RESEARCH PAPER

Asian Journal of Bio Science Vol. 6 Issue 1 (April, 2011) : 97-101

Discrimination of three sex morphotypes in *Plantago Ovata* Forsk.(Plantaginaceae) through floral characters

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(Received: October, 2010; Revised: January, 2011; Accepted : March, 2011)

Floral biology studies which were conducted for four characters (anther colour, anther size, anther length and style length) resulted in finding out the significant differences among sex-morphotypes (male fertile, partial male sterile and male sterile) of different lines. The differences were recorded in anther size and shape of anther. Anther length varied from 0.76 to 1.81 mm in three sex morphotypes. Breadth of anther varied from 1.19 to 1.73 mm. Size of seed varied from 2.43 to 2.73 mm in three sex morphotypes of different germplasm lines. Mean of style length was 5.12, 7.12 and 8.14 mm in fertile, partial male sterile and male sterile type respectively. It could be concluded that floral biological observation could be successfully utilized to characterize male sterility in *P. ovata* (Isabgol).

Key words : Cytoplasmic male sterility (CMS), P. *ovata,* Sex-morphotype

Ashish, G. Vala, Fougat, R.S. and Roshni, S. (2011). Discrimination of three sex morphotypes in *Plantago Ovata* Forsk. (Plantaginaceae) through floral characters. *Asian J. Bio. Sci.*, **6** (1): 97-101.

INTRODUCTION

Plantago ovata Forsk. commonly known as "Isabgol" belongs to family *plantaginaceae*. It is a native of Mediterranean region and is cultivated for its valuable husk used as medicine. Isabgol is one of the most important medicinal crops of Gujarat. However, so far only two varieties *viz.,* Gujarat Isabgol-1 Gujarat Isabgol-2 and Gujarat Isabgol-3 have been released for general cultivation in the state. Though the productivity has been increased from 604 to 672 kg/ha after release of Gujarat Isabgol-2, the amount of increase is very meagre due to its less adaptability to varying environmental conditions. Therefore, looking at the importance of Isabgol crop in the state, there is urgent need to enhance productivity and production to make the crop more profitable.

Cytoplasmic male sterility (CMS) is a common phenomenon among *plantago ovata* (Pillai *et al.,* 1997) and has received much attention due to its potential use in heterosis breeding and hybrid seed production. It's characterized by the failure of the plant to produce viable or functional pollen. In gynodioecious (Van *et al.,* 1982) (*Plantago ovata* Forsk.) populations, the male sterile plants vary from 2 to 50 % (Lewis, 1942). Paliwal and Hyde (1959) reported that male sterility in *Plantago cornopus* was due to the presence of B-chromosomes. Atal (1958) reported that male sterility in P. ovata was of cytoplasmic type Atal (1958). He further reported that sterile plants could be readily distinguished from the normal plants by floral characters viz; shriveled appearance of their anthers as compared to the membraneous, well developed anther of normal plants, Ross (1969). Floral biology has been extensively used in plants to discriminate the three sex morphotypes (Jamwal, *et al.,* 1998) and identify male sterile line. Keeping in view the above aspects the present study was planned to be carried out comparative floral biology of three sex-morphotypes *viz.,* fully fertile, partial sterile and fully sterile plants in *Plantago ovata* Forsk.

RESEARCH METHODOLOGY

The present investigation Discrimination of three sex morphotypes in Plantago Ovata Forsk.(Plantaginaceae) through floral characters was undertaken in the Department of Agricultural Botany and Biotechnology, B.A. College of Agriculture, Anand Agricultural

University, Anand. The experimental material for the present investigation was comprised of fifteen germplasm lines of *P. ovata* (Table 2). All of them were found to have all three sex morphotypes during preliminary screening in their population. The seeds were obtained from Spices and Condiments Research Station, Jagudan, Sardar Krushninagar Dantiwada Agricultural University, Sardar Krushinagar, Dist. Banaskantha, Gujarat.

Preliminary screening and isolation of three – sex morphotypes:

The seeds of a total of 28 germplasm lines were sown in the field in one replication by line sowing method in plots measuring 6x3 m in size. Screening and selection for three sex morphotypes was carried out on all the germplasm lines and plants representing the respective sex types were tagged. Finally only fifteen germplasm lines out of twenty eight were retained for further study which had all three sex types (Fig. 1).

Raising of experimental crop:

In the following season *i.e. Rabi*, experimental crop with a total of 45 treatments (15x3 sex types *i.e.* 15 sets) were raised in RBD design with two replications. Each

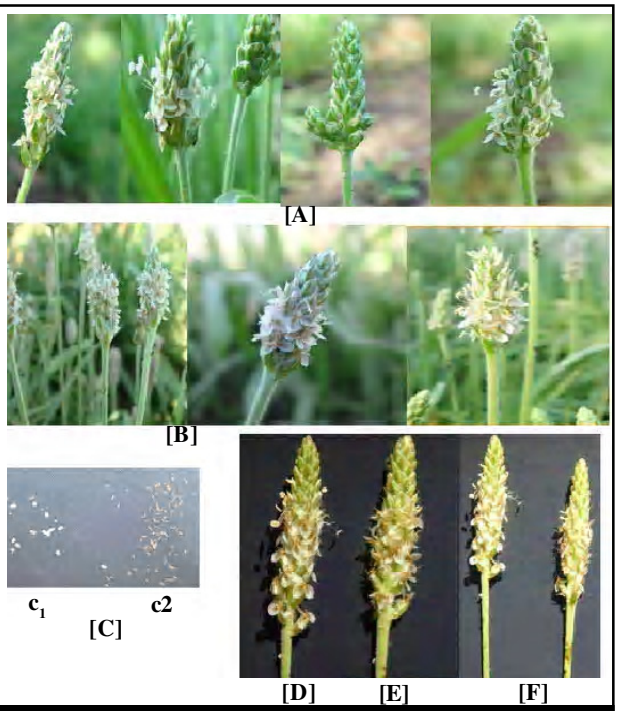

Fig. 1: Floral Biology of male sterile, partially sterile and fully fertile spikes in *P. ovata*. [A]- fertile spike, [B]- sterile spike, [C]- c_1-sterile anther;c_2-fertile anther, [D]- fertile spike, [E]- sterile spike, [F]- partial sterile spike

treatment was represented by a single row having a row to row distance of 30 cm and plant to plant 10 cm. Genotypes used in the present investigation were Gujarat Isabgol-2, Jagudan Isabgol – 189, 216, 227, 192, 206, 214, 107, 127, 129,130, 131, 132, 137 and 150.

No. of anther per plant (mm):

No. of anther counted per plant in different flower and also size of anther was measured with the help of ocular micrometry. 50 anthers were studied in each case,

Style length (mm):

The size of style was measured with the help of measuring scale.50 style length were studied in each case.

RESULTS AND ANALYSIS

During the present investigation floral biological of male sterilize plants on the basis of different floral characters were conducted recorded on three sex morphotype.

It was observed that male fertile, male sterile and partial male sterile plants flowered in an average anther shape and size. Anthers were shriveled with pale green color in all male sterile plants. The partially male sterile plants had pale green shriveled and papery anthers whereas fertile plants had a peppery, normal shaped white anther which was a clear-cut difference to identify and differentiate three sexmorphotypes (Gupta *et al.*, 1997).

Significant differences were observed for anther size among three sexmorphotypes. Significant differences were recorded for anther length and breadth between fertile, partial male sterile and male sterile morphotypes of *P. ovata*. The maximum anther length and breadth (Table 1) was recorded in male fertile plants of Gujarat Isabgol -2 which had 2.21 mm length and 1.43 mm breadth where as partial male sterile counterpart had 1.82 mm, 1.74 mm length and breadth respectively and male sterile

Table 2: Pooled data of different *P. ovata* germplasm lines under three sexmorphotypes group

Sr. No.	Germplasm	Seed length	Anther length	Anther breadth	Stigma length
1.	GI-2	2.73	1.18	1.73	7.1
2.	JI – 214	2.43	1.65	1.19	6.34
3.	JI – 216	2.57	1.72	1.66	6.81
4.	JI -150	2.66	1.74	1.56	6.85
5.	JI – 192	2.6	1.75	1.48	6.9
6.	JI – 206	2.55	1.72	1.47	6.82
7.	JI – 107	2.55	0.78	1.6	6.69
8.	JI – 132	2.54	0.76	1.40	6.7
9.	JI – 189	2.57	1.75	1.53	6.83
10.	JI –129	2.6	1.72	1.52	6.78
11.	JI – 130	2.54	1.73	1.56	6.89
12.	JI – 227	2.55	1.75	1.55	6.88
13.	JI – 127	2.5	1.76	1.57	6.85
14.	JI – 137	2.57	1.74	1.45	6.73
15.	JI – 131	2.56	1.76	1.53	6.69
	Mean	2.57	1.57	1.52	6.79
	S.E. ±	0.016	0.008	0.032	0.083
	C.D.	0.045	0.024	0.091	0.236
	male fertile	2.12	2.12	1.24	5.12
	partial male sterile	2.65	1.66	1.51	7.12
	male sterile	2.93	1.46	1.81	8.14
	Mean	2.57	1.75	1.52	6.79
	S.E. ±	0.007	0.004	0.014	0.037
	C.D.	0.020*	0.011*	0.041*	0.105*
	V*S Intraction	0.078*	0.41*	0.158*	NS
	C.V. %	1.51	1.15	5.15	2.97

Table 3: Analysis of variance for different floral biological characters of *P. ovata* under three sex-morphotypes

Source of variation	Replication	Sterility	Genotypes	Germplasm X Sterility	Error	C.D. at 5% d.f. (Interaction)	C.V.%
Seed length	0.009	5.073	0.025	0.005	0.002	0.078*	1.51
Anther length	0.000	3.492	0.013	0.001	0.000	0.041*	1.15
Anther breadth	0.008	2.443	0.091	0.012	0.003	0.158*	5.15
Stigma length	0.167	70.694	0.189	0.054	0.041	NS	2.97

counterpart had 1.61 mm and 2.03 mm length breadth respectively. Pooled analysis for anther length and breadth (Table 2) revealed that anther in male fertile measured 2.12 mm whereas partial male sterile 1.66 mm and 1.51 m and male sterile had 1.46 mm and 1.81 mm. As the anther length decreases breadth of anther increases. Significant differences were recorded for this character among three sexmorphotypes which easily differentiated male fertile, partial male sterile and male sterile plants from each other. The data presented in table 3 for interaction was also found to be significant for this trait. The co-efficient of variation recorded for anther length and breadth was 1.15% and 5.15%, respectively. Jamwal *et al*. (1998) also studied anther size *i.e.* length and breadth among fertile, partial male sterile and male sterile morphotype of Plantago ovata. Anther length in fertile plants was reported to be 2.06±0.15 mm, partial male sterile had 1.34 ± 0.46 mm and male sterile plants had 1.43±0.16 mm long anthers. Breadth of fertile plants was 1.20 ± 0.22 mm, partial male sterile plants had 0.78 ± 0.96 mm and male sterile plants had 0.36 ± 0.08 mm broad anthers. Significant differences were observed in anther size by said researcher also. Significant differences were observed for style length among three sex morphotypes. The data presented reveals that among different germplasm lines male fertile counterparts had less style length (Table 1) where as partial male sterile and male sterile had comparatively longer style length. Style length in fertile counterpart of GI-2 was 5.32 mm only whereas its partial male sterile and fully sterile counterparts had styles measuring 7.54 mm and 8.73 mm respectively. Minimum style length was observed in male fertile line of JI-214 (4.70 mm). Its partial male sterile and male sterile counterparts had styles measuring 6.42 mm and 7.90 mm. Pooled analysis for this character revealed that average size of style in fertile counterparts (Table 2) was 5.12 mm whereas partial male sterile and male sterile plants had 7.12 mm and 8.14 mm longer styles. Interaction (Table 3) between sterility types and germplasm line was found to be non significant for style length. Co–efficient of variation was 2.97%. Jamwal *et al*. (1998) also reported style size to be differentiated among fertile, partial male sterile and male sterile plants of *Plantago ovata.*

Conclusion

The combination of above studies may give new impetus to research efforts directed towards the development of stable male sterility system in P. ovata through conventional plant breeding methods.

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