Oryza (1987) 24, 119-122

Genetic variability in cold tolerant genotypes of rice

Received : October 5, 1985

S. SARDANA* and B. SASIKUMAR

ICAR Research Complex for N. E. H. Region, Tripura Centre, Lembucherra 799210, India

ABSTRACT

A wide variation in days to 50% flowering, plant height, effective tillers per plant, panicle length, number of filled grains per panicle, 1000-grain weight and grain yield per plant was observed in 62 cold tolerant strains of rice examined. Estimates of the various genetic parameters indicated scope for further improvement by selection for some of the characters. Three promising strains (TRC 245-C116, TRC 246-C10 and TRC 246-C14) most suited for the local conditions have been identified.

In India rice is grown over a wide range of latitudes. In eastern part of the country, the crop is subjected to cold stress during seedling stage (Srinivaslu and Balakrishna Rao 1971). Non-availability of high yielding cold tolerant varieties is one of the major bottlenecks for raising a third crop in Tripura. Attempts have been made herein to assess the genetic variability of 62 rice strains derived from three crosses involving cold tolerant rice cultivars.

MATERIALS AND METHODS

Sixty-two promising cold tolerant strains of rice (*Oryza sativa* L.) were selected on the basis of their performance. The strains were developed from seeds of three crosses involving cold tolerant parents received from the International Rice Research Institute, Philippines (Table 1). The 62 strains along with a known cold tolerant cultivar, Kalinga were raised in a randomised block design with three replications during November to April in the year 1982-83 at Tripura. A spacing of 15×10 cm was adopted. A single plot consisted of three rows each of 4 m length. Observations on days to 50 per cent flowering, plant height, effective tillers per plant, panicle length, filled grains per panicle, 1000-grain weight and grain yield were recorded with 10 randomly selected plants in each plot. The seedlings were scored for cold tolerance as per the method of Li and Vergara (1980). The genetic coefficient of variation (Burton 1952) and expected genetic advance (Johnson *et al.* 1955) were calculated.

RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences among the 62 rice strains examined with respect to the various characters studied (Table 2). Days required for fifty per cent flowering ranged from 113 (TRC 245-C114) to 133 days (TRC 246-C27). This trait was fairly stable [phenotypic coefficient of variability (pcv), 3·16; genotypic coefficient of variability (gcv), 2·91] with a high heritability estimate (84·92). However, it registered a very poor genetic advance (Table 3). Plant height varied from 70.3 to 143.7 cm, the entry TRC 246-C15 registering the lowest height and TRC 246-C16 the maximum height. Plant height was highly influenced by the environment as it had shown a high estimate of pcv as compared to a low gcv value coupled with a low heritability and genetic advance.

In the present study, the effective tillers per plant ranged from 4.3 (TRC 246-C16) to 16.7 (TRC 245-C116). The estimate of pcv was slightly higher than the gcv value, while it had

a moderate heritability with high genetic advance. Panicle length varied from 17.7 (TRC 246-C5) to 27.7 cm (TRC 246-C18). The estimate of pcv was higher than the gcv estimate. Both heritability and genetic advance were low. The test entries showed a very high variation in the number of filled grains per panicle ranging from 60.7 (TRC 245-C125) to 224.7 (TRC 246-C10). However, this trait was highly influenced by the environment. The heritability value was low with moderate genetic advance. The 1000-grain weight ranged from 16 g (TRC 246-C8) to 28 g (TRC 246-C27). The pcv and gcv estimates showed that this character was fairly stable. A high heritability coupled with a low genetic advance was observed in this case. Grain yield per plant ranged from 6 g (TRC 245-C118) to 38 g (TRC 246-C27). Compared with its components, this character was greatly influenced by the environment. However, the heritability was moderate and the genetic advance was high.

Wide and significant differences were observed for the different characters studied among the cold tolerant strains of rice. Considerable influence of environmental factors was observed in all the traits studied excepting for 50 per cent flowering, panicle length and 1000-grain weight. In most of the characters studied (50% flowering, 1000-grain weight, effective tillers per plant and grain yield per plant) a high or moderate heritability estimate coupled with low or high genetic advance was observed. However, a low or moderate estimate of heritability along with genetic advance of similar magnitude was observed in case of plant height, panicle length and filled

Table 1. *Parentage, cold tolerance at early seedling stage and seedling vigour of sixty-two strains of rice* (Data are number of individuls in eaeh group)

Index No.	IR No.	Parentage	Total strains	*Score at early seedling stage					*Score for seedling vigour				
			(No)	1	3	5	7	9	1	3	5	7	9
TRC 245	IR 26216	Thimpu/IR 5853-118-5//KN-1B-361	23	1	12	3	6	1	1	3	8	10	1
TRC 246	IR 26226	Thimpu/IR 9129-102-2//KN-1B-361	34	1	23	6	4	0	2	3	12	17	0
TRC 247	IR 26237	Toyo Nishiki/IR 9093-195-1//KN-1B-361	5	0	3	2	0	0	0	0	2	3	0
Kalinga	(Control)	Dunghanshali × IR 8				4	6			0	6	2	2

*The germinated seeds were subjected to cold treatment in a refrigerator at 4°C for 10 days and scored for cold tolerance and seedling vigour in a scale of 1-9, where 1 : no mortality, above 10 cm seedling height; 3 : less than 30% mortality, 8-10 cm seedling height ; 5 : 30-50% mortality, 5-7 cm seedling height; 7 : more than 50% mortality, 3-4 cm seedling height; and 9 : 100%mortality, less than 1 cm seedling height.

Table 2. *Mean squares, range and general mean for seven agronomic traits in rice strains*

Characters	Mean squares		Range		Mean ± S.Em.
	Treatments	Error			
(df)	(62)	(124)			
50% flowering (days)	37.95**	2.12	113.0 (TRC 245–C114)	— 133.0 (TRC 246–C27)	118.79 ± 1.19
Plant height (cm)	642.92**	321.88	70.3 (TRC 246–C15)	— 143.7 (TRC 246–C6)	86.03 ± 14.65
Effective tillers per plant	21.15**	5.70	4.3 (TRC 246–C16)	— 16.7 (TRC 245–C116)	9.60 ± 1.95
Panicle length (cm)	17.66**	4.35	17.7 (TRC 246–C5)	— 27.7 (TRC 246–C18)	21.81 ± 1.70
Filled grains per panicle	2641.72**	728.54	60.7 (TRC 245–C125)	— 224.7 (TRC 246–C10)	107.75 ± 22.04
1000-grain weight(g)	3.61**	0.30	16.0 (TRC 246–C8)	— 28.0 (TRC 246–C27)	22.40 ± 0.45
Grain yield per plant (g)	102.10**	17.98	6.0 (TRC 245–C118)	— 38.0 (TRC 246–C27)	14.13 ± 3.46

**Significant at 1% level

grains per panicle. Ghosh *et* al. (1981) and Chauhan and Tandon (1984) have reported similar findings for days to flowering, plant height, ear bearing tillers per plant, panicle length and 1000-grain weight in rice.

In our study, eight strains viz., TRC 246-C27, TRC 246-C10, TRC 245-C116, TRC 245-C122, TRC 245-C114, TRC 246-C13, TRC 245-C105 and TRC 246-C5 registered more than 20 g of grain yield per plant (control, 15·3 g). However, out of these TRC 246-C10, TRC 245-C116 and TRC 246-C14 appeared to be the most suitable to fit in the three crop sequence followed in Tripura on account of their high grain yield, early maturity, short stature and other characters. Even though the strain TRC 246-C27 registered the highest grain yield per plant (38 g), it may not be an ideal genotype for a three crop sequence due to its late maturity (133 days). But, it can be successfully grown in a two crop sequence.

Thus, the present study indicates that apart from providing better agronomic practices for realising some of the traits fully, there is also vast scope for genetic improvement of other characters. Selection will be highly effective, if it is made for effective tillers per plant. Characters like filled grains per panicle and grain yield per plant can also be improved to some extent by further selection.

Table 3. *Estimates of genetic parameters for seven agronomic traits in rice strains*

Characters	Phenotypic variance	Genotypic variance	Phenotypic coefficient of variation (pcv)	Genotypic coefficient of variation (gcv)	Heritability in broad sense (%)	Genetic advance (as % of mean)
50% flowering (days)	14·06	11·94	3·16	2·91	84·92	5·31
Plant height (cm)	428·73	106·85	24·07	12·02	24·92	11·88
Effective tillers per plant	21·15	15·45	47·92	40·95	73·05	69·27
Panicle length (cm)	8·79	4·49	13·59	9·67	50·51	13·57
Filled grains per panicle	1366·27	637·73	34·30	23·43	46·68	31·70
1000-grain weight (g)	1·40	1·10	5·27	4·69	78·50	8·21
Grain yield per plant (g)	46·02	28·04	47·98	37·51	60·93	57·83

REFERENCES

BURTON, G. W. 1952. Quantitative inheritance in grasses. Proc. 6th Int. Grass Congr. 1, 277-283.

CHAUHAN, V. S. and TANDON, J. P. 1984. Genetic variability and character association in hill rices. Oryza 21, 138-142.

GHOSH, A. K., BHATTACHARYA, P. K. and ASTHANA, A. N. 1981. Genetic variability in indigenous rice varieties of Meghalaya. Indian J. Agric. Sci. 51, 281-283.

JOHNSON, H.W., ROBINSON, J.F. and COMSTOCK, R. E. 1955. Estimates of genetic and environmental variability in soybean. Agron. J. 47, 304-308.

LI, T. G. and VERGARA, B. S. 1980. A method for testing cold tolerance of rice at early seedling stage. Int. Rice Res. Newsl. 5 (5), 13-14.

SRINIVASLU, K. and BALAKRISHNA RAO, M. J. 1971. Breeding rice varieties for cold tolerance. Oryza 8, 101-108.