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THE IDENTIFICATION AND NATURE OF A NEW THERMOSENSITIVE GENIC MALE STERILITY SOURCE, UPRI 95 - 140 TGMS IN RICE

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ABSTRACT

A spontaneous thermosensitive genetic male sterile line, UPRI 95 - 140 TGMS was identified and studied for its agronomic worth and nature of fertility transformation. Plants of the line are semidwarf with erect flag leaf and good yield potential. Male fertility transformation in it occurred before May 1 in dry season (DS) and August 12 onwards in wet season (WS) under Pantnagar conditions in the northwestern India. Optimum spikelet fertility was shown more than 40% and the period of complete male sterility was 104 days. The TGMS line had strong thermosensitive reaction with male fertility. The 15 - day average thermosensitive temperature for complete sterility was 27.1 (DS) to 28.7^{0} C (WS) and for optimum fertility it was 21.8 (DS) to 26.2^{0} C (WS). The TGMS line has great potential for exploitation in hybrid breeding and is currently being used in combination breeding programme.

KEY WORDS : Thermosensitive genic male sterility (TGMS), fertility transformation, thermosensitive temperature, hybrid rice.

INTRODUCTION

Two line hybrid breeding system utilising environmental sensitive genic male sterility (EGMS) is more simple and highly efficient in hybrid rice seed production and obtaining heterotic combinations compared to commonly used three line hybrid system. However, the EGMS involving male sterile line with sensitivity to temperature called thermosensitive genic male sterility (TGMS) is considered more feasible under tropical conditions like India (Virmani, 1994 ; Yuan, 1994 and 1996, Lu *et al.*,1996). Although, there have been significant progress in the development of two line hybrids in China (Lu *et al.*, 1994 and 1996 ; Yuan, 1996) , new TGMS sources were discovered in succession and TGMS breeding programmes successfully launched elsewhere (Siddiq , 1996). In this paper, an attempt has been made to gather information on the agronomic features and the fertility

transformation behaviour of a spontaneous mutant, UPRI 95 -140 during 1994 wet season.

MATERIALS AND METHODS

Seeds of UPRI 95 -140TGMS were sown in winter (Nov. 20, 1995) inside the glasshouse and transferred after three months to a nethouse on Feb. 20, 1996. To facilitate heading on different dates and study the male fertility characteristic related to heading dates, tillers from the TGMS plants were separated and transplanted in pots at six dates (March 20, April 20, May 20, June 20, July 20, and Aug. 20) in the year. Observations on important morphological traits of the TGMS line viz. plant type, spikelet and grain number per panicle and grain length and breadth were recorded . Heading date of each panicle was recorded and its spikelet fertility studied.

Data on daily temperature was obtained from the Meteorological Observatory of the University located very close to the experimental field and screenhouse. Daily average temperature was the mean temperature of daily maximum and minimum temperatures. Thirty - day transformation temperature was the mean temperature of 30 days before the heading. Twenty day and 15 - day transformation temperatures were the mean temperatures of 20 and 15 day periods, respectively, taken five days before the heading of any panicle. The relationships of spikelet fertility with the heading time and temperature were analysed.

RESULTS AND DISCUSSION

Morphological features of the TGMS line

The TGMS line has shown good vigour and heavy tillering. Plants are 62 cm tall and erect and flag leaves 19 cm long and 1.1 cm wide. Mean panicle length was 20.0 cm with 136 spikelets per panicle. Length and breadth of grains were 8.4 and 2.3 mm, respectively. Mean growth duration in the wet season based on average of 1994 and 1995 was 92 days . These features indicated good agronomic value of the TGMS line.

Model of fertility transformation

Model of fertility transformation in relation to heading date and daily mean temperature is depicted in Figure 1. Low fertility was obtained when heading occurred

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Table 1. Correlation coefficie

Fertility	30-d daily temperature (	
(%)	Min.	Ave
Dry season	-.981**	-.97
Wet season	-.956**	-.95

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during period between April 4 to October 10 and it was due to temperature lower than the critical low temperature. The first and the second peaks of fertility were recorded when heading occurred on April 4 and October 15, respectively. Fertility showed declining trend between periods April 1 and October 15 due to increase in the mean daily temperature. It revealed completely sterile period on heading between May 1 and August 12.

Relationship of fertility transformation and thermosensitive temperature

During both the periods of male fertility transformation ie. from fertility to sterility from April 4 to May 1 in the dry season and from sterility to fertility from August 12 to October 15 in the wet season, highly significant negative correlation of spikelet fertility with 30-20 and 15-days thermosensitive period temperatures was observed (Table 1). Thus it is evident that this TGMS line possessed strong thermosensitive response with respect to its male fertility.

Table 1. Correlation coefficients between spikelet fertility and thermosensitive temperature

Fertility	30-d daily temperature (^{0}C)		20-d daily temperature (^{0}C)		15-d daily temperature (^{0}C)	
(%)	Min.	Average	Min.	Average	Min.	Average
Dry season	-.981**	-.976**	-.851**	-.989**	-.974**	-.953**
Wet season	-.956**	-.955**	-.968**	-.865**	-.946**	-.755**

Thermosensitive temperature of the TGMS line

Table 1 indicated distinct relationship of daily minimum and average temperature in thermosensitive period with spikelet fertility. These temperature parameters were therefore, used to describe the thermosensitive nature of the TGMS line. In dry season, the critical thermosensitive temperature with respect to daily average for optimum fertility and complete sterility were 21.8 and 27.1 , 21.7 and 26.9 and 21.3 and 26.6 ^{0} C in 15 - 20 - and 30-d thermosensitive periods, respectively, and in wet season Corresponding temperatures were 26.2 and 29.1 , 26.8 and 28.9 and 26.5 and 28.5^0 C, respectively. Similarly, the critical thermosensitive temperature with respect to daily minimum was also indicated (Table 2). These results indicated low thermosensitive temperature nature of UPRI 95- 140 TGMS line.

Differences in the critical temperature between dry and wet seasons under north Indian conditions were observed. Higher critical temperature in WS was shown as compared to DS but the cause for this needed further investigation. However, the different transformation models operating for fertility to sterility in DS and just opposite of it in WS, the daily maximum and minimum temperature difference and the day length difference in dry and wet seasons may cause critical temperature difference between seasons. Photosensitivity response of the line, if any, must be very weak in nature and the line is considered a TGMS line due to its very strong thermosensitive response (Fig.1, Table 1 and 2).

Duration of sterility and fertility recovery

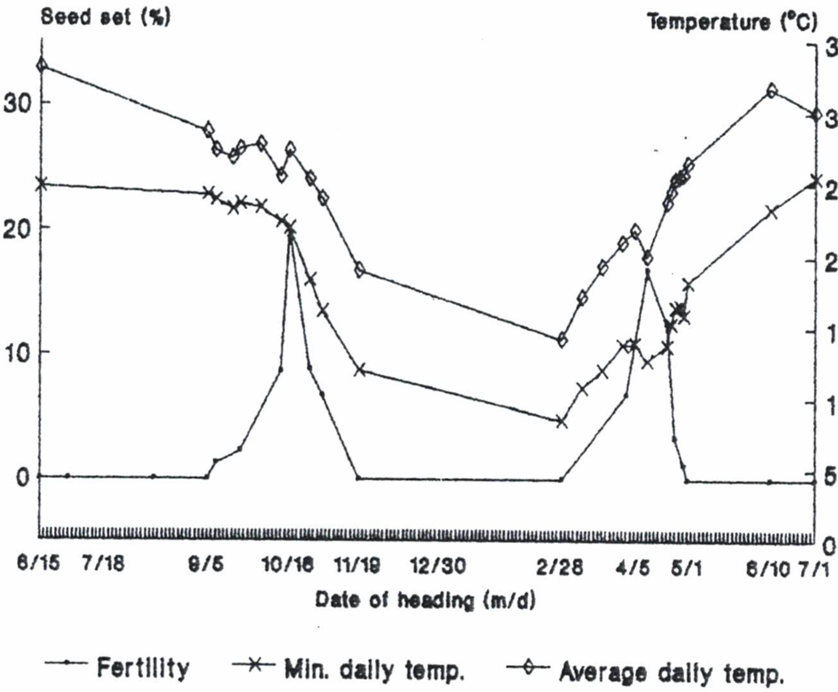
The line has shown very long duration of 104 days of sterility ranging between May 1 and August 12 under Pantnagar conditions in the northwest India. This period is suitable for taking up hybrid seed production in the region (Fig.1). Fertility recovery of more than 40% in both dry and wet seasons was indicated (Table 2). Therefore, seed multiplication of the TGMS parent can be easily taken up by choosing the most appropriate heading dates between mid April and May i.e. early summer or during the late wet season i.e. in the month of October. It is quite evident that the TGMS source has great potential for exploitation in hybrid breeding.

Table 2. Thermosensitive temperatures of the TGMS line (Pantnagar, 1995)

Date	Fertility	30-d daily temperature (^{0}C)		20-d daily temperature (^{0}C)		15-d daily temperature (^{0}C)	
(d/m)	(%)	Min.	Average	Min.	Average	Min.	Average
5/4	41.5	13.3	21.3	14.2	21.7	13.9	21.8
1/5	0.0	17.2	26.6	17.3	26.9	18.2	27.1
12/8	0.0	24.8	28.5	25.0	28.9	25.1	28.7
15/10	42.3	21.3	26.5	21.7	26.8	21.0	26.2

The exploitation of this line in the development of new and improved TGMS lines is in progress in our breeding programme through biotechnology and conventional methods. Several superior lines with different plant types and improved grain quality have been identified.

Fig. 1. The fertility transformation of UPRI 95-140 TGMS with relation to temperature.



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