



Evaluation of promising TGMS lines for exploitation of two line heterosis in rice (*Oryza sativa* L.)

R. Kalaiyarasi, Asish K. Binodh and K. Thiyagarajan

Deptt. of Rice, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore 641 003

(Received: April 2005; Revised: August 2006; Accepted: August 2006)

Use of the thermo sensitive genie male sterility (TGMS) system in two line breeding is simple, inexpensive, efficient and eliminates the limitations associated with the cytoplasmic-geneic male sterility (CMS) system in rice. The present study is aimed to isolate and identify stable TGMS lines for commercial exploitation of two line heterosis breeding in rice. Two line hybrid in rice by employing thermo sensitive or photosensitive genic male sterility (TGMS or PGMS) lines is considered as an effective substitute for the three line hybrid using CMS system because of its potential to exploit higher heterosis and simple procedure of hybrid seed production [1]. Male sterility expression in TGMS lines is influenced by temperature. The temperature occurring just after panicle initiation is the most critical in the expression of sterility and fertility. TGMS lines are completely male sterile at higher temperature and almost normal male fertile at lower temperature. Therefore, the TGMS lines are used for purpose as male sterile lines for commercial hybrid seed production and as male fertile for self-multiplication at two different temperature. The TGMS system was considered to be more useful than the PGMS in tropical areas where large temperature differences between different regions and seasons exist [2]. In the tropical countries like India, where temperature fluctuations are common, the thermo sensitive genie male sterility (TGMS) system can be effectively utilized. Hence the present investigation was made to develop new TGMS lines with stable sterility, floral traits, medium duration group for exploiting two line heterosis in rice.

The present investigation was carried out during summer 2003 at the Paddy Breeding Station, TNAU, Coimbatore. The materials comprised, 60 suspected TGMS lines from different populations viz., 11 F₅'s, 13F₄'s and 22 doubled haploids (DHs), 14 GDs (Advanced TGMS populations from HREC, Gudalur). The crop was raised during the period between mid February 2003 and June 2003 for screening the sterility /fertility expression. All the population of TGMS lines initiated panicle development during April 2003 when the maximum/minimum temperature (day/night) was 30.5-37.8°C/22.0-26.4°C.

The suspected TGMS lines were evaluated for pollen fertility by using 1% Iodine Potassium Iodide (I-KI) solution. Pollen grains from three randomly chosen fields were evaluated and pollen fertility was expressed in percentage. Five panicles per plant were evaluated for spikelet fertility. Sterile plants identified from promising TGMS lines were ratooned for self multiplication of seeds to confirming fertility transformation during *kharif* 2003. Pollen fertility/spikelet fertility observation were recorded for ratooned plants. Seeds were collected from each ratooned promising TGMS lines and raised for evaluation during *rabi* 2004. Panicle development of TGMS lines were observed during April 2004 when the average maximum/minimum temperature was 37.0°C/24.3°C (day/night). Pollen/spikelet fertility was assessed for all TGMS lines.

Promising TGMS lines identified during summer 2003 (Table 1). Out of 60 population evaluated for TGMS expression, 175 sterile plants were identified based on pollen/spikelet sterility. The sterile plants consisted of 27 F₄'s, 40 F₅'s, 20 DH's and 88 GD No's. The results showed that 25 lines found promising for stable TGMS expression along with good floral traits. Among the TGMS lines CBTS 0280, CBTS 0283, CBDHTS 025, GD 98014, GD 98028 had early flowering (Table 1). Similar results were reported for the TGMS line viz., TS29 [3]. All the twenty five promising TGMS lines exhibited 100 per cent pollen/spikelet sterility during summer season when the maximum, minimum temperature was 30.5-37.8/22.0-26.4 (day/night). The TGMS lines viz., CBTS 0268 and CBTS 0272 are found to be possessing long slender grain, purple tip, well exerted purple stigma. Similar type of promising TGMS line were reported for intermated progenies of TGMS lines [4]. The TGMS line viz., CBTS 0252 and CBTS 0254 were developed from *Indica/Japonica* crosses which showed 100% pollen sterility, medium slender grain with purple stigma [5]. The results revealed that the TGMS line viz., CBTS 0252 and CBTS 0254 could be useful to produce two line hybrids with high heterosis for yield with good plant type.

Pollen fertility status of promising TGMS lines during *kharif* 2003 (Table 1). Pollen fertility was high in CBTS 0276, CBTS 0282, CBTS 0268, CBTS 263, CBTS 0254 while spikelet fertility was high in CBTS

pollen sterility expression with medium slender grain and good floral traits which has been utilized for developing two line hybrids in rice.

Table 1. Pollen/spikelet fertility status of promising TGMS lines over different seasons at Coimbatore

Sl.No.	TGMS lines	Days to 50% flowering	Summer 2003		<i>Kharif</i> 2003		<i>Rabi</i> 2004		Stigma exsertion (%)
			Pollen fertility (%)	Spikelet fertility (%)	Pollen fertility (%)	Spikelet fertility (%)	Pollen fertility (%)	Spikelet fertility (%)	
1.	CBTS 0248	95	0.00	0.00	80.00	53.00	0.00	0.00	57
2.	CBTS 0252	106	0.00	0.00	75.00	55.00	0.00	0.00	74
3.	CBTS 0253	106	0.00	0.00	78.00	43.00	0.00	0.00	60
4.	CBTS 0254	95	0.00	0.00	90.00	52.00	0.00	0.00	25
5.	CBTS 0260	94	0.00	0.00	75.00	55.00	0.00	0.00	64
6.	CBTS 0261	96	0.00	0.00	85.00	50.00	0.00	0.00	67
7.	CBTS 0263	95	0.00	0.00	90.00	52.00	0.00	0.00	70
8.	CBTS 0268	93	0.00	0.00	92.00	60.00	0.00	0.00	80
9.	CBTS 0272	92	0.00	0.00	85.00	55.00	0.00	0.00	76
10.	CBTS 0273	92	0.00	0.00	75.00	45.00	0.00	0.00	20
11.	CBTS 0276	90	0.00	0.00	95.00	60.00	0.00	0.00	45
12.	CBTS 0277	93	0.00	0.00	90.00	53.00	0.00	0.00	42
13.	CBTS 0278	89	0.00	0.00	85.00	50.00	0.00	0.00	42
14.	CBTS 0280	86	0.00	0.00	90.00	58.00	0.00	0.00	53
15.	CBTS 0282	89	0.00	0.00	95.00	50.00	0.00	0.00	41
16.	CBTS 0283	83	0.00	0.00	88.00	54.00	0.00	0.00	45
17.	CBTS 0290	94	0.00	0.00	80.00	40.00	0.00	0.00	60
18.	CBTS 0112	101	0.00	0.00	85.00	40.00	0.00	0.00	15
19.	CBDHTS 023	90	0.00	0.00	55.00	35.00	0.00	0.00	20
20.	CBDHTS 024	90	0.00	0.00	60.00	54.00	0.00	0.00	18
21.	CBDHTS 025	87	0.00	0.00	50.00	38.00	0.00	0.00	19
22.	CBDHTS 026	92	0.00	0.00	62.00	55.00	0.00	0.00	22
23.	GD98 014	81	0.00	0.00	75.00	45.00	0.00	0.00	33
24.	GD 98028	84	0.00	0.00	80.00	55.00	0.00	0.00	30
25.	GD 98029	90	0.00	0.00	90.00	58.00	0.00	0.00	40

0276, CBTS 0280. Lowest spikelet fertility was observed in CBDHTS 023. All the twenty five promising TGMS lines exhibited 100 per cent pollen/spikelet sterility during *rabi* 2004. The result showed that all the promising TGMS lines showed 100 per cent pollen sterility during high temperature (summer 2003 and *rabi* 2004) and reverted to fertility during *kharif* 2003 indicated that occurrence of fertility transformation nature of TGMS in these lines.

The results showed that high stigma exsertion was observed in the TGMS lines *viz.*, CBTS 0268, CBTS 0272, CBTS 0252, CBTS 0263, CBTS 0261, CBTS 0260 and CBTS 0253 indicated that these TGMS lines could be effectively utilized for exploitation of two line heterosis breeding in rice. The result showed that the TGMS lines *viz.*, CBTS 0268, CBTS 0272, CBTS 0252, CBTS 0263 are found to be promising for stable

References

1. Yuan L. P. 1998. Hybrid rice breeding in china. *In*: Viramani S.S., Siddiq, E.A. and K. Muralidharan (Eds). Advances in hybrid rice technology. Proc. of the 3rd International Symposium on Hybrid Rice. 14-16 Nov. 1996 (Hyderabad, India). Int. Rice Res. Institute, Manila, Philippines, pp : 27-33.
2. Virmani S. S. 1992. Scientist push hybrid rice technology for higher yields. IRRI reporter (IRRI suppl.) 2-1.
3. Kirubakaran A. P. M., Thiyagarajan K. Arumugachamy S. and Ali S. 2002. Prospects of two line hybrid rice breeding in Tamil Nadu, IRRN 21 : 27(1).
4. Kalaiyarasi R. and Vaidyanathan P. 2003. Cytological screening of rice TGMS lines. Plant Breeding, 122: 334-338.
5. Kalaiyarasi R., Palanisamy G. A. and Vaidyanathan P. 2002. The potentials and scope of utilising TGMS lines in inter-subspecies crosses of rice (*Oryza sativa* L.). J. Genet. & Breed., 56: 137-143.