection differential					Realized selection response				
		Tillers/ plant (No.)	Panicle length (cm)	Grains/ panicle (No.)	1000-grain weight (g)	Grain yield/ plant (g)	Tillers/ plant (No.)	Panicle length (cm)	Grains/ panicle (No.)	1000-grain weight (g)	Grain yield/ plant (g)
Biased	15 × 10	2.08	1.27	12.03	3.63	14.58	1.90	–1.48	11.17	4.79	–5.36
	20 × 10	5.83	1.45	30.88	1.83	11.66	–1.44	–0.88	–13.70	3.72	–1.27
	20 × 15	0.53	–0.31	5.28	2.61	14.84	–0.17	–0.02	–8.93	2.05	–8.63
	20 × 20	3.82	0.79	19.57	2.07	12.77	–1.87	–3.89	–11.82	3.61	–2.72
Random	15 × 10	0.50	0.40	3.49	0.10	–0.13	0.59	–1.23	–0.85	4.35	1.28
	20 × 10	0.07	0.28	–2.73	–0.54	–0.91	3.27	1.23	2.78	4.05	–1.38
	20 × 15	–0.26	0.24	–1.12	–0.02	0.48	2.79	–2.03	6.40	3.20	–2.06
	20 × 20	–0.21	–0.31	1.36	0.54	1.21	0.68	–2.32	–1.07	2.78	–5.77

Based on the results of the present investigation, it may be concluded that high selection differential obtained through biased selection of plants based on phenotypic superiority may not always give good responses in the next generation, especially when we are dealing with the polygenic traits with very low heritability. Biased selection is expected to give better results in the next generation if the plants had been selected at the spacings lower than the optimum. Only most competitive plants will have superior phenotypic performance at closer spacings. On the other hand, random selection was found to be better at optimum plant densities, as both heterozygous and homozygous plants have equal opportunities of being selected in this method. Their competitive ability may not play crucial role in being chosen. Secondly, the trait under consideration is also very important.

A positive selection response for one or few yield components may not necessarily result into positive selection response for grain yield. Small sample size to some extent may affect the results, the main reason could be the proportion of homozygous versus heterozygous loci in the group of plants selected. The genotype × environment interaction has also been reported for such discrepancies [6, 7].

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