SELECTION OF RESTORERS AND MAINTAINERS FROM TEST CROSSES FOR THE DEVELOPMENT OF RICE HYBRIDS

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ABSTRACT: The objective of this study was to identify male and female parents for the development of rice hybrids in Pakistan. Fifty five (55) rice genotypes were evaluated for their status in hybrid rice gene pool. From 65 test crosses, seven (7) restorers and eleven (11) maintainers have been identified for use in hybrid rice research programme. Most of the material was found as partial restorer and partial maintainer. Maintainer lines possessing desirable characteristics will be converted into cytoplasmic male sterile (CMS). In addition, seven best heterotic combinations were also identified from the testcrosses on the basis of filled grains per panicle and spikelet fertility percentage. All these seven heterotic hybrid combinations had more than 75 % spikelet fertility and acceptable maturity days and plant height. All test hybrids had more number of filled grains per panicle than the check variety (Basmati 385). New CMS lines may be developed by using the local genotypes especially Basmati varieties for successful breeding programme of hybrid rice.

Key words: *hybrid rice, restorers, maintainers, test crosses.*

INTRODUCTION

The Chinese experience and the dire need of increasing rice productivity and production encouraged rice scientists to develop and disseminate hybrid rice technology in the tropics. About 2 million ha. are presently planted with hybrid rice in India, Vietnam, Philippines, Bangladesh, Myanmar and Indonesia where about 2.0-2.5 million ton of extra paddy is produced (Virmani and Kumar, 2004). 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 high frequency of restorers (21%) than was the maintainers (11%) from the evaluation of the 6000 testcrosses in India. Ali and Khan (1996) observed that frequency of the maintainers (63%) was much higher than that of restorers among 76 hybrids tested. Similarly Akhter et al. (2007) and Sabar et al. (2007) found that local germplasm have more frequency of maintainers than restorers. Shihua et al. (2006) observed using indica or indicalinous CMS lines to cross the restorer lines with different indica and japonica genetic background, the hybrid from the indicalinous or japonicalinous restorer lines gave higher yield. Therefore emphasis must be given to use intermediate type for the development of super hybrid. The objective of this study was to identify male and female parents for the development of hybrid rice.

MATERIALS AND METHODS

Local and exotic germplasm was evaluated to identify commercially usable restorers and maintainers in Basmati and coarse rice at Rice Research Institute, Kala Shah Kaku. For this purpose, during Kharif (July-October) 2006, forty eight (48) parental lines were crossed with 7 CMS lines (IR 58025A, IR73328A, SMS2A, IR70369A, IR68897A, IR79156A, and IR68885A). During kharif 2007, sixty five (65) entries along with their respective parental lines were transplanted on 05.07.2007 in the rows of 12 plants with 22.5 cm spacing on each side on plot size 2.7m X 0.5m. Standard agronomic and plant protection measures were adopted during the season.

Pollen studies were carried out for their fertility / sterility of testcross F_1 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. 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 (Virmani et al. 1997). 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 65 testcross hybrids, seven (7) restorers (Table-1) and eleven (11) maintainers (Table-2) were categorized on the basis of pollen and spikelet sterility / fertility studies. The frequency of restorers were (11%) and maintainers (17%), respectively. Three basmati and four coarse lines were identified as restorers from the tested genotypes. The CMS lines used for the restorers and maintainers are given against each in table 1 and 2. All the CMS line(s) were carrying wild abortive (WA) cytosterility source. Among 7 restorers, Basmati 385 and Basmati 198 are the approved and commercial varieties. Furthermore, eleven lines (9 Basmati and 2 coarse) were identified as maintainers. Among maintainers; Super Basmati and Basmati 2000 are commercial varieties. The morphological characteristics of these line(s) except Basmati 2000 are suitable for CMS lines and can be converted into new CMS lines for the development of new rice hybrids. In addition, seven best heterotic combinations were also identified from the testcrosses under study on the basis of filled grains per panicle and spikelet fertility (Table-3). It was revealed that all seven identified heterotic hybrid combinations had more than 75 % spikelet fertility and acceptable maturity days and plant height. From the test hybrids, four hybrids had more number of filled grains per panicle than the check variety (Basmati 385). Yield performance of the test hybrids on larger area and cooking quality characteristics are needed to be determined before their release for commercial cultivation. 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), and Virmani and Kumar (2004). It is recommended that new CMS lines may be developed by using the local lines especially Basmati varieties for successful breeding programme of hybrid rice.

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Table 1: Genotypes identified as restorers

Sr. No.	Genotypes	Group	CMS used	Pollen Fertility (%)	Spikelet Fertility (%)
1	LG141	Coarse	IR58025A	75	78
2	LG141	Coarse	IR70369A	82	88
3	PK7868-3-1-1	Coarse	IR79156A	86	79
4	IR63870-123-2	Coarse	IR58025A	77	77
5	Basmati 385	Basmati	IR79156A	75	75
6	Basmati 198	Basmati	IR79156A	78	84
7	PK7375-2-3-7-1	Basmati	IR58025A	75	86

Table 2: Genotypes identified as maintainers

Sr. No.	Genotypes	Group	CMS used	Sterility %age (Lab Pollen)
1	Super basmati	Basmati	IR58025A	100.0
2	99417	Basmati	IR58025A	100.0
3	48463	Basmati	IR58025A	100.0
4	454	Coarse	IR58025A	99.0
5	Basmati 2000	Basmati	IR68897A	100.0
6	99417	Basmati	IR68897A	100.0
7	Super basmati	Basmati	IR73328A	100.0
8	F7TGMS16	Coarse	IR73328A	99.6
9	Super basmati	Basmati	IR79156A	100.0
10	Basmati 2000	Basmati	IR79156A	99.6
11	99417	Basmati	SSMS2A	100.0

Table 3: Morphological attributes of heterotic rice hybrids identified from the test crosses

SR. No.	Parentage	Maturity Days	Plant Height (cm)	Tillers/ Plant	Filled grains /Panicale	Spikelet Fertility %age
1	IR58025A/ LG141	93	105	9	110	78
2	IR70369/ LG141	99	105	8	115	89
3	IR79156A/ PK7868-3-1-1	87	140	11	144.2	79
4	IR58025A/ IR63870-123-2	80	98	12	118	77
5	IR79156A/ BAS 385	104	147	12	149	76
6	IR79156A/ Bas 198	102	142	15	167.6	85
7	IR58025A/ PK7375-2-3-7-1	88	127	11	159	86
Check variety	Basmati 385	149	130	15	130	84