Indian J. Genet., **61**(2): 140-142 (2001)

Inheritance of photoperiod sensitivity in jute (*Corchorus olitorius* L.)

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(Recised: July 1999; Revised: April 2001; Accepted: April 2001)

Abstract

Seeds of two parents (German - a photoperiod insensitive mutant and JRO 7835 - a photoperiod sensitive variety), F_1, F_2, F_3, BC_1 and BC_2 were sown in the field in natural condition on the 15th of both February and May (short and long day period respectively). The mutant and F_1 hybrids flowered after a fixed period of 35 and 67 days respectively irrespective of sowing time whereas the other parent (JRO-7835) being photoperiod sensitive flowered after 42 and 104 days for sowing in February and May respectively. The F_2 population showed three distinct groups with respect to flowering habit in the ratio of 1:2:1. (mutant : $2F_1$: JRO 7835). The backross population exhibited segregation in 1:1 ratio. F_3 population had three groups and out of that two were true breeding and the rest group segregated in 1:2:1 ratio for sowing in both February and May. The segregation patterns showed that photo-period sensitivity is a simple monogenic trait (PPS) and it is incompletely dominant over photoperiod insensitivity (pps).

Key words : Jute, photo-period sensitivity, inheritance

Introduction

The *olitorius* and *capsularis* jute (*Corchorus olitorius* and *C. capsularis*) are short day plants and their critical photoperiod is around 12.15 hours with slight variation depending on the varieties. But photo-period insensitive mutants belonging to both species have been reported [1-4]. All these mutants flower at a fixed time whenever sown during the jute season. The inheritance pattern of photoperiod sensitivity of *C. capsularis* (white jute) has been reported by Basu and Hossain [1] and Joshua and Thakare [4]. But the genetics of the trait in *olitorius* jute has not been worked out.

The aim of the present study was to study and confirm the inheritance pattern of photo-period sensitivty in jute.

Materials and method

The reciprocal F_1 hybrids were raised by crossing photoperiod sensitive standard *olitorius* variety, JRO 7835, and insensitive mutant designated as 'German'. The performance of F_1 hybrids were noted and reciprocal backcrossings were made. The F_2 seeds were collected by selfing the F_1 plants. Fresh F_1 seeds were also raised. The F_1, F_2 and back-cross seeds were sown on 15th February (having short day) and on 15th May (having long day). Germination of all seeds were completed by 5th day after sowing. The seeds of three groups appearing in the segregating F_2 population and back-cross seeds were collected and sown in next year on 15th February and 15th May as before. The data were collected at the appearance of first flower.

Results and discussion

The photo-period insensitive mutant (German) flowered in around 35 days irrespective of sowing time. This shows the photo-period insensitivity of the mutant. On the other hand, JRO 7835 flowered after 42 days for February sowing (day length 11.13 hours) and after 103 days for May sowing (day length 13.07 hours). These signify its photo-period sensitivity. For sowings in February and May, it flowered at the end of March and August respectively when day length was around 12.30 hours. This trend confirms the photo-period sensitivity of JRO 7835. This day length (12.30 hours) is supposed to be the critical photo-period for JRO 7835 (Table 2).

The day-length increased from 11.13 hours (on 15th February) to 13.07 hours on 15 May upto 13.28 hours on 21st June and then decreased onwards upto 12.13 hours on 15th Sept. Hence, the photo-period-sensitive parent, 'JRO 7835' (being sown in May) did flower at the end of August when the critical photo-period was attained. This parent (being sown in February) had early flowering due to the prevailing day-length being below critical photo-period (Table 1).

The photo-period insensitive mutant of Capsularis jute has also been reported by Hossain and Sen [2] and Joshua and Thakars [3] and these mutants had

Table 1. The day length (Sun rise to Sun set) during the period of the experiment was as follows :

Month (on 15th day)	February	March	April	May	June	July	Aug.	Sept.
Day length: inhours (H) and Minute (M)	11 13 H M	11 51 H M	12 32 H M	13 07 H M	13 21 H M	13 19 H M	12 52 H M	12 13 H M

Table 2. Pattern of flowering in parents, F_1, F_2, F_3 and back-cross progenies (BC_1, BC_2) sown under both short and long day periods

Types	Sowing on 15th Feb. (short day)		Sowing on 15th May (long day)		Ratio for both sowing	Estimated χ^2 value	Significant χ^2 at P = .05 P = .01
	Days to flower	Frequency	Days to flower	Frequency			
parent							
Mutant	35	all (156)	35	all (181)			
JRO 7835	42	all (170)	103	all (193)			
Hybrids							
F_1	68	all (236)	68	all (279)			
F_2-gr.I	35*	202	36*	292			
Gr.II	67**	413	67**	645	1:2:1	2.17	5.99
Gr.III	42**	195	103**	321		0.34	9.21
F_3 - A	35*	all (308)	35*	all (309)			
	35*	483	35*	209			
B	67***	987	68***	397	1:2:1	.054	5.99
	41**	506	105**	198		.43	9.21
C	42**	all (391)	104**	all (373)			
Back-cross							
BC_1	35*	324	35*	290	1:1	2.00	
	68***	361	67***	301		0.20	3.84
BC_2	68**	241	67***	339		1.33	6.63
	41**	267	103**	367	1:1	1.11	

*like mutant parent; **like JRO 7835 parent; ***like F_1

floral initiation after respective fixed vegetative periods irrespective of sowing time.

The F_1 hybrids ('German' × 'JRO 7835') exhibited floral initiation after 68 days for both sowings in February and in May just like photo-insensitive parent "German" (Table 2). The fixed period for initiation of flowering in the F_1 hybrids indicates their photo-period-insensitiveness.

Three distinct groups of plants (with respect to flower initiation) were observed in the segregating F_2 population for both sowings in February and May. One group had flower initiation in 35 days like mutant, second group in 67 days like F_1 hybrids for both sowings, while third group took around 42 days and 103 days for flowering after germiantion sown in February and May respectively. Those three groups were in distinct ratio of 1:2:1 confirmed by χ^2 test (Table 2). The segregation pattern clearly show incomplete dominance of photo-period sensitivity.

The BC_1 progeny exhibited two groups of plants in 1:1 ratio one group flowering like F_1 in 67-68 days and other group flowering like mutant in 35 days for sowing in both February and May. On the other hand BC_2 progeny also showed two groups of plant in 1:1 ratio - one group flowering in 67 to 68 days like F_1 and other group flowering in 41 and 103 days like sensitive parent (JRO 7835) for sowing in February and May respectively.

In F_3, out of the three groups of plants (with respect to flowering) identified in F_2 generation two parental types were true breeding while the third group showed segregation in 1:2:1 ratio as in F_2 generation (Table 2). This result also confirmed the incomplete dominance of photo-period sensitivity of *olitorius* jute over photo-period insensitivity.

The chi-square tests for segregation in the segregating generation of F_2 and F_3 (the group like F_1 appearing in F_2) confirmed 1:2:1 ratio and the ratio in both reciprocal back crosses, BC_1 and BC_2 was 1:1 (Table 2). These segregations in the above ratios distinctly confirm the monogenic inheritance of photoperiod sensitivity having incomplete dominance over photo-period insensitivity.

The results of this experiment confirm the observation of Joshua and Takare [4] in Capsularis jute. Basu and Hossain [1] also reported partial dominance of photo-period sensitivity over insensitivity in F_1 generation but continuous distribution of flowering in F_2 generation exhibiting polygenic control for flowering. The genic symbols for photo-period sensitivity and insensitivity as *PPS* and *pps* respectively are appropriate.

The whole experiment was conducted under natural conditions and known and unknown factors for initiation of flowering were automatically involved though the naturally occuring variation in day-length was taken into consideration. Hence, the results of this experiment are quite convincing.

References

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