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Comparative Study of Five CMS System of India Mustard (*Brassica juncea*) with their maintainer, Based on floral Biological Characters

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Abstract

The freshly opened flowers were randomly chosen from the main shoot of each of the male sterile system and their maintainer at time when entire line was in full bloom. On critical observation following deformities were recorded in male sterile flowers of five male sterility systems In general all the male sterile line were late in flowering and with smaller flowers in comparison to their maintainer. On comparison of flowers parts as petal, anthers, stamins and carpel length was found that the male sterile lines were smaller than their maintained.

Keywords: Agra, Floral Biological Characters, Male Sterility mustard

INTRODUCTION

Cyloplasmic male Sterility cms system in cruciferaei was discovered for the first time by *Ougra* [8] in *Raphanus sativus.* According to Kaul [6] male sterility is caused by alterations in differentiation and development of the androecium so that no viable pollen is produced. The action at the ms gene is highly diverse, ranging from complete absence to the promotion at maldeveloped androecium.Thus, the stamens may be absent, aborted deformed or transformed into other floral or foliar structures which may be referred to as sepaloidy, petaloidy, staminoidy, carpeloidy and phylloidy.

Since a good number of cms line are available in Indian mustard now a days it is desirable to have a complete data base for their identification at the flowering stage. The present investigation to work out the floral characters in five male sterile line along with their maintainer include length of petal, Anther, stamen and carpel. The seed of cms *Ogura,* cms *Tournefortii,* cms *Oxyrrhina,* cms *Moricandia* and cms *Trachystoma* with their maintainer were sown in R.B.S College Agricultural Research Farm, Khandari, Agra.

MATERIAL AND METHOD

The Experimental material comprises five cms line along with their maintainer. These cms lines are of the following cytoplasmic background *Ogura* system, *Tournefortii* system, *Oxyrrhina* system, *Moricandia arvensis* system and *Trachystoma* system. The present experiment was conducted during 1999-2000 and 2000-2001 at R.B.S College Agricultural Research Farm, Agra. This experiment is will be comprised at different male sterility systems along with their maintainer lines. A single row of each above materials was planted for the study.

Ten freshly opened flowers randomly chosen from the main shoot of each germplasm were utilized for recording the following characters: petal size, length of stamen, length of anther, length of carpet these four parts of flowers was measured in millimeters. And pollen viability test with acteocarmine stain method was conducted on freshly open flowers. At time of anthesis anthers were separately crushed on the slide and their pollen grains were immediately stained, five fields of microscopic observations from each slide were calculated for the average value of viable and non viable pollen grain in each flower.

Observation

Flowers in the cruciferae family are characteristically four-petaled, the petals bifurcate with varying degrees of incision, and deep yellow to pale yellow or cream in colour. There are six stamens, four medium with long and two lateral with short filaments.The anthers are at lower level than the stigmas at bud stage, but prior to flower opening the filaments elongate and carry the anthers upward so that they are as high as or above the stigma. The flowers begin to open before 8 am and continue to open until about noon. The flowers remain open for 3 to 4 days after which the petals, sepals and stamens are shed.

The freshly opened flowers were randomly chosen from the main shoot of each of the male sterile system and their maintainer at the time when entire line was in full bloom. On critical observation following deformities were recorded in male sterile flowers of five male sterility systems: In general all the male sterile lines were late in flowering and with smaller flowers in comparison to their maintainers. The male sterile flowers in *Trachystoma* and *Tournefortill* system were smallest (Fig 1.).

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Fig 1. Flowers of male sterile and their maintainer lines showing variation in size (A) male sterile flower (B) flowers of maintainer lines.

The *Trachystoma* male sterile line was late in flowering by 6-7 days while *Ogura, Tournefortii* and *Oxyrrhind* were late by 10-12 days. Flowering in *Moricandia* male sterile system was delayed by 30-35 days, making it difficult to pollinate with its maintainer line. To overcome these difficulty plants of the maintainer lines were pruned before initiation of flowering and thus some flowers on newly emerged branches of maintainer lines were obtained for pollination.

In *Ogura, Tournefortii* and *Trachystaoma* male sterile systems many flower buds on the inflorescence did not open. Most of them did not develop in to fruits and abscised after several days. In *Tourefortii* and *Trachystoma* rarely a "cleistogamous bud may develop into a fruit (figs. 2 A & B) On close examination it was found that these buds had protruded stigmatic lobes which might have facilitated cross pollination.

(A) In cms *Tourefortii* (B) in cms *Trachystoma*

Fig 2. Showing unopened flower buds on inflorescence

Petaloid anthers have been recorded in T*ournefortii* and *Trachystoma* male sterile lines. The number of petaloid stamens in a flower may vary from one to four. Various stages of petaloidy are observed in these flowers (Fig.3). In the petaloid stamens the number of anther lobes were also reduced (fig. 4 A & B).

Fig.3 Petaloid stamers (in upper row) in Trachystoma male sterile and normal stamens in its maintainer line.

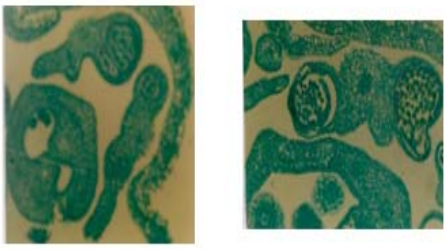

Fig.4 (A-B) Showing reductions in sporangia in the anthers.
(A) *Tournefortii* (B) *Trachystoma*

The gynoecia along with nectary glands of male sterile lines when compared with their maintainer lines were found smaller (fig 5 A & D). The petaloid stamens are generally found fused with the gynoeciaum in *Tournefortii,* the styles in such gynoecia are crooked in *Trachystoma.* The splitting of stigmatic lobes was also seen along with other abnormalities of stamens.

(A) (B) (C) (D)

Fig. (5) (A-D) Flowers of male sterile plants alongwith maintainers showing comparative account of nectary glands, petals and gynoecia.
(A) *Ogura* (B) *Tournefortii*
(C) *Oxyrrhina* (D) *Trachystome*
Male sterile flowers are arranged on left side.

The average length of petal varied from 8.06 to 9.76 mm in male sterile lines. The maximum petal length of 9.76 mm was attained by *Oxyrrhina* and *Trachystoma* genotypes whereas minimum length (11.00mm) of petal in maintainer lines was observed in *Moricandia* genotype and the minimum (9.96mm) in *Tourneforill* maintainer line. On the other hand, maximum length (11.00mm) of petal in maintainer lines was observed in *Moricandia* genotype and the minimum (9.96mm) in *Tourneforii* maintainer line. On comparison of length of petal in male sterile lines with their maintainers it was found that length of petal in male sterile lines with their maintainers it was found that length of petal of maintainer line was always larger than their male sterile lines.

When analyzed statically the difference in the length of petal was found significant at 1 percent probability level in Ogura, *Taurneforii,Moricanda* and *Trachystoma* genotypes and at 5 percent probability level in *Oxyrrhina* genotype (Table-01).

The average length of anthe valied from 1.5 to 2.84 mm in male sterile lines. The maximum anther length (2.84mm) was attained by *Trachystoma* genotype whereas minimum (1.15mm) by *Tourneforii* male sterile plants. On the other hand, maximum (2.26mm) length of anther in maintainer line was observed in *Ogura* genotype and the minimum (2.12mm) in *Trachstoma* genotype. On comparison of length of anther in male sterile lines with their maintainers it was found that length of anther of maintainer line was larger the male sterile lines except in *Trachystoma* genotype which showed slightly, larger anther than its maintainer.

When analyzed statistically the difference in the lingth of antherof anther was found significant at 1 percent probability level In *Ogura*, *Tourneforii Moricandia* and *Trachystoma* genotype. In *Oxyrrhina* system the variation in the length of anther lobes in male sterile as well as in its maintainer line remained insignificant (Table-01).

The average length of stamen varied (5.38 to 6.52 mm) in male sterile lines. The maximum length (6.52 mm) was attained by *Moricandia* whereas minimum (5.38 mm) by *Oxyrrhina* male sterile plants. On the other hand, maximum length (9.04 mm) of stamen in maintainer line was observed in Ogura genotype and the minimum (8.31 mm) in *Trachystoma* genotype. On comparison of length of stamen in male sterile line with their maintainer it was found that length of stamen of maintainer line was larger than their male sterile lines.

When analyzed statistically, the difference in the length of stamen was found significant at 1 percent probability level in all the five systems (Table -01).

(Table-01) – Genetic Variability of floral biology in male sterile and maintainer lines of Indian mustard (*Brassica juncea*).

		Ogura		*Tournefortii*		*Oxyrrhina*		*Moricandia*		*Trachystoma*	
Characters	Parametars	A	B	A	B	A	B	A	B	A	B
Petal length In mm	Mean±	8.06±.36	10.10±.42	8.13±.18	9.96±.15	9.76±.06	10.54±.29	9.73±.16	11.00±.27	9.76±.15	10.43±.14
	Range	6.50-9.50	8.00-12.00	7.20-9.00	9.20-10.60	9.50-10.00	9.30-12.00	9.00-10.50	10.00-12.50	9.00-10.50	10.00-11.50
	t-value	3.70**		7.92**		2.57*		4.11**		3.19**	
Anther length In mm	Mean±	1.98±.06	2.33±.05	1.50±.08	2.22±.07	2.13±.08	2.25±.05	1.89±.03	2.26±.06	2.84±.33	2.12±.21
	Range	1.70-2.30	2.00-2.50	1.00-1.90	1.90-2.50	1.70-2.50	2.00-2.50	1.70-2.00	2.00-2.50	1.70-2.00	2.00-2.20
	t-value	2.99**		6.53**		1.16NS		5.64**		4.59**	
Stamin length In mm	Mean±	5.67±.08	9.04±.14	5.68±.07	8.42±.12	5.38±.25	8.56±.11	6.52±.36	8.39±.19	6.37±.33	8.31±.05
	Range	5.20-6.00	8.20-9.70	5.40-6.00	7.90-9.00	4.00-6.50	8.00-9.00	5.00-8.00	7.50-9.10	8.31-.05	8.00-8.50
	t-value	20.80**		18.85**		11.72**		4.57**		5.70**	
Carpel length In mm	Mean±	7.19±.30	7.29±.25	7.14±.70	7.24±.70	7.67±.25	7.87±.06	6.25±.24	7.48±.12	6.72±.06	8.84±.19
	Range	6.20-8.50	6.00-8.50	7.40-8.00	6.50-7.50	7.40-8.00	7.00-9.50	5.00-7.00	7.00-8.00	6.50-7.00	8.00-9.60
	t-value	.250NS		4.17**		.75NS		4.49**		10.57**	

*=Significant at 5 percent probability level.
**= Significant at 5 percent probability level.
NS=Not Significant.

The average length of carpel varied from (6.25 to 7.67 mm) in male sterile lines. The maximum carpel length (7.67 mm) was attained by *Oxyrrhina* male sterile genotype. Whereas minimum (6.25 mm) by *Moricandia* male sterile plants. On the other hand, maximum length (8.84 mm) of carpel in maintainer line was observed in *Trachystoma* genotype and the minimum (7.24 mm) in *Tourneforii* maintainer genotype. On comparison of length of carpel in male sterile line with their maintainers it was found that length of carpel of maintainer lines was larger than their male sterile plants.

When analyzed statistically the difference in the length of carpel was found significant at 1 percent probability level in *Tournforii, Moricandia* and *Trachystoma* genotypes. In rest of the two systems length of carpel in between male sterile and their maintainer lines remained insignificant (Table -01).

Percentage of pollen viability was recorded in five cms lines and their maintainers. When stained with acetocarmine stain, nonviable pollen grains were characterized by their shriveled nature and lack of granular cytoplasm.

The data recorede is processed and presented in the following (Table 02). The perusal of table reveals that, maximum percentage of viable pollen grains occurred in Trachystoma (16.70) male sterile system followed by *Tourneforii, Moricandia,Oxyrrhina* and *Ogura*

cms lines. On selfing of these male strile lines, viable seed formation could not be achieved in any case.

(Table-02)- Pollen viability in five male sterile and maintainer lines of Indian mustard (*Brassica juncea*).

Name of system	Male sterile		Maintainer	
	Fertility %	Sterility %	Fertility %	Sterility %
Ogura	5.00	95.00	97.10	2.90
Tournefortii	13.70	86.30	98.00	2.00
Oxyrrhina	7.00	93.00	96.00	4.00
Moricandia	13.00	87.00	90.35	9.65
Trachystoma	16.70	83.30	97.00	3.00

RESULT AND DISCUSSION

Floral characters studied in five male sterile lines along with their maintainers include length of petal, anther, stamen and carpel. Some deformities were also recorded in male sterile flowers of *Tournefortii* and *Trachystoma*.

On comparison of petal it was found that male sterile petals were significantly shorter as compared to the maintainers petal. Badwal and Labana [1], Gupta *et al.,* [5], Ram Bhajan *et al.,* [3] also reported the same event in male sterile plants of Indian mustard.

On comparison of anther length it was found that the male sterile anthers were significant smaller than their maintainer in cms *Ogura*, *Tournefortii*, *Oxyrrhina* and *Moricandia* whereas in *Trachystoma* system the anther in the flowers of male sterile plants were larger than its maintainer plants. Brar *et al.,* [2], Rao *et al..* [9], Das and Pandy [4], Ram Bhajan *et al.,* [3], Gupta *et al.,* [5], Malik *et al.,* [7] reported that anther of male sterile were smaller than their male fertile. Thus larger male sterile anthers as compared to its maintainer plants are an unusual feature for *Trachystoma* cms system. But this larger size of the anther lobe is due to the petaloid nature of the anther. Petaloidy in anthers was comman in cms *Tournefortii* system but the size of anther remained smaller due to very small flowers in this male sterility system.

The overall size of the stamens in male sterile lines was found smaller in comparison to their maintainer plants in all the cms systems studies in the present investigation inducing *Trachystoma.* So far as the size of carpel in concerned it was significant smaller in male sterile plants than their maintainer lines. However, this difference was not so significant in cms *Ogura* system.

A peculiar situation of cleistogamous flowers was observed in some male sterile plants of *Ogura, Tournefortii* and *Trachystoma* systems. These flower buds had protruded stigmatic lobes and rarely one or two such flowers buds, on later stages, developed into fruits whereas rest of them abscised.

The overall assessment of morphological characters in five cms systems observed revealed that *Oxyrrhina* male sterile and maintainer lines are highest seed producer followed by *Tournefortii* system. This is probably because both these systems have developed by interspecific hybridiazation, whereas the other three systems are the result of intergeneric hybridiazation.

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