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Research Note

Identification of restorers and maintainers for CMS lines of rice (*Oryza sativa* L.) under shallow low land condition.

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Abstract :
Based on the pollen fertility (%) and spikelet fertility (%), ten genotypes were identified as potential restorers. Among the genotypes RPHR 203-3 and R 1216-6 have been identified as potential restorers for all three lines (CRMS 31A, CRMS 32A and IR 58025A). Among others , WAR 120-1-5-6-2-B-B-3, CR 780-1937 and Chinikapoor were considered as potential restorers for CRMS 31A and IR 58025A. IR 68830-NDR-1-1 for CRMS 32A and R 1130-102-3-88-1, OR 1898-18RAU 729-12-44 and WAR 89-4-A9-1-B-B-B-2 were found to be good restorers for CRMS 32A. The study also concluded that the frequency of potential restorers is much higher in number and no effective maintainer could be identified in the material under study.

Key words:
Hybrid rice, pollen sterility, restorers, maintainers, rice.

Commercial exploitation of heterosis has been made possible by the use of cytoplasmic genetic male sterility and fertility restoration system. A number of cytosterile maintainers and restorer lines in rice have been developed to diversify the genetic and cytoplasmic base of commercial F_1 rice hybrids. The CMS lines developed outside the country are not very good for being used as such in developing rice hybrids in India as well as in the state. Therefore, it is imperative to identify locally adapted maintainers and restorers among the lines developed using conventional breeding procedures, which could be converted into CMS lines for wide adaptability. Identification of locally adapted restorers which show consistently high degree of restoration of CMS lines would be of great value in commercial hybrid programme, if restoring ability is combined with high combining ability. Exotic CMS line IR 58025A has been widely used in 3 line breeding system and therefore, incorporation of some new indigenous CMS lines *viz*., CRMS31A and CRMS32A with have immense value. The present piece of research work reports the results of identification of and study undertaken for maintainer and restorer lines for three CMS lines mentioned above.

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The experimental material comprised 33 hybrids obtained from the lines involving three CMS lines (CRMS 31A, CRMS 32A, IR 58025A) and eleven testers (WAR 120-1-5-6-2-B-B-3, RPHR 203-3, R 1130-102-3-88-1, IR 68830-NDR-1-1, CR 780-1937, R 1241-1856-1-1, R 304-34, R 1216-6, Chinikapoor, OR1898-18RAU 729-12-44 and WAR 89-4-A9-1-B-B-B-2). A set of hybrids were generated in Line x Tester pattern for the purpose and evaluated along with parents in Randomized Complete Block Design with two replications at Experimental Research Farm under rainfed conditions. Twenty one days old seedlings of 33 hybrids and 14 parents were transplanted in the field. A standard spacing of 20 x 20 cm was adopted for planting and 12 plants were maintained in a single row. Single seedling per hill was transplanted. Recommended package of practices were followed. Spikelet fertility (%) was recorded on five randomly selected plants in both the replications.

Pollen studies were carried out to asses' fertility / sterility status of testcross F_1 plants. For this purpose, 15-20 spikelet's from the just emerged panicles of three randomly selected plants were collected in a vial containing 70% ethanol. All the anthers from at least six spikelets were taken out with forceps and placed on a glass slide with a drop of 1 per cent iodine potassium iodide (I-KI) stain. The anthers were gently crushed by using a needle to release the pollen grains. After removing the debris, a cover slip was placed and the slide was observed under the microscope. For spikelet fertility/sterility, five panicles of each testcross were

covered with butter paper bags to avoid foreign pollen contamination and were harvested at maturity. The indications (Table 1) were used for classifying the parental lines as maintainers and restorers as proposed by Virmani *et al*. (1997).

The maintainers and restorers identified in the present investigation are presented in the Table 1. In the present study, the frequency of restorers appears to be quite high as compared to maintainers for cytoplasmic Male sterile lines CRMS 31A, CRMS 32A and IR 58025A. Identification of maintainers and restorers could be possible by way of recording pollen and spikelet fertility percentages. The studies on pollen and spikelet fertility percentages indicated that none of the hybrids possessed complete pollen and spikelet sterility. So, none of the hybrids could be identified as maintainer, of course partial maintainers were identified based on the pollen and spikelet fertility percentage ranging between 0.1 to 50%. R 1130-102-3-88-1, R 304-34 and OR 1898-18RAU 729-12-44 can be reconsidered as partial maintainers for the CMS line CRMS 31A. The parents R 1241-1856-1-1 and R 304-34 have been identified as partial maintainers for the line CRMS 32A. The genotypes R1130-102-3-88-1 and IR 68830-NDR -1-1 can be identified as partial maintainers in relation to line IR 58025A. The partial maintainers so identified could be multiplied and used developing in CMS line through repeated back crossing programme, following work plans reported by Singh and Singh (2000) and Durai and Nadarajan (2007).

The parents WAR 120-1-5-6-2-B-B-3, RPHR 203-3, IR 68830-NDR-1-1, CR 780-1937, R 1216-6 and Chinikapoor can be considered as potential restorers for the CMS line CRMS 31A as their respective hybrids have shown more than 80% pollen fertility and more than 75% spikelet fertility percentage. Parents IR 68830-NDR-1-1, RPHR 203-3, R1130-102-3-88-1, R 1216-6, OR 1898-18RAU 729-12-44 and WAR 89-4-A9-1-B-B-B-2 were identified as potential restorers for the CMS line CRMS 32A for the same reason as above, whereas the parents, WAR 120-1-5-6-2-B-B-3, RPHR 203-3, CR 780-1937, R 304-34, R 1216-6, Chinikapoor and OR 1898-18RAU 729-12-44 can be considered as potential restorers for CMS line IR 58025A. Chinikapoor is a land race of Chhattisgarh state. This variety is a short slender aromatic type. This is a very long duration variety and its yield is also very poor. Hence this parent can be used as potential restorer to develop high yielding, short slender aromatic hybrids.

Hybrid IR 58025A/WAR 120-1-5-6-2-B-B-3 showed highest pollen fertility (96.88%) and spikelet fertility (96.43%) followed by crosses CRMS 32A/WAR 89-4-A9-1-B-B-B-2 (96.62% and 95.18%),CRMS 31A/IR 68830-NDR-1-1(96.47% and 96.13%), CRMS 31A/WAR 120-1-5-6-2-B-B-3 (93.41% and 93.07%), IR 58025A/OR 1898-18RAU 729-12-44 (92.90 % and 91.33%) and IR 58025A/R 304-34 (91.68% and 91.47%). Therefore these crosses can be effectively utilized as good restorer lines to develop high yielding rice hybrids.

The genotypes, R 1241-1856-1-1 and WAR 89-4-A9-1-B-B-2 recorded as partial restorers, for the line CRMS 31A, while the lines WAR 120-1-5-6-2-B-B-3, CR 780-1937 and Chinikapoor acted as partial restorers for the line CRMS 32A. The Genotypes R 1241-1856-1-1and WAR 89-4-A9-1-B-B-B-2 were observed as partial restorers for CMS line IR 58025A. Similar type of results were reported by Bisne and Motiramani (2005).

In some cases, the genotype identified behaved as a restorer for one CMS line but partial restorer for other CMS source and as a maintainer for a third CMS line. R 1241-1856-1-1 behaved as partial restorer for CRMS 31A and IR 58025A and as partial maintainer for CRMS 31A and CRMS 32A. R 304-34 recorded as a potential restorer for IR 58025A, but it proved to be a partial maintainer for CRMS 31A. The parent Chinikapoor was found to be only a partial restorer for CRMS 32A, but it completely restores the fertility of CRMS 31A and IR 58025A. Genotypes RPHR 203-3 and R 1216-6 restores good fertility in all the CMS lines. Such type of rice genotypes with variable effects on different CMS lines of the same cytoplasmic sources have been reported by several workers Yogesha and Mahadevappa (1994).This may also be due to the influence of female genetic background on the restoration ability of the genotypes tested (Wilson, 1968). Further, this phenomenon has also been interpreted arising as the result of variation in number of sterility genes or due to the presence of fertility genes that interact in a complementary or additive fashion with restorer genes. Virmani *et al.* (1986) indicated that the excessive sterility genes could act as inhibitors of pollen fertility restoration in the F_1 generation. The variations in the behavior of fertility restoration indicated either the fertility restoring genes are being different or their performance and expressivity varied with the genotypes of parent's modifiers (Pandey *et al*., 1990).

The study concludes that the frequency of restorers was found to be quite high as compared to maintainers. Infact, no effective maintainer could be identified. Ten genotypes were identified as potential restorers, among which two genotypes *viz*., RPHR 203-3 and R 1216-6 were identified as potential

restorers for all three CMS lines (CRMS 31A, CRMS 32A and IR 58025A). Among the remaining, WAR 120-1-5-6-2-B-B-3, CR 780-1937 and Chinikapoor have been identified as effective restorers for CRMS 31A and IR 58025A, while, IR 68830-NDR-1-1 for CRMS 32A and R 1130-102-3-88-1, OR 1898-18RAU 729-12-44 and WAR 89-4-A9-1-B-B-B-2 as restorers for CRMS 32A. Potential restorers identified in the present study will be used to develop good hybrids under shallow low land ecosystem.

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Table 1: Maintainers and restorers for three CMS lines (Based on pollen and spikelet fertility)

CMS lines	Partial Maintainers (0.1-50)	Partial restorers (50.1-75)	Potential restorers (>75)
CRMS 31A	R 1130-102-3-88-1 R 304-34 OR 1898-18RAU 729-12-44	R 1241-1856-1-1 WAR 89-4-A9-1-B-B-B-2	WAR 120-1-5-6-2-B-B-3 RPHR 203-3 IR 68830-NDR-1-1 CR 780-1937 R 1216-6 Chinikapoor
CRMS 32A	R 1241-1856-1-1 R 304-34	WAR 120-1-5-6-2-B-B-3 CR 780-1937 Chinikapoor	IR 68830-NDR-1-1 RPHR 203-3 R 1130-102-3-88-1 R 1216-6 OR 1898-18RAU 729-12-44 WAR 89-4-A9-1-B-B-B-2
IR 58025A	R 1130-102-3-88-1 IR 68830-NDR-1-1	R 1241-1856-1-1 WAR 89-4-A9-1-B-B-B-2	WAR 120-1-5-6-2-B-B-3 RPHR 203-3 CR 780-1937 R 304-34 R 1216-6 Chinikapoor OR 1898-18RAU 729-12-44