ABSTRACT

Two-line system hybrid rice is an important technical innovation in hybrid rice seed production based on photo/thermo-sensitive genic male sterile (P/TGMS) lines in rice. The outcome of the research presented in this thesis was conducted to evaluate the newly PTGMS lines under natural conditions and to identify the PTGMS genes using molecular markers. The materials used in this study included Pei'ai64S as a control and four new PTGMS lines *viz*: NS30a, NS30f, NS30g, and NS30h. Fertility alteration characteristics, combining ability and standard heterosis were studied. The sensitivity response to temperature and daylength of the lines was discussed and fertility stability of lines was evaluated by AMMI model using pollen fertility (%), and also screening RAPD markers to identify PTGMS genes were analysed.

The main results are summarized as follow: Fertility alteration of selected PTGMS lines under natural conditions was determined by a consequence interaction between temperature and daylength. However, the temperature was the most important factor inducing fertility transformation in these lines.

The selected PTGMS lines were all sterile under the conditions of temperature >24^{0}C and daylength>13h, but they became fertile under low temperature (<24^{0}C) and daylength (<12.7h) and also these PTGMS lines were completely sterile between late July to early September. The critical sterility point (CSP) of Pei'ai64S was 22.4 °C and it was lower than that of the new PTGMS lines, which was ranged from 23.2°C-23.9 °C and the NS30g line had the lowest CSP (23.2 °C) among the new PTGMS lines. Also these PTGMS lines had responded to daylength in their fertility alteration, and the CSP of their photosensitive stage ranged between 12.7h-13h.

The selected PTGMS lines had clear three sensitive periods of fertility alteration: transformation period, sterility period and fertility period during the study period of two years. The sterility period of new PTGMS lines was 36- 38 days during 1999, while it was 42-54 days during the year 2000. The sterility period of Pei'ai64S (58 days) was longer than that of new PTGMS lines.

The correlation coefficient for thermo-sensitive stage of Pei'ai64S was significant from 6-21d and 9-24d before heading in 1999 and 2000, respectively, while it was significantly different among the new PTGMS lines during the two years and the most sensitive period of significant correlation between pollen fertility (%) of PTGMS lines and both daily minimum temperature and daylength was 15 days before heading. The sensitive stage of fertility transformation by temperature was from pistil and stamen formation to pollen mother cells (PMC) meiosis, and its effect was not accumulative. This study revealed that the fertility expression of selected PTGMS lines depended on its genetic properties itself and the ecological factors inducing the fertility alteration. Also this study suggested that the new PTGMS lines might belong to the type of photo-thermosensitive genic male sterility (PTGMS).

Pei'ai64S line had quite big positive interaction effect with environment more than the new lines. However, the new PTGMS lines showed small negative genotype-environment interaction effect suggesting that these lines have more stable fertility under high temperature and long day combination.

The characters of PTGMS lines were determined by the effects of general combining ability (GCA) and specific combining ability (SCA) of both the sterile and restorer lines, and the GCA was found to be more effective. Pei'ai64S was the best general combiner among sterile lines followed by NS30g line, while the Minghui63 was the best general combiner among the restorer lines followed by Sh623 line. Significant differences in combining ability among the PTGMS lines and positive correlation between the values of GCA and standard heterosis of hybrids were observed. The higher GCA of parents exhibited stronger standard heterosis in hybrids.

The results showed that the time of spikelets opening varied from one genotype to another and the time ranged between 10:00 am to 13:00 pm had the highest spikelets opening rate for all the lines. The total number of flowering per day was highest in Pei'ai64S followed by NS30g line. Also the longest period of spikelet opening was 4:30h in Pei'ai64S and it was longer than that of the new PTGMS lines, which was ranged from 2:24h-4:00h. The distance between opening spikelets tips was highest in Pei'ai64S (0.45cm) and the opening angle of spikelets was over 26° for all the lines, which was the highest in Pei'ai64S (30.3°), while it arranged from 26.6° to 29.1° in the new PTGMS lines. The results revealed that the Pei'ai64S (control) line had the highest rate of single SER, double SER and total SER followed by NS30g line, which had 71% SER and it was the best line among the new PTGMS lines in the SER. The proportion of single SER was higher than that of double SER for all selected PTGMS lines.

Only one single-copy sequence fragment was found, a 0.85-kbp fragment amplified by primer S8. It suggested that this primer was linked with the PTGMS genes of Pei'ai64S, but the distance is not known.

Keywords: Photo-thermo sensitive genic male sterile (PTGMS), Fertility alteration, AMMI model analysis, Fertility stability, Molecular markers, Combining ability, Flowering habits, Indica Rice

CONTENTS