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GENETIC POTENTIALITIES OF SOME MEDIUM DURATION RICE VARIETIES

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ABSTRACT

An investigation was carried out with five high yielding medium duration rice varieties and three gall midge resistant genotypes to evaluate for their combining ability by line X tester analysis so as to utilise them as parents in breeding programmes. The parents *viz.*, Co 45, ADT 38, ACM 19 and W 1263 were found to be better than others based on mean and *gca* effects. These can be utilised in multiple crosses to isolate segregants combining all the desired economic traits. The cross combinations *viz.*, ADT 38 X ACM 19, ADT 38 X W 1263 and Co 45 X W 1263 would be useful for recombination breeding.

KEY WORDS : Rice, Combining Ability, Breeding Value

In India, the productivity of rice has been considerably increased to 2620 kg/ha during 1990 from 1070 kg/ha during 1951. At the present rate of population growth with area and production being static, and more often going down due to the expansion of industrial growth in urban areas, the productivity now realised needs to be increased rapidly to feed the expected population of a billion in 2000 AD. This situation necessitates continuous flow of high yeilding varieties by employing efficient crop improvement programmes. The choice of best parents and their ability to produce desirable offsprings play a major role in the successful breeding programme. Therefore, breeder always attempt to gather in advance as much genetic information as possible on the parents that are to be used in hybridisation. Many biometrical methods help the breeders to choose appropriate parents. Among them, "line X tester" analysis is one which enables the breeder to make predictions from the combining ability of parents and hybrids (Kempthorne, 1957). Therefore, the present study was taken up to evaluate selected medium duration rice varieties for their combining ability by line X tester analysis so as to utilize them as parents in breeding programmes.

MATERIALS AND METHODS

Five high yielding medium duration rice varieties *viz.*, IR 20, Co 43, Co 45, BG 380-2 and ADT 38 as 'lines' were crossed with three gall midge resistant genotypes *viz.*, MDU 3, ACM 19 and W 1263 as 'testers'. The resultant 15 hybrids along with the parents were planted in a randomised block design with three replications during *rabi*, 1991-92. Within each replication, each genotype had 30 plants grown as single plant per hill in a row adopting a spacing of 20 X 10 cm. All the recommended cultural practices and plant protection measures were followed to raise a good crop. A total of 15 plants was selected at random in each genotype per replication for recording biometerical observations on days to flowering, plant height, productive tillers, ear length, grains per ear, 100 grain weight and grain yield. The mean values of 15 plants of a genotype were utilised for

Table 1. Analysis of variance for combining ability

Source	df	Mean squares						
		Days to flowering	Plant height	Productive tillers	Ear length	Grains per ear	100-grain weight	Grain yield per plant
Replication	2	0.07	1.84	0.37	0.03	0.01	0.001	0.53
Genotypes	22	14.93*	100.15*	24.20*	4.13*	1121.40*	0.028*	35.75*
Lines	4	7.67*	86.01*	32.55*	1.32*	1047.96*	0.019*	44.00*
Testers	2	13.30*	70.07*	0.27	2.52*	797.37*	0.028*	56.44*
Line X Tester	8	8.89*	95.12*	25.37*	3.48*	457.43*	0.007*	120.45*
Error	44	0.24	1.63	0.29	0.03	4.68	0.001	0.81

Table 2. Mean performance and *gca* effects of parents in rice

Parents	Days to flowering		Plant height (cm)		Productive tillers		Ear length (cm)		Grains per ear		100-grain weight (g.)		Grain yield per plant	
	Mean	*gca*	Mean	*gca*	Mean	*gca*	Mean	*gca*	Mean	*gca*	Mean	*gca*	Mean	*gca*
Lines														
IR 20	89.9	-1.5*	95.4	-2.3*	13.8	1.5*	26.3*	-0.2*	134.9	-8.5*	2.1	-0.04*	24.2*	0.3
Co	90.7	0.5*	92.7	0.8*	13.9	0.3	23.6	-0.1	139.8*	17.6*	2.2	-0.05*	19.6	0.3
Co 45	88.9*	-0.3*	103.2*	3.1*	13.7	2.1*	25.5*	0.7*	135.1	-7.8*	2.5*	0.04*	23.6*	-2.5*
BG 380-2	91.2	0.3*	103.6*	-4.1*	12.5	-2.0*	24.4	-0.3*	149.3*	-4.0*	2.4*	0.05*	22.4	-1.4*
ADT 38	90.7	0.9*	95.3	2.5*	14.3*	-2.0*	26.1*	-0.2*	135.6*	2.7*	2.2	0.01	26.0*	3.3*
SE_{gi}	-	0.1	-	0.4	-	0.2	-	0.1	-	0.7	-	0.01	-	0.3
Testers														
MDU 3	90.4	-0.3*	98.6	-2.5*	11.6	0.1	22.0	-0.4*	116.8	8.3*	2.2	-0.04*	18.1	-2.2*
ACM 19	91.4	-0.7*	98.5	1.3*	14.7*	0.1	25.2*	0.2*	125.4	-2.8*	2.5*	-0.01	25.1*	1.3*
W 1263	91.8	1.1*	109.9*	1.2*	12.1	-0.2*	25.2*	0.4*	118.9	-5.5*	2.4*	0.05*	18.1	1.0*
SE_{gi}	-	0.1	-	0.3	-	0.1	-	0.1	-	0.6	-	0.01	-	0.2
Grand Mean	90.6	-	99.7	-	13.2	-	24.8	-	132.0	-	2.3	-	22.1	-
SE (d)	0.4	-	1.0	-	0.4	-	0.1	-	1.8	-	0.0	-	0.7	-
CD (5%)	0.8	-	2.1	-	0.9	-	0.3	-	3.6	-	0.1	-	1.5	-

* Significant at 5% level.

statistical analysis. The data gathered on each of the seven traits were subjected to an analysis of variance appropriate for line X tester crossing design (Kempthorne, 1957). The combining ability effects of lines, testers and hybrids were estimated as per the usual procedure.

RESULTS AND DISCUSSION

The analysis of variance for seven metric traits revealed significant differences among the 23 genotypes. The 'line X tester' analysis for combining ability of all the characters showed significant difference between lines, testers and line X tester interaction (Table 1). In the choice of parents, high mean value was the main criterian among the breeders for a long time. Dhillon (1975) has pointed out that the combining ability effects of parents gives useful information on the choice of parents in terms of expected performance of their progenies. However, Chawla and Gupta (1983) suggested that the potentiality of a genotype may be judged by its *per se* performance and *gca* effects together. Hence, the parents used in the present study were assessed based on both mean performance and *gca* effects. A perusal of mean and *gca* effects of parents together (Table 2) indicated that Co 45 possessed significantly superior mean values and *gca* effects for days to flowering. For plant height, Co 45 and W 1263 recorded significantly superior values. Among the eight parents of the study, Co 45, ACM 19 and W 1263 for ear length and Co 43 and ADT 38 for grains per ear had positively significant mean and *gca* effects. Similarly, for grain weight, Co 45, BG 380-2 and W 1263 and for grain yield ADT 38 and ACM 19 recorded superior mean values and *gca* effects. Based on the above consideration, the parents Co 45, ADT 38, ACM 19 and W 1263, which recorded significantly superior mean and *gca* effects for more than one character may be chosen for further breeding programme to improve grain yield and its component traits. It would be more useful to go for multiple crosses with these superior parents and exercise selection in the segregating generations.

The *sca* effect of hybrids, which is an interaction effect, may cause distortions on expectations. It is to be remembered here that the interaction effects are not fixable and only additive effects are fixable. Therefore, it will be useful only to select such of those hybrids having parents with high *gca* effects and without significant *sca* effects for recombination breeding. The segregation of these hybrids are likely to throw more recombinants possessing favourable additive genes from both the parents. In other cases where the *sca* effect is significant, the selection in early segregating generations is likely to fail as the interaction effects may mask the true performance of the selected parents.

Table 3. Promising hybrids for recombination breeding in rice

gca effects of parents		*sca* effects of hybrids		Selected hybrids for recombination breeding
Days to flowering				
IR 20	-1.5*	i) IR 20 X MDU 3	0.5	i) IR 20 X MDU 3
Co 45	-0.3*	ii) IR 20 X ACM 19	1.2*	ii) Co 45 x MDU 3
MDU 3	-0.3*	iii) Co 45 X MDU 3	-0.1	
ACM 19	-0.7*	iv) Co 45 ACM 19	-1.2*	
Plant height				
Co 43	0.8*	i) Co 43 X ACM 19	-6.6*	i) Co 45 X ACM 19
Co 45	3.1*	ii) Co 43 X W 1263	5.5*	ii) ADT 38 X ACM 19
ADT 38	2.5*	iii) Co 45 X ACM 19	-0.9	iii) ADT 38 X W 1263
ACM 19	1.3*	iv) Co 45 X W 1263	2.9*	
W 1263	1.2*	v) ADT 38 X ACM 19	-0.2	
		vi) ADT 38 X W 1263	1.6	
Productive tillers				
IR 20	1.5*			
Co 45	2.1*			
Ear length				
Co 45	0.7*	i) Co 45 X ACM 19	-0.7*	i) Co 45 X W 1263
ACM 19	0.2*	ii) Co 45 X W 1263	0.1	
Grains per ear				
Co 43	17.6*	i) Co 43 X MDU 3	-14.9*	i) ADT 38 X MDU 3
ADT 38	2.7*	ii) ADT 38 X MDU 3	0.8	
MDU 3	8.3			
100 grain weight				
Co 45	0.04*	i) Co 45 X W 1263	-0.03	i) Co 45 X W 1263
BG 380-2	0.05*	ii) BG 380-2 X W 1263	0.01	ii) BG 380-2 X W 1263
W 1263 1263	005*,			
Grain yield				
ADT 38	3.3*	i) ADT 38 X ACM 19	0.8	i) ADT 38 X ADM 19
ACM 19	1.3*	ii) ADT 36 X W 1263	-1.3	ii) ADT 38 X W 1263

* Significant at 5% level.

Based on the above points, the 15 hybrids were evaluated for all the traits and are listed as suitable for recombination breeding (Table 3). For days to flowering, favourable significant *gca* effects were possessed by the parents *viz.*, IR 20, Co 45, MDU 3 and ACM 19. Among the four hybrids with these parents, only two namely IR 20 X MDU 3 and Co 45 X MDU 3 recorded non-significant *sca* effects. Therefore, for getting segregants with earliness, these two cross combinations could be useful. Similarly, the crosses Co 45 X ACM 19, ADT 38 x ACM 19, and ADT 38 X W 1263 for plant height; Co 45 X W 1263 for ear length ; ADT 38 X MDU 3 for grains per ear; Co 45 X W 1263 and BG 380-2 X W 1263 for 100 grain weight and ADT 38 X ACM 19 and ADT 38 X W 1263 for grain yield would throw good segregants. However, for the trait productive tillers none of the hybrids showed promise. Finally it can be concluded that the three cross combinations viz; ADT 38 X ACM 19, ADT 38 X W 1263 and Co 45 X W 1263 which had superiority for more than one character would be useful for recombination breeding. Superior single plants having high yield along with one or two yield components may be fixed in the early segregating generations of these three crosses. The recombinants in these crosses may possess high yield along with resistance to gall midge also, since two gall midge resistant donors (ACM 19 and W 1263) were used in these crosses.

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