Evaluation for stigma receptivity in cytoplasmic male sterile lines of *Brassica juncea* L.Czern & Coss

S. K. Chakarbarty, Shiv K. Yadav, J. B. Yadav

Division of Seed Science and Technology, Indian Agricultural Research Institute, New Delhi- 110012
Email: skchakra_sst@yahoo.com

Abstract

Field experiment conducted for two years indicated that the seven CMS lines of *Brassica juncea* differed for stigma receptivity. Stigma receptivity was recorded up to 10 days in *Ogura, Moricandia and Erucoides* systems. Peak stigma receptivity was observed two to three days after flower opening in case of *Siifolia, Erucoides* and *Moricandia* (green). It was suggested that *Ogura and Moricandia* (green) could be useful for hybrid development and seed production.

Key words: CMS lines, *Brassica juncea*, stigma receptivity, artificial pollination

Development of hybrids in field crops lead to higher productivity and production in field crops. Use of male sterility system is one of the means to develop hybrids. Heterosis in *Brassica spp*. is a well-known phenomenon (Labana *et a*l., 1975; Banga and Labana, 1983; Anand, 1987; Pradhan *et a*l., 1993). A number of cytoplasmic male sterility (CMS) systems have been developed in *B. juncea* (Rawat and Anand, 1979; Prakash, 2001). Identification of fertility restorer is another pre-requisite. However, use of CMS lines for hybrid seed production depends upon the production potential of CMS lines in a specific heterotic cross combination.

Brassica juncea, a major oil crop in India, is predominantly self-pollinated in nature. Insects mainly (honey bees) act as pollen vectors effecting pollination to a great extent. Stigma receptivity is important for out crossing, fertilization and hybrid seed production. Stigma of *B. juncea*, in general, becomes receptive 3 days prior to its opening and remain receptive up to 3 days after opening of flower (Rai, 1991). A longer period of stigma receptivity of CMS line is desirable for higher seed production. Little information is available in this respect. Therefore, a study was made to understand duration of receptivity of stigma of CMS lines of Indian mustard and the results are presented in this paper.

Materials and Method

Seven CMS lines of *B. juncea* in Pusa Bold (PB) background were grown in winter season of 2001-2, and 2002-3 in the field of Indian Agricultural Research Institute, New Delhi. Pusa Bold plants were grown along with the CMS lines as pollen parent. Male sterility plants of CMS lines were identified and tagged. Unopened flower buds likely to open in the inflorescence were covered with butter paper bag. Open flower and immature buds were removed. Flowers were pollinated manually from the day it opened. Pollination were done up to 8 days in 2001–2 on different sets of flowers already covered before opening with fresh pollen of PB. The pollinated flowers were covered after pollination. After observing the result of 2001-02, pollination was extended for two more days i.e., upto 10 days in 2002-03. A similar set was kept for this study under open pollination in 2002-03. The experiment was conducted on 5-10 inflorescence with 5-15 developed buds in each inflorescence of the CMS lines in peak flowering period. Data were recorded on number of pods set with seeds per siliquae on the pollinated flowers of each CMS line.

Results and discussion

There was a reduction of siliquae setting and development up to 8 days from flower opening in all the CMS lines. The number of siliquae with seed declined drastically with an increase in flower age before pollination (Table1).

Table 1. Seed bearing siliquae (*per cent*) after pollination in CMS lines of *B. juncea* (2001-02)

CMS line	Siliquae set (%) after pollination (days)							
	1	2	3	4	5	6	7	8
Oxyrrhina	100	96	80	80	82	68	60	56
Siifolia	100	85	65	56	50	50	45	40
Erucoides	100	70	54	36	32	27	25	12
Ogura	100	92	70	65	50	55	35	30
Tournefortii	85	55	33	18	15	12	10	12
Moircandia(green)	95	85	70	72	65	48	45	21
Moricandia(chlorotic)	70	52	34	28	25	22	26	18

Oxyrrhina CMS showed maximum *percent* siliquae set even after 8 days of flower opening indicating a longer period of

stigma receptivity. A reduction in number of seeds set per siliquae was recorded with increased flower age also. Two to four seeds per siliquae were recorded in all the CMS lines except in *Tournefort*i on 8th day after flower opening (Table 2).

Table 2. Seed setting after artificial pollination in CMS lines of *Brassica juncea* (2001-2)

CMS Line	Mean number of seeds/pod after pollination (days)							
	1	2	3	4	5	6	7	8
Oxyrrhina	10	10	9	7	5	4	3	2
Siifolia	9	8	6	5	5	4	4	3
Erucoides	11	9	7	6	6	5	5	4
Ogura	13	12	10	7	6	5	5	4
Tournefortii	5	4	2	2	2	1	1	0
Moricandia(green)	11	10	10	9	9	8	4	3
Moricandia(Chlorotic)	9	6	5	5	5	4	5	2

In the flowering year, the study was extended up to 10 days in both open pollination and artificial pollination situations. The result indicated slight reduction of pod setting up to 6 days in most of the CMS lines except *Moricandi*a (chlorotic) and *Tournefortii* (Table3). *Tournefortii* has deformed style and stigmatic surface. *Oxyrrhina*,Ogura, *Moricandia* (green) and *Moricandia* (chlorotic) showed one seed per siliquae when pollinated artificially with pollens of PB on 10th day (Table 4). *Tournefortii* had the lowest number of seeds per siliquae even on the 1st day of flower opening both under open pollination and artificial pollination conditions (Table-4).

Table 3. Seed bearing siliquae (*per cent*) after pollination in CMS lines of *B. juncea* (2002-3)

CMS line	Siliquae set (%)after pollination (days)									
	1	2	3	4	5	6	7	8	9	10
Oxyrrhina	97	96	86	85	82	61	68	70	22	17
Siifolia	72	72	60	54	52	50	48	46	25	16
Erucoides	71	50	42	39	43	37	31	8	9	8
Ogura	85	75	65	65	55	53	41	31	24	14
Tournefortii	25	25	13	13	12	13	10	10	0	0
Moricandia (green)	89	89	76	72	61	45	41	15	18	12
Moricandia (chlorotic)	55	43	24	21	25	24	22	26	8	2

Table 4. Seed setting after pollination in CMS lines in *B.juncea* (2002-3)

CMS line	Mean number of seeds/pod after pollination (days)										Control
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Oxyrrhina	7	6	4	5	3	3	3	2	2	1	10
Siifolia	7	8	5	5	5	4	3	3	1	0	10
Erucoides	8	8	7	5	5	4	4	5	3	0	10
Ogura	12	7	8	5	6	5	6	4	2	1	12
Tounefortii	2	2	1	2	1	2	2	0	0	0	7
Moricandia (green)	9	10	10	7	9	8	4	1	2	1	12
Moricandia (Chloritic)	9	7	5	3	5	4	5	3	2	1	10

A critical observation of data on number of seeds per siliquae obtained after pollination indicated that maximum number of seeds were set on 2nd day after flower opening in *siifolia* and *Erucoides* while on 2nd and 3rd day in *Moricandia* (green). In *Moricandia* a prolonged period of stigma receptivity up to 6 days was recorded giving 8 seeds/ siliquae (Table-4). This indicated the peak stigma receptivity in these three CMS lines could be 2-3 days after flower opening.

The CMS lines possessing longer duration of stigma receptivity is useful for higher seed production. In our study a difference in *per cent* seed set under controlled condition compared to open pollination among CMS lines was observed. The CMS lines differed to produce at least 50 *per cent* seed per pod compared to its potential after an interval of flower opening under open pollination. *Erucoides* had longer duration (8 days) compared to *Ogura* and *Moricandia* (chlorotic) (7 days) and *Moricandia* (green)(6days). In *Oxyrrhina* lower than 50 % seed set was recorded after 4 days of flower opening (table 4). Therefore, *Erucoides*, *Ogura* and *Moricandi*a would be desirable for hybrid seed production.

Maximum stigma receptivity in *B. juncea* was reported to be one day before the opening of flower (Labana and Banga, 1984). Difference in stigma receptivity could be due to genetic reasons. Maximum stigma receptivity in CMS lines of *B. juncea* was recorded one day before anthesis. It declined gradually till 3-5 days and drastically thereafter. However, stigma remained receptive for 6-8 days after anthesis (Mankar, 2000). He also observed a difference in stigma receptivity in CMS lines. *Oxyrrhina* and *Siifoli*a had lower stigma receptivity (up to 6 days) as compared to that of *Tournefortii* (up to 8 days).

Thus, it can be concluded that on the basis of stigma receptivity and its favourable effects on the period of seed set and its

number the CMS lines, namely *Ogura* and *Moricandi*a (green) could be used successfully for hybrid development.

Acknowledgement

The guidance and facilities provided by Dr. S.P. Sharma, Dr. N.C. Singhal and late Dr. Rajendra Kumar of Division of Seed Science Technology, IARI for conducting the experiments is acknowledged. We are grateful to Dr.Shyam Prakash of NRCPB, New Delhi for providing the seeds of CMS lines and all scientific inputs.

References

Anand I.J. (1987). Breeding hybrids in rapeseed and mustard. In: Proc.7th Int .Rapeseed Conf., Poland, pp. 79-85.

Banga, S.S. and Lavana K.S.(1983). Heterosis in Indian mustard. *Brassica juncea* (L.) Coss. Z. Pflanzenuecht, 92:61-70.

Lavana K.S. and Banga, S.S. (1984). Floral biology in Indian mustard (*Brassica juncea* (L.) Coss. Genetica- Agraria 38(2) : 131-138.

Lavana K.S., Badawal, S.S. and Chaurasia, B.D.(1975). Heterosis and combining ability analysis in (*Brassica juncea* (L.) Czern. & Coss. Crop improvement. 2: 46-51 .

Mankar, K.S. (2000). A technology for the exploitation of hybrid vigour in Indian mustard (*Brassica juncea* (L) Czern . & Coss) in absence of restorer system . Ph.D. thesis submitted to the P.G. School, IARI, New Delhi.

Pradhan,A.K.; Sodhi, Y.S.; Mukhopadhya, A; and Pental A.S. (1993). Heterosis breeding in Indian mustard (*Brassica juncea* (L.) Czern & Coss : Analysis of component characters contributing to heterosis for yield . Euphytica, 69: 219 –229.

Prakash S. (2001). Utilization of wild germplasm of *Brassica* allies in developing cytoplasmic male sterility – fertility restoration system in Indian mustard (*Brassica juncea*) . In: H. Liu. & Fu, T. (Eds.) Proc. Int. Symp. Rapeseed Science, Science Press, New York. pp. 63-67.

Rai, B. (1991). Seed Production. In: Oilseed *Brassica* in Indian Agriculture, (Eds.Chopra V. L and Shyam Prakash (xiii) Har Anand Publications, Vikas Publishing House Pvt. Ltd., New Delhi pp. 241-256.

Rawat, D.S. and Anand, I.J. (1979). Male sterility in Indian mustard. J. Genet. Pl. Breed. 39: 412- 415.