NEW RESTORERS FOR WA-CYTOPLASMIC GENIC MALE STERILE (CMS) LINES IN RICE (ORYZA SATIVA L.)

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ABSTRACT

A study was undertaken with 50 cross combination obtained by crossing five cytoplasmic genic male sterile (CMS) lines of wild abortive (WA) source and ten male parents in a line x tester mating design. Based on pollen and spikelet fertility of the hybrids, seven male parents viz., BR 736-20-3-1, IR 31406, IR 50400-64-1-2-2, IR 8866-20-3-1-4-2, MDU 3, MDU 4 and Ponni were identified as effective restorers for all the five male sterile lines viz., PMS 9A, PMS 10A, V 20A, IR 58025A and IR 62829A. The other three pollen parents viz., BR 20370-0-4-2, IR 20 and IR 49457-33-1-2-2-2 were either partial restorers or partial maintainers of the CMS lines studied. No effective maintainer was identified for any of the CMS lines studied. Differential reaction of same genotype in restoring fertility of different lines of the same CMS source might be due to interaction between nuclear and cytoplasmic genomes. Since significant positive correlation between pollen and spikelet fertility was realized, spikelet fertility could alone be considered to be as criterion for classification of the male parents tested for fertility restoration into restorers and maintainers.

The practical use of cytoplasmic-genetic male sterility system in developing hybrid varieties in grain crops is possible only when effective restorer lines are identified and or developed. The first set of effective restorer lines used in China in commercial hybrids involving the WA cytoplasm was identified in 1973 (Linn and Yuan, 1980). Effective restorers are available mainly from tropics where indica rices are grown. The frequency of restorer lines among japonica varieties is negligible (Shinjyo, 1975). Present study was made to identify restorers and maintainers to some of CMS lines of WA cytosterility system in rice.

Five cytoplasmic male sterile lines (CMS) viz., PMS 9A, PMS 10A, V 20A, IR 58025A and IR 62829A and ten other genotypes viz., BR 20370-0-4-2, BR 736-20-3-1, IR 20, IR 31406, IR 49457-1-2-2-2, IR 50400-64-1-2-2-2, IR 8866-20-3-1-4-2, MDU 3, MDU 4 and Ponni as pollen parents formed the material of the present study. Their 50 hybrids obtained by line x tester mating design were raised during kharif 1996 in non-replicated rows having 20 plants per genotype with a spacing of 20 x 10cm. From the early emerging panicles of each plant, about five spikelets were fixed separately in 70 per cent ethanol during early morning hours just before anthesis. Anthers collected from spikelets were crushed in one per cent iodine - potassium iodide (I-KI) solution. Then the pollen grains were counted for stainability after 15 minutes under five microscopic fields and mean was arrived at. The pollen fertility was expressed in percentage based on the proportion of stained to the total pollen grains. Before anthesis, the primary panicles of all the plants were bagged to avoid contamination from foreign pollen. At maturity, grains in primary ears of all the plants were counted separately and the spikelet fertility was expressed in percentage.

The pollen and spikelet fertility were recorded on 20 plants in each hybrid combination. The pollen parents were classified into maintainers (0% pollen fertility and 0 -
1% spikelet fertility), partial maintainers (1 - 30% pollen fertility and 1 - 29% spikelet fertility), partial restorers (30 - 60% pollen fertility and 30 - 79% spikelet fertility) and restorers (60 - 100% pollen fertility and 80 - 100% spikelet fertility) (IRRI, 1995 and Govindaraj and Virmani, 1989). Correlation between pollen and spikelet fertility was worked out.

Among the different classes of pollen/spikelet fertility, hybrids showing 0 % pollen and up to 1% spikelet fertility and those showing more than 60 % pollen fertility and more than 80 % spikelet fertility are important as their male parents are found to be maintainer or restorers of their female parent which are essential for hybrid development in rice. Most of the hybrids showed high percentage of pollen fertility. The number of plants showing 0 % pollen fertility ranged from one (PMS 10A x IR 20) to eight (IR 58025A x BR 20370-B-2). In the range of 60 – 100 %, the number of plants varied from one (PMS 10A x IR 20 and V 20A x IR 49457-33-1-2-2) to 20 (IR 58025A x BR 736-20-3-1). Majority of plants (hybrids involving BR 736-20-3-1, IR 31406, IR 50400-64-1-2-2-2, IR 8866-20-3-1-4-2, MDU 3, MDU 4 and Ponni with all the five CMS lines) showed pollen fertility of above 60 %.

In the case of spikelet fertility none of the cross combinations recorded complete sterility of 0 per cent. However, the number of completely sterile plants in the hybrids ranged from one (PMS 9A x IR 20 and PMS 10A x BR 20370-B-2) to three (PMS 10A x IR 20 and V 20A x BR 20370-B-2). A total of 35 hybrid combinations (seven each in PMS 9A, PMS 10A, IR 58025A and IR 62829A) mainly consisted of plants with more than 80 per cent spikelet fertility.

Out of ten pollen parents studied seven were identified as effective restorer for all the five CMS lines since the hybrids involving them had recorded more than 60 % pollen fertility and more than 80 % spikelet fertility. They were BR 736-20-3-1, IR 31406, IR 50400-64-1-2-2-2, IR 8866-20-3-1-4-2, MDU 3, MDU 4 and Ponni. No effective maintainer was found for any of five cytosterile lines used as no hybrid combination recorded 0 % pollen fertility and 0-1 spikelet fertility (Table 1). Similarly Mauya et.al. (1993) could obtain no effective maintainer for any of the eight CMS lines studied by them.

Among the remaining three genotypes, BR 203-70-B-2 partially maintained sterility of four CMS lines viz., PMS 9A, PMS 10A, V 20A and IR 58025A. But the same genotype partially restored the fertility of the CMS line IR 62829A. Like this IR 49457-33-1-2-2-2 partially maintained sterility of PMS 9A, PMS 10A, IR 58025A and IR 62829A but it was partial restorer of V 20A. In the same manner IR 20 also maintained partially the sterility of V 20A, IR 58025A and IR 62829A while it is partial restorer for PMS 9A and PMS 10A. This kind of differential reaction of the same genotype in restoring fertility of different CMS lines of the same cytoplasmic source has already been reported (Tomar and Virmani, 1990, Pradhan, et al., 1990 and Prasad, et al., 1993).

Variation in the restoration ability of pollen parents for the same CMS source indicated that the cytoplasm of different male sterile lines interact differently with individual pollinator varieties. Lower effectiveness of some restorer lines in relation to CMS lines would be attributed to the presence of nuclear gene for sterility in the female parent which may inhibit pollen fertility restoration of F1 generation (Bobby and Nadarajan, 1994).

Either pollen fertility or spikelet fertility or both have been used as criteria to categorize the pollen parents into restorers or maintainer. In the present study, the pollen fertility was found to positively correlated (r=0.99) with the spikelet fertility (Uma, 1991). However, making observation on pollen fertility
<table>
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<th>SF</th>
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PM = Partial maintainer;  
PR = Partial restorer;  
R = Restorer;  
PF = Pollen fertility per cent;  
SF = Spikelet fertility per cent.
is more costly and tedious than recording parents into maintainers or restorers of the spikelet fertility. Hence, spikelet fertility of the CMS lines could alone be used to classify pollen

REFERENCES