

IDENTIFICATION OF RESTORERS AND MAINTAINERS FOR THE DEVELOPMENT OF RICE HYBRIDS

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ABSTRACT

Two hundred thirty nine (239) rice genotypes were evaluated for their status in hybrid rice gene pool during 2005 and 2006. From these 239 test crosses twelve (12) restorers and 16 maintainers (8 Basmati and 8 non basmati lines) were identified for use in hybrid rice breeding programs. Four basmati and eight coarse lines were identified as restorers from the tested genotypes. Most of the genotypes were found partial restorer and partial maintainer. In addition, eight best heterotic combinations were also identified. Six heterotic hybrid combinations had more than 80% spikelet fertility. Plant height of all the hybrids was less except IR 70372 / Bas 370 and IR 58025A / PK 1498-6-2-4 than check variety basmati 385. Filled grains per panicle of the hybrids ranged from 101.2 to 145.2 as compared to the check variety (84.6).

Key words: Genotypes, Basmati, Heterotic, Grains

INTRODUCTION

The dire need of increasing rice productivity and production encouraged rice scientists to develop and disseminate hybrid rice technology in the tropics. Experience in China (Ma and Yuan 2003) and outside China, in IRRI (Virmani 2003, 2006), India (Mishra *et al.*, 2003), Vietnam (Hoan and Nghia 2003), the Philippines (Redona *et al.*, 2003), Bangladesh (Julfiquar and Virmani 2003), and several other countries clearly indicates that hybrid rice technology offers a viable option to meet this challenge. Hybrid rice varieties have clearly shown a 1-1.5 t ha⁻¹ yield advantage over semidwarf inbred high-yielding varieties (HYVs) in farmers' fields in China and other countries. Rice hybrid for unfavorable environment can be developed using elite parental lines adapted to these environments. The establishment of testcross nursery to identify restorers and maintainers is the first step in three-line heterosis breeding.

McWilliam *et al.*, (1995) found higher frequency of restorers (21%) than that of the maintainers (11%) from the evaluation of the 6000 testcrosses in India. However, Ali and Khan (1996) observed that frequency of the maintainers (63%) was much higher than that of restorers among 76 hybrids tested. The local germplasm have the more frequency of maintainers than restorers from the study of six hundred eight (608) test crosses (Sabar and Akhter, 2003; Akhter *et al.*, 2007; Sabar *et al.*, 2007). Shihua *et al.*, (2006) observed that indica cms lines by crossing the restorer lines with different indica or japonica genetic background, the hybrids gave higher yield. The objective of this study was to identify better male and female parents for the development of good rice hybrids.

MATERIALS AND METHODS

Local and exotic genetic germplasm was evaluated to identify the commercially usable restorers and maintainers in Basmati and coarse rice at Rice Research Institute, Kala Shah Kaku. For this purpose, during the year 2004, 109 genotypes were crossed with nine CMS lines i.e., IR 58025A, IR 69616A, IR68275A, IR69628A, IR73328A, SSMS2A, 68886A, IR67684A and IR75606A. During 2005, 120 parental lines were crossed with 16 CMS lines i.e., IR 58025A, IR73328A, IR73794A, IR70372A, IR72788A, IR68902A, SMS2A, IR69628A, IR68280A, IR70369A, IR68886A, IR68275A, IR68897A, IR62829A, IR69616A and IR69619A. During 2005, one hundred thirty eight entries comprising of sixty nine (69) test crosses along with their respective parental lines were transplanted on 07.07.2005 in the rows of 12 plants with 22.5 cm plant spacing on each side. During 2006, three hundred forty entries along with their respective parental lines were transplanted on 29.06.2006 in the rows of 12 plants with 22.5 cm spacing on each side. Standard agronomic and plant protection measures were adopted during both the years.

During the years i.e, 2005 and 2006, pollen studies were carried out for their fertility / sterility of testcross F₁ plants. For the purpose, 15-20 spikelets from the just emerged panicles of 3 randomly selected plants were collected in a vial containing 70% ethanol. All the anthers from at least 6 spikelets were taken out with the help of a forceps and placed on a glass slide with a drop of 1% Iodine Potassium Iodide (IKI) 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, 5 panicles of each testcross were covered with butter paper bags to avoid foreign

pollen contamination and at maturity were harvested. The criteria for classifying the parental lines as maintainers and restorers were used as proposed by Virmani *et al.*, (1997).

RESULTS AND DISCUSSION

From 239 test hybrids evaluated during both the years 12 restorers, 47 partial restorers, 53 partial maintainers and 16 maintainers were categorized on the basis of pollen and spikelet sterility / fertility studies. The frequency of restorers, partial restorers, partial maintainers and maintainers were 9 %, 37 %, 41 % and 13% respectively.

Four basmati and eight coarse lines were identified as restorers from the tested genotypes. The CMS line(s) used for these restorers are given against each in Table 1. The maximum pollen fertility (95.7%) was observed in the cross of B 6144 with IR 58025A. While the minimum pollen fertility (72.5%) was observed in the cross of OP3 with IR 69628A. All the CMS lines used were carrying wild abortive (WA) cyto sterility source. Among these 12 restorers, Basmati 370 and Basmati 385 are the approved and commercial varieties having good cooking quality traits. Out of these 239 testcrosses, sixteen (8 Basmati and 8 coarse) were identified as maintainers. The CMS line(s) used for these

maintainers are given in Table 2. Two varieties i.e., Super Basmati and Basmati 2000 are commercial varieties being grown in the Punjab. The morphological characters of identified maintainers except Basmati 2000 are suitable for development of CMS lines and can be converted into new CMS lines for the development of local rice hybrids. From these studies, it is evident that the frequency of maintainers is quite higher than the restorers amongst the tested genotypes. The same results were also found by Ali and Khan (1996), Sabar and Akhter (2003), and Virmani and Kumar (2004). Eight best heterotic combinations were also identified from the testcrosses under study on the basis of economic traits (Table 3). It was revealed that six identified heterotic hybrid combinations had more than 80 % spikelet fertility and acceptable maturity days. Plant height of all the hybrids was less except IR 70372 / Bas 370 and IR 58025A / PK 1498-6-2-4 than check variety basmati 385. Filled grains per panicle of the hybrids ranged from 101.2 to 145.2 as compared to the check variety (84.6). In conclusion, local germplasm had more frequency of maintainers than restorer lines. New cms lines should be developed using the local germplasm / Basmati varieties for the development of good aromatic and non aromatic rice hybrids.

Table3: Morphological attributes of heterotic rice hybrids identified from the testcrosses

S. No.	Parentage	Maturity days	Plant Height (cm)	Tillers/ plant	Filled grains/ panicle	Spikelet Fertility (%)
1	IR70372A / Bas370	123	161.3	10.7	101.2	80.5
2	IR69628A / Bas385	109	136.0	11.0	124.7	86.4
3	IR69628A / OP3	95	132.3	9.3	124.8	84.8
4	IR69628A / KSK433	102	108.7	8.3	127.4	82.9
5	IR58025A / B6144	90	121.0	12.6	145.2	77.0
6	IR58025A / IR72909-139-1-2-2 Early	98	113.0	21.6	116.8	83.8
7	IR58025A / IR72909-139-1-2-2 Late.	108	102.0	18.7	142.8	76.0
8	IR58025A / PK 1498-6-2-4	112	164.7	19.7	119.7	84.5
9	Basmati 385 (Check Variety)	110	137.4	18.2	84.6	-

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