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Identification of Red Rice Maintainer of WA Cytoplasmic Male Sterile Line

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The role of hybrids in enhancing the productivity is widely acknowledged. The commercial rice hybrids are currently based on cytoplasmic genetic male sterility (CGMS) system. The availability of stable cytoplasmic male sterility and fertility restoring system is vital for commercial exploitation of heterosis in rice. Rice hybrids for unfavorable environment can be developed using elite parental lines adapted to these environments. The establishment of testcross nursery to identify restorers and maintainer is the first step in three-line heterosis breeding. Therefore, it is must to identify restorers and maintainers from local germplasm for development of component lines in hybrid programme. A large number of restorers have been already identified for the wild abortive (WA) CMS lines [1].

Four popular rice varieties viz. Jyothi, Aruna, Kanchana and Bharathy were used as male parent. The seed material was obtained from Regional Agricultural Research Station Pattambi and Moncompu, whereas CRMS31A was used as female parent, which was obtained from Central Rice Research Institute, Cuttack.

CMS line from wild abortive (WA) cytoplasmic male sterile source and four genetically diverse varieties were grown in a nursery and transferred to field 25 days after sowing. At the panicle initiation stage, plants were transferred to pots. Staggered planting of the CMS lines was done to ensure synchronous flowering. In the CMS lines, individual plants with complete pollen sterility were identified by observing the pollen grains under the microscope using one per cent Acetocarmine. Plants showing 100% pollen sterility were chosen for hybridization.

Emasculation was done by clipping method in the late afternoon. The anthers in each spikelet were removed with the help of the needle. Care was taken during emasculation not to damage the gynaecium Nanda [2]. After emasculation, water was sprayed on the panicle to maintain stigma receptivity for next day morning pollination. The panicle was covered with the butter paper bag. Emasculated spikelets were Pollinated the subsequent day by collecting pollen from male parents at the time of anthesis and dusted separately on the bagged panicles. All the four crosses were conducted and mature seeds were collected for further evaluation.

All the harvested F_1 seeds were half naked and shown less germination percentage. As a result of emasculation process, there may be fungal infection so the seed priming was done along with antifungal treatment. At flowering stage pollen sterility was recorded as microscopic pollen grain count. The total counts of sterile pollen grain were observed in relation to the total pollen grains in the five microscopic fields. The pollen sterility percentage was estimated using formula given below:

$$\text{Pollen sterility \%} = \frac{\text{No. of sterile pollen grains}}{\text{Total No. of pollen grains}} \times 100$$

The spikelet fertility and sterility was calculated on the basis of five randomly selected panicles from each hybrid at the time of maturity. The percentage of spikelet fertility was calculated using following formula:

$$\text{Spikelet fertility \%} = \frac{\text{No. of filled grains in a panicle}}{\text{Total No. of spikelet in a panicle}} \times 100$$

Spikelet sterility % = Spikelet fertility % - 100%

On the basis of pollen and spikelet fertility percentage, potential maintainers were identified among the four rice varieties used. Classification was done on the basis of standards given by Virmani *et al.* [3] in Hybrid Rice Breeding Manual (IRRI).

Pollen fertility (%)	Spikelets fertility (%)	
0-1	0	Maintainers
1.1-50	0.1-50	Partial maintainers
50.1-80	50.1-75	Partial restorers
>80	>75	Restorers

The pollen fertility per cent of hybrids was varying from 0.01% (CRMS 31A × Jyothi) to 63% (CRMS 31A × Aruna) and Spikelet fertility of hybrids ranged from 0% (CRMS 31A × Jyothi) to 60% (CRMS 31A × Aruna) given in (Table 1). The highest pollen and spikelet fertility % was observed in cross with Aruna with 60% seed set (Plate 1), which make it fall under

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category of partial restorer. The two out of four genotypes i.e. Kanchana and Bharathy behaved as partial maintainers for WA-CMS line with spikelet fertility of 9.89% and 25.17% respectively.

Table 1 Classification of rice genotypes into restorers (R), maintainers (M), partial restorers (PR) and partial maintainers (PM) for WA-cytosterile lines

Crosses	Pollen sterility	Spikelet fertility	
31A × J	99.99	0	M
31A × A	37	60	PR
31A × K	91	9.89	PM
31A × B	57	25.17	PM

F_1's obtained from a cross between CRMS31A × Jyothi formed sterile hybrid with 99.99% pollen sterility (Plate 1), hence in this work it is reported that Jyothi is a potential maintainer of CRMS31A. The line identified as effective maintainer can be further backcrossed with its F_1 to look for completely sterile backcross progenies so that this can be developed as new CMS line. Jyothi is most popular and high yielding rice variety of Kerala; it is widely accepted because of its superior grain quality and sterile version of Jyothi variety would be of great use in the development of rice hybrids in Kerala. Some popular sterile lines show fertility to some extent in tropics, where the 'Jyothi A' may prove as a boon for hybrid production. Similar to the findings of the present study, Rosamma and Vijayakumar [4] and Das [5] found Jyothi as effective maintainer.

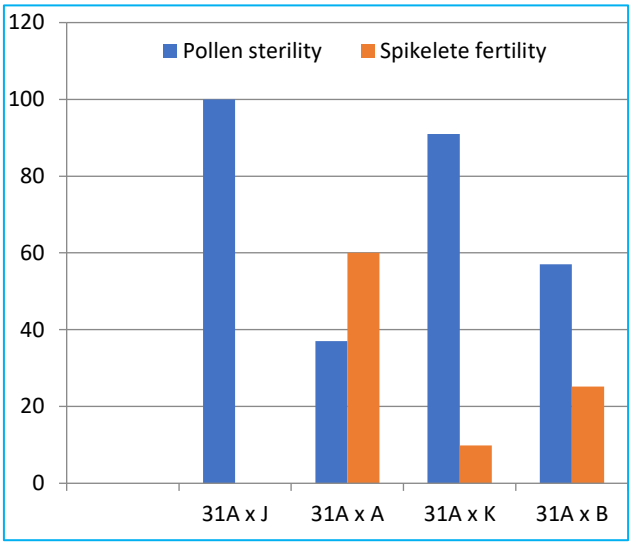

Fig 1 Pollen sterility and spikelet fertility of hybrids of four crosses

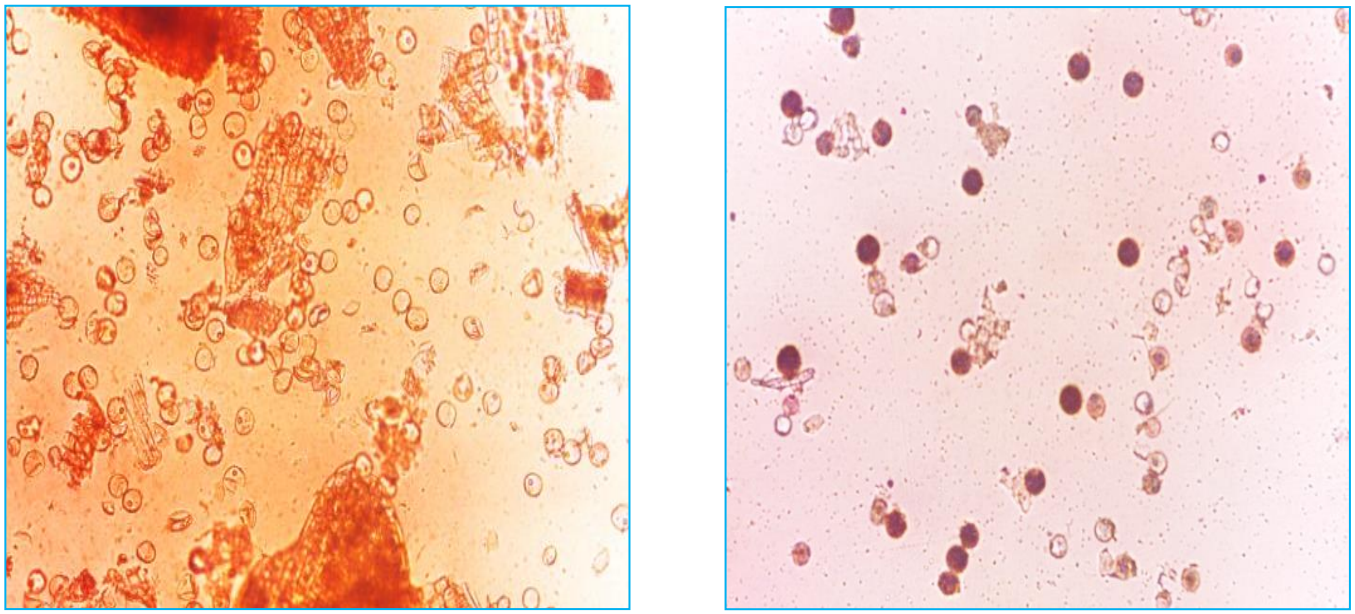

Plate 1 Pollen sterility of hybrid between CRMS31A × Jyothi and CRMS31A × Aruna

The variations in behavior of fertility restoration indicate that either the fertility-restoring genes are different or that their penetrance and expressivity varied with the genotypes of the parents. Similar results have been reported by Hemareddy *et al.* [6], Gannamani [7], Sao [8], Bisne and Motiramani [9].

SUMMARY

The present investigation was undertaken to identify a maintainer line for a cytoplasmic male sterile line among the four local and high yielding rice (*Oryza sativa* L.) varieties of Kerala. A CMS line of rice having wild abortive (WA) cytoplasmic male sterility source was crossed with four genotypes. The hybrids were subjected to pollen and spikelet fertility analysis. Among the four hybrids, one hybrid was expressed as maintainer, two as partial restorers (PM) and one as Partial restorer (PR). The identified maintainer line is most popular and high yielding rice variety of Kerala, it is widely accepted because of its superior grain quality and sterile version of this variety would be of great use in the development of rice hybrids in Kerala.

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