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THERMOSENSITIVITY IN GENIC MALE STERILE LINES OF BARLEY (*HORDEUM VULGARE* L.)

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ABSTRACT

Forty six genic male sterile lines of barley sown at two different dates were tested for their sensitivity towards temperature. Seven genic male sterile lines exhibited seed setting of more than 30% at different temperatures. Of these, four msg 7, msg 17, msg 21 and msg 33 showed high fertility at lower temperatures (20.3 to 24.2°C) and complete sterility/partial fertility at higher temperature of 27.7°C. Three msg lines msg 10, msg 30 and msg 38 behaved conversely and showed fertility at higher temperatures (24-27°C) and complete sterility/partial fertility at lower temperature of 23°C. These thermosensitive msg lines can be used in two line hybrid seed production in barley after extensive study in controlled environmental conditions.

Key Words : Genic male sterility, thermosensitive stage, two line hybrids

Cytoplasmic-genic type of male sterility is most effective system for developing hybrids in most of the crops. But this system is cumbersome as it involves three lines (A, B & R), restricted to those germplasms where restores and maintainers are abundant and negative effects of sterile cytoplasm are also present. New vistas in hybrid breeding in self pollinated crops have been opened by successful development of two line hybrids in rice by Chinese breeders, using thermosensitive genic male sterile (TGMS) lines. A number of recessive genes causing male sterility have also been reported in barley [1] and temperature has been found to be a potent factor affecting the expression of male fertility in genic male sterile lines in barley [2]. These thermosensitive genic male sterile lines revert back to partial or full fertility under certain temperature regimes. Based on this concept, present study was conducted for initial testing of genic male sterile lines for temperature sensitivity for the progress of successful two line hybrid breeding programme in barley.

MATERIALS AND METHODS

The material consisted of forty-six genic male sterile lines msg 1 to msg 11, msg 13 to msg 41 and msg 43 to msg 48. Different temperature treatments were provided by sowing them at two different dates viz. 19th November 1996 and 12th December 1996 at Plant Breeding Research Farm, CCS HAU, Hisar for testing the thermosensitivity of these lines. Two rows of 2m length were sown for each line maintaining a row to row distance of 40 cm and plant to plant distance of 15 cm. Five spikes of male sterile plants in each line were bagged before flowering. Data was recorded for the flowering date for each line and seed set in percentage was calculated at the time of maturity. Temperature corresponding to each line for the thermosensitive stage which occurs around pollen mother cell formation and meiosis i.e. 2 weeks prior to flowering, for 2 days, was recorded and averaged for the period to test the thermosensitivity of genic male sterile line.

RESULTS AND DISCUSSION

Flowering date and seed set percentage of genic male sterile lines sown at two different dates, have been shown in Table 1. Temperatures in degree Celsius (°C) corresponding to per cent seed set in genic male sterile line at thermosensitive stage are given in brackets. Out of forty six genic male sterile lines, seven msg lines namely msg 7, msg 10, msg 17, msg 21, msg 30, msg 33 and msg 38 showed seed setting of more than thirty per cent, the minimum level of fertility induction recommended by rice breeders in China [3] for the development of two-line hybrids.

Four genic male sterile lines msg 7, msg 17, msg 21, and msg 33 showed seed setting in the range of 31.7 to 56.2% at lower temperature range of 20.3 to 24.2°C. Among these lines, msg 7 and msg 33 showed complete sterility at higher temperature of 27.7°C, thereby suggesting that higher temperature induces complete sterility/partial fertility and lower temperature induces high fertility in this group of lines. These results are similar as reported by [2] that high temperature induces male sterility in barley msg lines and also [4-6] in rice.

Three genic male sterile lines msg 10, msg 30 and msg 38 behaved conversely to first group and showed higher seed setting in the range of 32.0 to 37.7% in higher temperature range of 24.3 to 27.6°C. Among these, msg 38 showed complete sterility at lower temperature of 23.0°C and the other two showed semi-sterility at lower temperature. This leads to the conclusion that low temperature induces sterility/semi-sterility and higher temperature induces fertility in this group of lines. These results are in agreement with those reported in rice [7] and in onion [8].

Table 1. Seed setting percentage in genic male sterile lines of barley at two different sowing dates

msg No.	Date of flowering		Seed set (%)(a)		msg No.	Date of flowering		Seed set (%)(a)	
	E_1	E_2	E_1	E_2		E_1	E_2	E_1	E_2
msg 1	28/2/97	12/3/97	0.0	8.83	msg 25	25/2/97	15/3/97	17.8	0.0
msg 2	1/3/97	14/3/97	17.8	0.0	msg 26	21/3/97	2/4/97	0.0	0.0
msg 3	25/1/97	22/2/97	5.1	0.0	msg 27	28/2/97	14/3/97	10.3	0.0
msg 4	21/2/97	12/3/97	8.3	0.0	msg 28	13/2/97	6/3/97	0.0	0.0
msg 5	3/3/97	16/3/97	15.4	16.6	msg 29	28/2/97	16/3/97	9.7	0.0
msg 6	24/2/97	13/3/97	0.0	0.0	msg 30	3/3/97	18/3/97	7.8 (23.2°C)	31.9 (24.3°C)
msg 7	24/12/97	11/3/97	46.1 (23.8°C)	0.0 (27.7°C)	msg 31	3/3/97	8/3/97	0.0	0.0
msg 8	24/2/97	12/3/97	0.0	0.0	msg 32	25/2/97	10/3/97	10.5	0.0
msg 9	20/2/97	6/3/97	0.0	0.0	msg 33	25/2/97	10/3/97	31.8 (24.2°C)	0.0 (27.7°C)
msg 10	3/3/97	18/3/97	16/6 (23.0°C)	32.0 (24.3°C)	msg 34	16/2/97	5/3/97	0.0	0.0
msg 11	25/2/97	15/3/97	24.9 (24.2°C)	0.0 (26/7°C)	msg 35	21/2/97	4/3/97	0.0	3.6
msg 13	24/2/97	15/3/97	25.5 (23.8°C)	0.0 (26.7°C)	msg 36	28/2/97	12/3/97	0.0	11.1
msg 14	27/2/97	18/3/97	0.0	0.0	msg 37	1/3/97	15/3/97	18.8	0.0
msg 15	20/2/97	4/3/97	11.8	0.0	msg 38	3/3/97	13/3/97	0 (23.0°C)	37.7 (27.6°C)
msg 16	25/2/97	13/3/97	10.6	0.0	msg 39	17/2/97	8/3/97	0	0
msg 17	7/3/97	26/3/97	56.2 (23.1°C)	27.1 (29.0°C)	msg 40	22/2/97	24/2/97	0	0
msg 18	21/2/97	28/3/97	0.0	10.4	msg 41	26/2/97	10/3/97	0	0
msg 19	13/2/97	15/3/97	0.0	0.0	msg 43	26/2/97	12/3/97	0	0
msg 20	26/2/97	15/3/97	22.2 (22.1°C)	0.0 (26.7°C)	msg 44	25/1/97	24/2/97	0	0
msg 21	18/2/97	26/2/97	31.7 (20.3°C)	22.4 (22.1°C)	msg 45	31/1/97	15/3/97	0	0
msg 22	2/3/97	12/3/97	12.5	17.3	msg 46	1/3/97	14/3/97	0	0
msg 23	25/2/97	11/3/97	0.0	0.0	msg 47	28/2/97	15/3/97	0	0
msg 24	25/2/97	12/3/97	22.1 (24.2°C)	0.0 (27.5°C)	msg 48	3/2/97	18/3/97	10.66	0

(a) Temperatures in degree celsius (°C) at thermosensitive stage corresponding to percent seed set are given in brackets. Date of sowing of E_1 is 19/11/96 and that of E_2 is 12/12/96

Four genic male sterile lines msg 11, msg 13, msg 20 and msg 24 showed seed setting in the range of 22 to 26% in lower temperature range of 22.1 to 24.2°C and were completely sterile at higher temperature range of 26.7 to 27.5°C indicating their thermosensitive behaviour inclined towards first group of genic male sterile lines.

In this study temperature was found to be a potent factor affecting the expression of male sterility in msg lines. One group of msg lines i.e. msg 7, msg 17, msg 21 and msg 33 showed fertility at lower temperatures and complete or partial sterility at higher temperatures, while another group of lines i.e. msg 10, msg 30 and msg 38 behaved conversely in their response to temperature.

The thermosensitive genic male sterility system.(TGMS) is considered to be useful in tropical areas where temperature differences exist between low and high altitudes [5] and the thermosensitive lines can be used for hybrid seed production. India, being a tropical country, the thermosensitive lines identified in this study can be exploited for two line hybrid barley breeding after extensive studies under controlled environmental conditions.

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