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Spikelet Fertility Restoration Studies for Identification of Restorers and Maintainers in Rice (*Oryza sativa* L.)

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A B S T R A C T

A study was conducted on fertility restoration of 24 Rajendra nagar genotypes to identify the restorers, partial restorers, partial maintainers and maintainers. Twenty four genotypes were test crossed with IR 58025A during rabi 2014-15 at Rice Research Centre, ARI, Rajendra nagar. Out of 24 genotypes 8 were identified as restorers, 10 were identified as partial restorers and 6 genotypes were identified as partial maintainers. None of them were identified as maintainers.

Introduction

Rice (*Oryza sativa* L.) is the most important staple food crop for more than 60 percent of the global population and most important crop in Asia. Rice (*Oryza sativa* L.) is a staple food for over 3 billion people (Cantral and Reeves, 2002).

In many countries, rice accounts for more than 70 percent of human caloric intake. In India rice cultivation area is 44 million hectares and production is 106 million tones where as China produces 144 million tonnes from 30.6 million hectares. In China the rice production is high due to high adoption of hybrid rice where as India the hybrid rice adoption is about 2.5 million hectares (RICESTAT 2014). In hybrid rice seed production three-line system and two-line systems are used. Mostly three line or CGMS (Cytoplasmic Genic Male sterility) system will be followed to eliminate emasculation process.

The combination of a CMS line, maintainer line and restorer line carrying the restorer gene (Rf) to restore the fertility are indispensable for the development of hybrids. The establishment of test cross nursery to identify restorers and maintainers is the first step in three line heterosis breeding (Akhter *et al.*, 2008).

Materials and Methods

The CMS line IR 58025A and twenty four rice genotypes of Rajendra nagar were comprised the materials for present study. Those materials were grown in source nursery at Rice Research Centre, Agriculture Research Institute, Rajendra nagar during rabi 2014-15. The pollen parents were planted with a spacing of 20 cm (row-to-row) x 15 cm (plant-to-plant) in main field.

The CMS lines IR 58025A were tested to assure 100 % pollen sterility before crossing. The panicles of CMS lines were covered with a butter paper at anthesis period to prevent cross pollination. At 10-11 am the pollen was dusted on panicles of IR 58025A CMS lines. So utmost care was taken while test crossing and crossed seeds from the combinations were collected for their evaluation.

Estimation of spikelet fertility

Estimation was done on three panicles per plant (two selected at random and one from the main culm) from five randomly selected plants for each testcross hybrid at maturity. Spikelet fertility of hybrids was assessed by taking the count of well filled and chaffy spikelets in each panicle.

Spikelet fertility (%) = {No. of filled spikelets panicle^{-1}/total number of spikelets panicle^{-1}} x 100

Classification of pollen parents

The pollen parents were classified into four categories - Maintainers (M), Partial Maintainers (PM), Partial Restorer (PR) and Restorer (R) based on their spikelet fertility percentages (Srijan *et al.,* 2015) and presented in the following study.

Results and Discussion

The test cross establishment is the initial step in fertility restoration studies of three line hybrid rice production. The results showed that out of the attempted test crosses, 24 test crosses were successfully evaluated (Table 1).

It was reported in some cases higher frequency of maintainers (17%) than that of restorers (11%) from 65 testcrosses (Akhter *et al.,* 2008).

The spikelet fertility of hybrids varied from 11.03 to 91.95. Similar observations have been reported by other researchers (Ali *et al.,* 2014, Krishnalatha and Sharma 2012, Sharma *et al.,* 2012 and Srijan *et al.,* 2015).

In this evaluation 8 genotypes were completely restored, 10 genotypes were partially restored and 6 were identified as partial maintainers. None of them were identified as maintainers. These 8 genotypes (restorers) can contribute for the development of good hybrids by utilizing them as parental lines in hybridization programmes (Table 2).

In this investigation the finding were revealed that fertility restoration reaction was varied with genetic background. These identified restorers were locally adopted genotypes. So, we can use them in production of superior hybrids for local climatic conditions.

Table.1 Fertility restoration study for identification of restorers and maintainers among 24 lines test crossed with IR 58025A

S. No.	Hybrids	Days to 50% flowering	No. of filled grains per panicle	No. of unfilled grains	Total no. of grains	Spikelet fertility %	Grain yield per plant	Fertility reaction
1	**IR 58025A × RNR 21615**	94	300	58	368	81.52	12.50	R
2	**IR 58025A × RNR 21604**	90	153	17	170	90.00	18.96	R
3	**IR 58025A × RNR 21304**	89	150	36	186	80.60	13.83	R
4	**IR 58025A × RNR 21218**	87	183	16	199	91.95	24.87	R
5	**IR 58025A × RNR 21301**	90	262	43	305	83.90	36.24	R
6	**IR 58025A × RNR 21288**	86	209	21	230	90.08	21.76	R
7	**IR 58025A × MTU 1010**	88	190	35	225	84.44	18.02	R
8	**IR 58025A × RNR 15048**	91	128	25	153	83.60	11.59	R
9	**IR 58025A × RNR 21677**	93	168	120	288	58.33	10.74	PR
10	**IR 58025A × RNR 21606**	92	273	123	396	68.90	17.31	PR
11	**IR 58025A × RNR 21230**	87	120	225	345	34.00	11.39	PM
12	**IR 58025A × RNR 21297**	89	28	225	253	11.03	4.07	PM
13	**IR 58025A × RNR 21290**	92	95	191	286	33.21	10.86	PM
14	**IR 58025A × RNR 21232**	85	247	80	327	74.50	12.34	PR
15	**IR 58025A × RNR 21219**	92	373	130	503	74.15	19..74	PR
16	**IR 58025A × RNR 21236**	87	123	119	242	50.80	11.36	PR
17	**IR 58025A × RNR 21222**	95	154	80	234	65.81	12.19	PR
18	**IR 58025A × RNR 21287**	88	100	42	142	70.42	10.30	PR
19	**IR 58025A × RNR 21243**	93	116	59	175	66.28	10.72	PR
20	**IR 58025A × RNR 21295**	88	110	210	320	34.37	7.47	PM
21	**IR 58025A × RNR 21229**	84	48	137	185	25.94	6.89	PM
22	**IR 58025A × RNR 19397**	93	74	27	101	73.20	9.83	PR
23	**IR 58025A x RNR 19311**	90	125	170	295	42.37	10.43	PM
24	**IR 58025A × MTU 1001**	93	121	80	201	60.19	9.78	PR

Table.2 Classification of the lines studied based on fertility reaction of test cross hybrids

S. No.	Class	Spikelet fertility %	No. of genotypes identified	List of genotypes
1	Restorers	>75	8	RNR 21615, RNR 21604, RNR 21304, RNR 21218, RNR 21301, RNR 21288, RNR 15048 and MTU 1010
2	Partial Restorers	50-75	10	RNR 21677, RNR 21606, RNR 21219, RNR 21236, RNR 21222, RNR 21287, RNR 21243, RNR 19397, RNR 21232 and MTU 1001
3	Partial Maintainers	0.1-50	6	RNR 21230, RNR 21297, RNR 21290, RNR 21295, RNR 21229 and RNR 19311
4	Maintainers	0	0	Nil

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