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Fertility Restoration Studies in Cytoplasmic Genic Male Sterile Lines of Rice (*Oryza sativa* L.)

R. Saravanan, S. Palanisamy and N. Senthil

School of Genetics, Tamil Nadu Agricultural University
Coimbatore, Tamil Nadu, India

ABSTRACT. *In a commercial hybrid breeding programme, identification of restorers that show consistently high degree of restoration of cytoplasmic male sterile (CMS) lines would be of higher value. Hence, in the present study to identify best restorers and maintainers two CMS (IR 58025 A and IR 62829 A) lines were crossed with eighteen testers in a L × T mating design and the resultant thirty six hybrids were screened for pollen and spikelet fertility. All the testers restored the fertility on IR 58025 A partially. The ASD 16 and IET 6711 were found to be partial maintainers for IR 62829 A and all others were partial restorers. High spikelet fertility was found in IR 58025 A × CO 33 followed by IR 58025 A × CR 1009.*

INTRODUCTION

Heterosis breeding has been successfully utilised to increase rice productivity in China with the development of F1 rice hybrids using cytoplasmic male sterility and fertility restoration system. The hybrids out yielded the best pure line varieties by 20–30 % (Lin and Yuan, 1980). Hence, a technology with such a potential may prove very relevant to developing countries like India. However, still it is at its infancy because of the non availability of stable male sterile lines, maintainers and a low degree of fertility restoration by restorer lines. Therefore, it is necessary to identify maintainers and restorers for commercial exploitation of hybrid rice in India.

MATERIALS AND METHODS

In the present study two cytoplasmic male sterile (CMS) lines, namely IR 58025 A and IR 62829 A, were crossed with eighteen varieties of rice in a L×T mating design and resultant thirty six hybrids along with parents were raised in a RBD with two replications. The hybrids were screened for pollen fertility as described by Young *et al.* (1983) and spikelet fertility was estimated as the % of filled grains with respect to the total spikelets.

RESULTS AND DISCUSSION

Precise understanding of the male fertility restoration helps to plan a sound hybrid breeding strategy for the development of best restorers which results in high yields and ensures stability in hybrids. In cytoplasmic male sterility (CMS) involving hybrids, complete heterosis cannot be realised unless restoration is complete. Thus, there is a need to search for strong restorers combined with stability. In the present investigation the % of pollen fertility ranged from 53.4 (IR 62829 A × ASD 16) to 96.3 (IR 62829 A × CO 33). Twenty five hybrids had more than 80 % pollen fertility (Table 1).

Table 1. Pollen fertility and spikelet fertility of hybrids.

Testers	Pollen Fertility (%)		Spikelet Fertility (%)	
	Lines			
	IR 58025 A	IR 62829 A	IR 58025 A	IR 62829 A
CO 33	94.7	96.3	71.9	70.3
CO 37	92.4	91.7	64.3	52.8
CO 41	87.6	90.3	58.9	53.3
CO 43	84.8	87.5	62.6	54.5
IR 36	89.5	88.3	69.3	62.6
IR 50	83.7	92.3	52.7	63.4
IR 64	74.3	82.5	58.5	56.5
ASD 16	63.3	53.4	41.6	29.8
ASD 17	65.8	62.5	59.6	41.9
ADT 36	83.7	85.3	61.7	53.7
ADT 37	80.3	90.3	42.8	58.6
Basmati 370	53.9	77.8	39.8	41.4
CR 1009	95.6	85.0	70.4	53.9
DgWg	82.3	74.3	64.4	52.9
IET 6711	78.8	53.9	59.8	22.5
T 614 Kolamba	85.3	87.6	57.6	55.5
HEERA	80.4	79.3	63.3	59.8
TKM 9	83.3	87.8	54.3	59.8
CHECK IR 50	96.50		83.45	

Based on pollen fertility, all the testers except Basmathi 370 were found to impart strong fertility restoration for IR 58025 A and all except ASD 16 and IET 6711 for IR 62829 A. All the testers were found to be partial restorers for IR 58025 A based on spikelet fertility (Table 2). The frequency of restorer genotypes were higher in a tropical environment than that in sub–tropical environment (Virmani, 1985). Among 731 varieties observed in a test cross nursery by Lin and Yuan (1980), 625 (83.5%) were maintainers.

Table 2. Fertility reaction of F1 hybrids involving IR 58025 A and IR 62829 A.

Testers	Pollen Fertility		Spikelet Fertility	
	Lines			
	IR 58025 A	IR 62829 A	IR 58025 A	IR 62829 A
CO 33	R	R	PR	PR
CO 37	R	R	PR	PR
CO 41	R	R	PR	PR
CO 43	R	R	PR	PR
IR 36	R	R	PR	PR
IR 50	R	R	PR	PR
IR 64	R	R	PR	PR
ASD 16	R	PR	PR	PM
ASD 17	R	R	PR	PR
ADT 36	R	R	PR	PR
ADT 37	R	R	PR	PR
Basmathi 370	PR	R	PR	PR
CR 1009	R	R	PR	PR
DgWg	R	R	PR	PR
IET 6711	R	PR	PR	PM
T 614 Kolamba	R	R	PR	PR
HEERA	R	R	PR	PR
TKM 9	R	R	PR	PR

R - Restorer (61 - 100% pollen fertility; 81 - 100% spikelet fertility)
PR - Partial restorer (31 - 60% pollen fertility; 31 - 80% spikelet fertility)
PM - Partial maintainers (1 -30% pollen fertility; 1 - 30% spikelet fertility)

The testers *viz.*, ASD 16 and IET 6711 were partial maintainers for IR 62829 A based on spikelet fertility and all others were partial restorers. Manuel *et al.* (1991) identified Rasi, CO 37, ASD 16 and TM 4309 as potential maintainers, IR 36 and IR 50 as effective restorers of new CMS line V 20 A, and IR 50 as an effective restorer for IR 46828 A.

Spikelet fertility of the hybrids on selfing ranged from 22.5 % (IR 62829 A × IET 6711) to 71.9 % (IR 58025 A × CO 33). All the hybrids recorded spikelet fertility between 20 % and 80 %, of which the hybrids *viz.*, IR 58025 A × CO 33, IR 58025 A × CR 1009 and IR 62829 A × CO 33 recorded 71.9 %, 70.4 % and 70.3 % spikelet fertility, respectively. These hybrids can be tested for commercial exploitation of hybrid rice.

The spikelet fertility of the hybrids was lower than the pollen fertility. This was clearly observed in the hybrid IR 62829 A × CO 37 which had pollen fertility of 91.7 % as against 52.8 % spikelet fertility. This lower magnitude of spikelet fertility reflected on the seed set due to the inadequacy of the abundance of pollen in these situations. Indehiscence of anther might be the reason for the inadequacy of pollen. Population of conventional varieties were purified only for morphological characters and not for fertility restoration.

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