

**Research Article****Development of new TGMS lines with good floral traits in rice**

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**Abstract**

Two-line breeding in exploitation of thermo-sensitive genic male sterile system is pursued with the objective of development of hybrids with high heterotic potential. A total of 66 new TGMS lines were developed and screened under sterility favoring environment for *tgms* gene expression during summer and sterility limiting environment during winter at Paddy Breeding Station, Coimbatore for the past five years. Out of 66 TGMS lines, 15 lines showed stable performance and seven TGMS lines *viz.*, COTGMS 02, COTGMS 07, COTGMS 10, COTGMS 11, COTGMS 12, COTGMS 13 and COTGMS 15 were completely pollen sterile throughout the summer period. These lines had wider sterility expression period with very good floral traits *viz.*, higher pollen sterility per cent, panicle and stigma exertion per cent, wider glume opening favorable for enhanced out-crossing rate and seed set percentage during seed production.

**Index words:** Rice, TGMS lines, floral traits, pollen sterility.

**Introduction**

The application of thermo-sensitive genic male sterile (TGMS) lines has a great potential to exploit two-line hybrid rice technology. Exploitation of hybrid rice through CGMS is cumbersome and restricts use of varieties or elite lines as parental lines, because want of specific maintainer (B) and restorer (R) lines. The two line hybrid breeding system, utilizing thermo-sensitive genic male sterility is economically feasible as well as a viable alternative to cytoplasmic male sterile (CMS) based three line breeding due to much simplified hybrid seed production (Shukla and Pandey, 2008). Here there is no need for a maintainer line for seed multiplication, thus making seed production simpler and more cost-effective. Any fertile line can be used as a pollen parent (PP); therefore, the frequency of heterotic hybrids is higher among two-line hybrids than among three-line hybrids, thereby increasing hybrid-breeding efficiency. Characterization of TGMS lines for floral traits is one of the important aspects that a breeder should keep in mind while selecting a line in hybrid breeding. Therefore, the present study was conducted to evaluate TGMS lines for floral characters to develop two line hybrids.

**Material and Methods**

Sixty six TGMS lines of rice (*Oryza sativa* L.) of

diverse sources were raised during Rabi 2009 at Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore. Sixty six TGMS lines were raised to study the fertile phases at low temperature condition (24/18<sup>0</sup>C day/night) and high temperature conditions for getting sterile phases (32/24<sup>0</sup>C). The traits namely days to 50 % flowering, angle of glume opening, panicle exertion percentage, stigma exertion percentage, pollen sterility percentage, spikelet fertility percentage, plant height, number of productive tillers per plant, panicle length and number of filled grains per panicle were observed. About 10-15 spikelets from the freshly emerged panicles of all the plants were collected and examined under microscope with 1% Iodine Potassium Iodide (I-KI) solution for pollen sterility assessment. Five competitive plants in the middle row were selected in each treatment at random and tag labeled and observed for the above characters.

**Result and Discussion**

The preliminary step in exploitation of two line rice hybrids on a large scale is the identification of TGMS lines with stable fertility transformation behaviour. The major advantages of EGMS system are simplicity, overcoming the negative effects of male sterile cytoplasm and the ease multiplication under restoration (Yuan, 1997). These two line

hybrids have 5-10 % yield advantage over the three line hybrids. The observations recorded on the floral and morphological characters of TGMS lines are listed in table 1. Out of 66 TGMS lines, 15 lines showed stable performance and seven TGMS lines viz., COTGMS 02, COTGMS 07, COTGMS 10, COTGMS 11, COTGMS 12, COTGMS 13 and COTGMS 15 were completely pollen sterile through out the summer period at Coimbatore (36/22°C) (Fig 1). These lines had complete pollen sterility under high temperature condition and more than 35-60% selfed seed set under low temperature condition. (Fig 2). These lines could be utilized for two line hybrid rice breeding as they can be multiplied during winter month and hybrid seed production can be taken up during summer months. Latha *et al.* (2005) identified the maximum, mean and minimum temperatures to be the primary factors influencing pollen sterility. The TGMS lines viz., COTGMS 03, COTGMS 04, COTGMS 05, COTGMS 09, COTGMS 10, COTGMS 11, COTGMS 12, COTGMS 13 and COTGMS 14 registered highest value for angle of glume opening, panicle exertion percentage, stigma exertion percentage (> 40%) and spikelet fertility percentage. Angle of glume opening / floret opening for these lines varied from 15° to 25°. In the present study maximum glume angle was observed in COTGMS 08 and COTGMS 09 (25°) and minimum in the case of COTGMS 04 (15°). Singh and Rang (1999) reported the glume angle range of 35.0 to 48° and Ravneet S. Behta *et al* (2007) reported the range of 23.43 to 30.20°.

Panicle exertion ranged from 53.65 to 83.10 % for COTGMS 01 and COTGMS 09 respectively. Stigma exertion percentage ranged from 37.84 (COTGMS 06) to 80.28 (COTGMS 08). Spikelet fertility percentage ranged from 33.28 to 80.32 COTGMS 12 and COTGMS 01 respectively. Ten TGMS lines recorded higher spikelet fertility per cent than the mean value. The TGMS lines viz., COTGMS 01 and COTGMS 15 exceeded general mean significantly for all the characters except days to fifty percent flowering, pollen sterility and glume angle. The lines COTGMS 10, COTGMS 11 and COTGMS 12 recorded significantly higher mean value for panicle exertion and pollen sterility (Fig 2). Ali *et al.* (2008) reported 50 per cent natural out crossing rate with more than 70 % panicle exertion. The TGMS lines, COTGMS 08 and COTGMS 09 had wider angle of glume opening with significantly higher fertility per cent

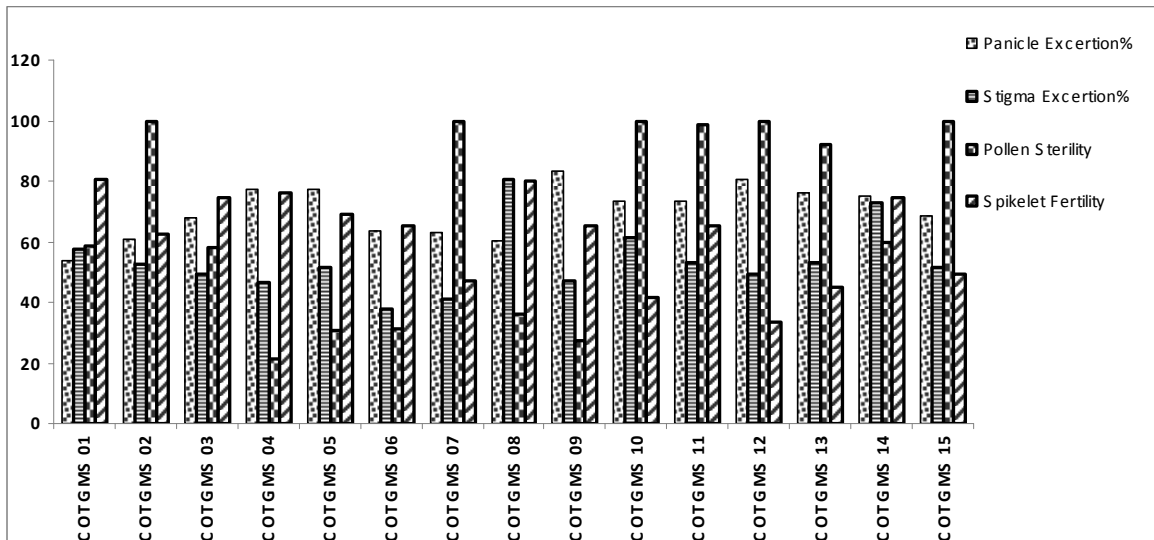
and number of grains per panicle. Similar results were reported by Jayaramaiah, 2007 in their study with fifteen CMS lines.

The results of the evaluation studies showed that TGMS lines, COTGMS 02, COTGMS 07, COTGMS 10, COTGMS 11, COTGMS 12 and COTGMS 15 are promising for the characters viz., pollen sterility, panicle exertion, stigma exertion, angle of glume opening and natural out crossing and they can be utilized for the development of two line hybrids with superior yield.

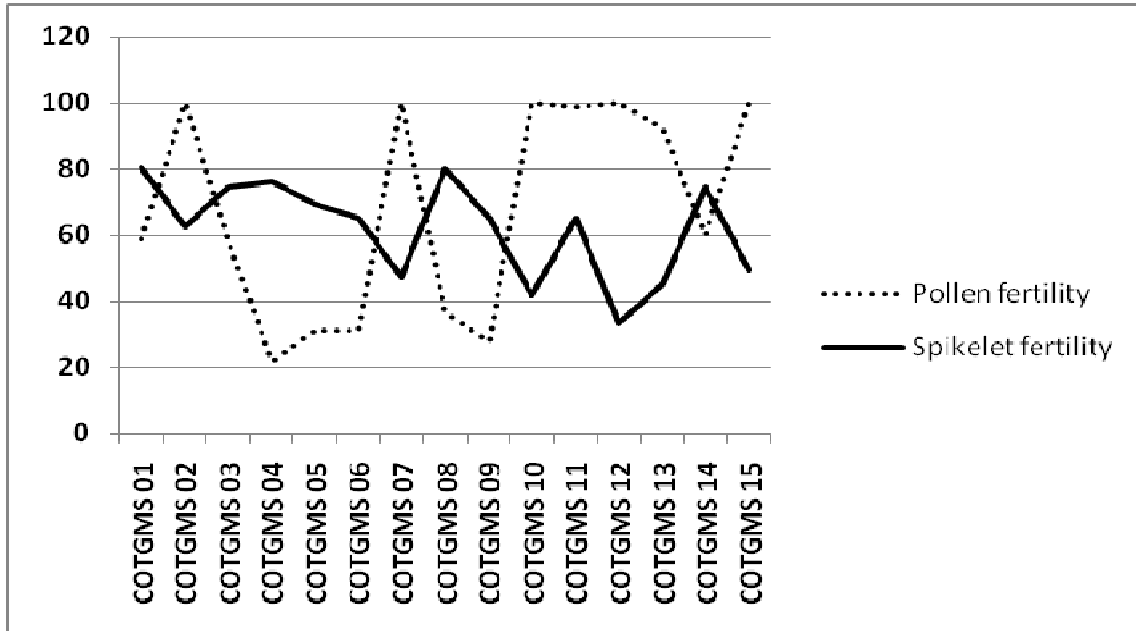
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**Fig. 1. Performance of promising TGMS lines for floral traits**



**Fig. 2. Comparison of pollen fertility and spikelet fertility percent**



**Table 1. New TGMS lines with morphological and floral traits**

Entries	DFE	PH	NPT	PL	PE%	SE%	PS	NG	SF	GA	SC
COTGMS 01	111.00*	82.00*	18.50	26.50*	53.65	57.34*	58.65	110.00*	80.32*	20.00	Purple
COTGMS 02	112.50*	71.00*	16.00	19.50	61.00	52.48	100.00*	66.50	62.66	20.00	Purple
COTGMS 03	104.50	59.00	22.50*	22.50	67.81	49.31	58.10	91.50*	74.33*	18.00	White
COTGMS 04	107.00	75.00*	13.50	25.50*	77.24*	46.84	21.57	105.00*	76.28*	15.00	White
COTGMS 05	111.00*	73.50*	17.00	24.00	77.05*	51.33	30.92	71.00	69.28*	20.00	Purple
COTGMS 06	106.00	61.00	25.00*	20.50	63.55	37.84	31.00	79.50	65.18*	20.00	White
COTGMS 07	82.00	55.00	21.00	20.00	62.97	41.30	100.00*	76.50	47.39	20.00	Purple
COTGMS 08	86.00	66.00*	17.00	22.00	60.07	80.28*	36.37	93.50*	80.06*	25.00*	White
COTGMS 09	107.50*	63.50	17.50	19.50	83.10*	47.39	27.65	86.50*	65.01*	25.00*	White
COTGMS 10	114.00*	64.00*	21.00	24.00	73.16*	61.37*	100.00*	71.00	41.56	20.00	Purple
COTGMS 11	106.00	54.00	16.50	20.50	73.32*	52.97	98.54*	61.00	65.05	20.00	Purple
COTGMS 12	105.50	72.50*	19.50	23.50	80.70*	49.44	100.00*	76.50	33.28	18.00	Purple
COTGMS 13	82.00	48.50	20.50	18.00	76.28*	53.11	92.26*	61.00	45.03	20.00	Purple
COTGMS 14	86.00	71.50*	24.00*	29.00*	75.00*	72.99*	59.86	86.00*	74.36*	18.00	White
COTGMS 15	110.00*	58.50	27.00*	24.00	68.56	51.47	100.00*	68.00	49.41	18.00	White
<b>G. Mean</b>	<b>102.07</b>	<b>65.00</b>	<b>19.17</b>	<b>22.00</b>	<b>70.16</b>	<b>53.70</b>	<b>67.66</b>	<b>80.23</b>	<b>61.95</b>	<b>20.03</b>	-
SEd	3.54	1.48	1.56	1.06	1.88	1.78	3.00	3.45	1.53	1.03	-
CD 5 %	7.60	3.16	3.34	2.28	4.02	3.80	6.44	7.40	4.56	2.21	-
CV %	3.47	2.27	8.11	4.71	2.67	3.31	4.43	4.30	2.47	5.14	-

\* Significant mean performance

DFE- Days to 50% flowering, PH – Plant height, NPT- Number of productive tillers, PL- Panicle length, PE- Panicle Exertion, SE- Stigma Exertion, PS- Pollen sterility, NG – no. of grains , SF- Spikelet fertility, GA - , SC – Stigma color