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DIFFERENTIAL FERTILITY RESTORATION ABILITY OF SOME RESTORER LINES IN RICE (*ORYZA SATIVA* L.)

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ABSTRACT

The fertility restoration ability of five restorer lines with ten CMS lines was assessed. The hybrids Intan Mutant A x ARC 11353 R, Mangala A x ARC 11353 R and Mangala A x IR 9761-19-1 R had more than 70% pollen fertility, but, they did not have good seed set. Therefore, spikelet fertility (%) was taken as criterian for the restoration ability of R lines. Based on this, the line ARC 11353 R is considered as the best restorer followed by IR 36 R for WA source of cytoplasm. IR 46 R and IR 54 R are effective restorers for *O. nivara* source of cytoplasm. However, variation in the restoration ability of R lines for the same CMS source was also observed.

Key words: Fertility restoration, rice.

Restoration of the fertility in the hybrids depends on the interaction of cytoplasm with nuclear genes. Identification and development of cytoplasmic genetic male sterility system in rice was a major step in the successful development of hybrid rice technology in China. The cytoplasmic male sterility is of practical use only when effective restorer lines are identified. Shinjyo [1] was the first to identify restorer gene Rf for Borotype (BT) CMS line found in Japan. Since then, several restorer lines have been identified by rice scientists. The present study aims to assess the fertility restoration ability of five proven restorers with different CMS lines under Madurai environment.

MATERIALS AND METHODS

Ten cytoplasmic male sterile lines, viz., V20 A, ZS 97 A, IR 54753 A, TNMS 37 A, ADCMS 1 A and Intan mutant A of WA source; Pushpa A, Mangala A and Improved Sona A of *O. nivara* source; and five restorer lines, viz., ARC 11353 R, IR 36 R, IR 9761-19-1 R, IR 46 R and IR 54 R were crossed following line x tester crossing design to obtain 50 hybrid combinations at the Agricultural College and Research Institute, Madurai. The hybrids were raised in randomized block design with 3 replications at 20 x 20 cm spacing maintaining uniform

population of 30 plants per row per replication. Normal agronomic practices were followed to raise the crop.

To study the fertility restoration ability of R lines, pollen as well as spikelet fertility were recorded on 10 panicles from 10 random plants in each cross in a replication. Anthers were crushed in a drop of 1% potassium iodide – iodine solution and examined under microscope. Fully stained and round pollen grains were counted as viable and unstained, withered pollen grains were counted as inviable. The proportion of fertile pollen grains in the total number of pollen grains was expressed in percentage. Spikelet fertility was assessed at maturity by taking counts of well filled and empty spikelets in each ear. The proportion of well filled spikelets was calculated as percentage of total number of spikelets. An analysis of variance appropriate for RBD exhibited by the hybrids for pollen and spikelet fertility was made following Panse and Sukhatme [2].

RESULTS AND DISCUSSION

The pollen fertility of hybrids ranged between 31.3 (Improved Sona A x IR 46 R) and 75.8% (Mangala A x IR 9761 19-1 R) (Table 1). Twenty four hybrids had significantly higher values than the general mean of 52.8% fertile pollen. Saran and Mandal [3] and Sutaryo [4] classified the male parents of F_1 hybrids and concluded more than 70% pollen fertility to be effective restorer. In the present study, though the hybrids Intan Mutant A x ARC 11353 R (72.7%), Mangala A x ARC 11353 R (71.2%) and Mangala A x IR 9761-19-1 R (75.8%) showed more than 70% pollen fertility, they had low spikelet fertility (32.9, 33.0 and 29.6% respectively) (Table 1), which is due to the difference in the stage of pollen abortion, as reported earlier [5, 6].

Thus, pollen fertility assessed by the staining technique does not serve as good index of fertility restoration ability of R lines. Therefore, spikelet fertility per cent has been used as a criterion for classification, as suggested earlier [7–10].

In the present study, ARC 11353 R and IR 36 R combined well with three of the A lines of WA cytoplasm to give seed set more than 70%. Hence ARC 11353 R can be considered as the best restorer, followed by IR 36 R for WA cytoplasm. IR 36 R has already been identified as complete restorer for V 20 A [11]. But, Rangaswamy et al. [7] observed that IR 36 R was a weak restorer of ZS 97 A. This is in accordance with the results of the present study, where IR 36 R has been found to be a weak restorer of ZS 97 A with 50.5% spikelet fertility. Though the restorer lines ARC 11353 R and IR 36 R are effective restorers for TNMS 37 A, ADCMS 1 A and V 20 A with WA cytoplasm, they are partial restorers for other A lines, viz., IR 54753 A, Intan Mutant A, ZS 97 A and IR 54756 A of the same CMS source [12, 13]. Similarly, IR 46 R and IR 54 R are effective restorers for Improved Sona with *O. nivara* cytoplasm. But they are poor restorers for the other A lines (Pushpa and Mangala) of the same source.

Table 1. Pollen and spikelet fertility per cent in hybrids of rice

Line	Testers									
	ARC 11353 R		IR 36 R		IR 9761-19-1 R		IR 46 R		IR 54 R	
	pollen	spikelet	pollen	spikelet	pollen	spikelet	pollen	spikelet	pollen	spikelet
V 20 A	53.1	78.8**	53.7	70.1	68.3**	59.4*	61.2**	61.0**	61.5**	67.7**
ZS 97 A	54.0	56.0	52.0	50.5	56.0**	64.4**	59.0**	48.3	42.6	54.2
IR 54753 A	59.0**	32.7	63.1**	51.6	50.8	46.1	41.3	32.9	41.2	61.9
IR 54756 A	38.5	47.5	42.4	43.5	35.0	49.1	37.3	43.2	32.9	49.7
TNMS 37 A	49.1	82.9**	47.6	75.2**	45.2	68.2**	45.3	65.6**	56.7**	63.5**
ADCMS 1 A	53.9	76.1**	46.0	70.1**	44.0	66.4**	40.5	60.2**	57.9**	62.8**
Intant Mutant A	72.7**	32.9	64.6**	47.7	57.3**	24.5	61.9**	25.8	57.7**	28.7
Pushpa A	60.1**	61.0**	63.6**	39.6	62.8**	30.5	59.3**	26.7	54.7**	33.8
Mangala A	71.2**	33.0	64.1**	31.3	75.8**	29.6	59.0**	35.8	49.4	32.1
Improved Sona A	52.3	52.0	33.1	56.7	42.4	61.8**	31.3	74.2**	56.1**	74.0**
			Pollen fertility			*Spikelet fertility*				
General mean			52.8			51.8				
SE			0.5			2.1				
CD (P = 0.05)			1.4			5.9				
(P = 0.01)			1.9			7.7				

*,**Significant at 5% and 1% levels, respectively.

Variation in the restoration ability of R lines for the same CMS source was also reported [11, 14, 15] which indicated that the cytoplasms of different male sterile lines interact differently with individual pollinator varieties. Lower effectiveness of some restorer lines in relation to CMS lines could be attributed to the presence of nuclear genes for sterility in the female parent which may inhibit pollen fertility restoration of the F_1 generation [16]. Also, the identified restorer lines are often a mixture of genotypes with regard to the gene(s) for fertility restoration. Therefore, purification of restorer lines is essential in developing and breeding F_1 rice hybrids.

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