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Studies on parental synchronization in flowering for hybrid seed production in onion (*Allium cepa* L.)

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ABSTRACT

An experiment was conducted at the Indian Institute of Horticultural Research, Bangalore, in Rabi season during 2001-2002 and 2002-2003 to study the flowering of Cytoplasmic Male Sterile Lines CMS (A) and pollinator lines (C) of onion cv. Arka Lalima for working out effective synchrony in hybrid seed production. Results indicated that days to 100% flowering and days to complete flowering in a plant varied significantly in the parental lines and C line was found to be earlier than A line by 12 days and 25 days, respectively. The duration of flowering in a plant was also less in C line (23 days) than in A line (29 days). Due to lack of floral synchrony between parental lines, pollen availability becomes a limiting factor in hybrid seed production in cv. Arka Lalima. Delay in planting of C lines by a week after planting A lines resulted in synchronised flowering of parental lines at peak flowering stage. This also resulted in higher fruit set (80%) and hybrid seed yield (15g/ plant) as against planting of A and C lines simultaneously (29.54% and 0.38g, respectively).

Key words: Cytoplasmic male sterility, flowering, hybrid seed production, onion, synchronization

INTRODUCTION

Onion is one of the important vegetable crops grown in India under 42 million hectares with a production of 4.21 million tonnes and productivity of 9.9 million tons/ hectare (National Horticulture Database, 2003). Onion is one of the pioneering crops in which heterosis was commercially exploited since early 1930's (Jones and Emsweller,1933). In India, Cytoplasmic Male Sterile (CMS) based hybrids were developed in onion. Synchronisation of flowering of parental lines is absolutely essential in onion hybrid seed production for effecting natural crossing in CMS lines (A line) by pollinators from pollinator lines (C line) (Peters,1990). In any hybrid seed production system using CMS hybrids, supply of adequate amount of pollen and its continuous supply by the pollen parent until male sterile lines are in bloom, is important (Peters,1990). Lack of synchrony in flowering in parental lines of onion hybrids has been reported even under simultaneous planting and identical storage conditions (Currah,1981). Flowering of onion is initiated by environmental factors (Pike,1986). In the light of the above, the present study was undertaken to obtain information on the extent of synchronization possible in respect of various floral traits of male sterile and pollinator lines in hybrid seed production of CMS-based onion hybrid Arka Lalima.

MATERIAL AND METHODS

A field experiment was conducted to study flowering behavior in parental lines of onion hybrid Arka Lalima during the Rabi Season (December) at the experimental farm of Indian Institute of Horticultural Research, Bangalore, in 2001-2002. The seed parent of hybrid Arka Lalima, namely, CMS line (A line) ms-48 and pollinator line (C line), Sel-14-1-1 were raised for the study. A bulb-to-seed method of seed production by annual method was followed (Yawalkar, 1989). Three plots of twenty plants each were maintained in both the parents. Onion bulbs weighing 10-20 g and equatorial diameter of 2.5 to 3.5 cm were cut transversely at the top to one third to expose the inner scales for early and uniform flowering. Cut bulbs were smeared with copper oxychloride to avoid microbial infection. Cut bulbs of both the parental lines were planted simultaneously in 4:1 ratio such that four rows of A line alternated with one row of C line (Swarup,1991). Closer planting of 30x30 cm between rows

Table 1. Flowering behavior of CMS and male fertile parental lines in Onion cv. Arka Lalima for hybrid seed production

Character	2001-2002		2002-2003		Pooled mean		Difference between A and C	t-test value
	A	C	A	C	A	C		
Days to first flowering **	64	64	69	84	66.50	74.00	7.50	NS
Days to 50%flowering **	92	87	80	86	86.00	86.50	0.50	NS
Days to 100% flowering **	140	136	111	88	126	114	12.00	11.03*
Days to complete flowering in the plant	140	96.54	122	116	131	106	24.73	5.91*
Duration of flowering in the plant	19.11	21.80	39.06	24.14	29.09	22.97	6.12	3.03*
Number of scapes/plant	4.50	2.86	2.84	2.55	3.67	2.71	0.96	NS
Number of flowers/umbel	166	133	314	265	240	199	41	NS

** from planting of bulbs (simultaneously) * P<0.05 NS= Non Significant

and plants was adopted as recommended for medium sized onion bulbs.

Observations were recorded on the number of days taken for first flowering, days to 50% and 100% flowering (to start flowering). For observations on days to complete flowering, duration of flowering in a plant and the number of scapes/plant, twenty plants in each of the parents were selected at random. Five umbels from both the parents were randomly selected to record within an umbel, on number of flowers/umbel, duration of flowering in an umbel, days to 5%, 30%, 50%, 80%, and 100% flowering.

In addition to this, an experiment was conducted on manipulating date of planting of parental bulbs for effecting floral synchrony (Atkin and Davis,1954).The methods employed were: T1- simultaneous planting of parental bulbs, and, T2- delayed planting of C line by one week after planting A line. Three plots of twenty plants each were maintained in each parent. Observations on per cent plants in flowering (with opened flowers to effect natural crossing of A lines from pollen of C line) at the same time, per cent fruit-set / umbel and hybrid seed yield / plant were recorded. Recommended package of practices was followed to raise the seed crop. Statistical analysis using a 'student-t' test was performed to test the significance between the parental lines of onion hybrid and between the two planting dates of parental bulbs.

RESULTS AND DISCUSSION

Flowering behaviour

Pooled data on flowering behavior of parental lines of onion hybrid Arka Lalima (on simultaneous planting of A and C lines) in a population and plant is presented in Table 1. Perusal of results revealed that there were no significant differences between A and C lines up to 50% flowering from planting. There were also no significant differences in respect of number of scapes / plant and number of flowers / umbel between the parents. However, days to 100% flowering and in the days to complete flowering in a plant varied significantly between the parental lines, which has led to problems in synchronized flowering. The duration of flowering in a plant was also less in C line (23 days) compared to A line (29 days).

Data on flowering in an umbel in the parental lines of onion are presented in Table 2. Differences between A and C lines for duration of flowering in an umbel were significant. Hence, it is concluded that lack of floral synchrony between parental lines of onion hybrid Arka Lalima observed at peak flowering stages of A line limited natural crossing in A lines in a situation where onion parental bulbs were planted simultaneously.

Effect of date of planting of parental bulbs on synchronisation in flowering and hybrid seed yield

The effect of planting dates of parental bulbs on synchronisation of flowering and hybrid seed yield has been presented in Tables 3 and 4, respectively. Synchronisation of flowering at peak flowering was observed in T2: delayed planting of C bulbs by one week after planting A bulbs compared to T1: simultaneous planting of parental bulbs.

Table 2. Flowering pattern in onion umbel

Character	A line	C line	Difference	t-test value
Days to 5% flowering	5	3	2	2.66*
Days to 30% flowering	7	5	2	NS
Days to 50% flowering	9	7	2	NS
Days to 80% flowering	14	11	3	NS
Days to 100% flowering	17	14	3	NS
Duration of flowering in the umbel(days)	20	25	5	3.47*

* P <0.05

Table 3. Effect of date of planting of parental bulbs on synchronisation of flowering in onion

Days from planting	Percentage of plants flowering (with open flowers) at the same time			
	Simultaneous planting of parental bulbs		Delayed planting of C bulbs by one week after planting A bulbs	
	A line	C line	A line	C line
73	23.08	18.18	6.67	0
81	7.69	0	63.33	0
88	7.69	36.36	73.33	0
95	30.76	18.18	81.25	100
108	0	0	100*	100*
115	0	0	62.5	100
122	0	0	0	57.14
129	0	0	0	28.6
136	15.39	9.09	0	28.6
140	15.39	18.18	0	0

* perfect synchronization of flowering in A and C lines

Table 4. Effect of date of planting of parental bulbs on hybrid seed yield in onion

Planting date	Fruit set/ umbel (%)	Hybrid seed yield/ plant (g)
T1- Simultaneous planting of parental bulbs	29.54	0.38
T2- Delayed planting of C bulbs by one week after planting A bulbs	80.00	15.00
t - test value	6.25*	11.12*

* $p < 0.05$

Percentage of plants with open flowers was 100 in both A and C lines at 108 days from planting of A line(peak flowering of both the parental lines) in delayed planting of C bulbs by one week after planting A bulbs.

Thus, there was lack of flowering synchrony in simultaneous planting of parental bulbs to effect natural cross pollination. Similar observation of poor co-ordination of flowering time in synchronous planted bulbs was also reported by Currah (1981).

With regard to fruit-set per umbel, higher fruit-set was observed in delayed planting of C lines by one week after planting A lines (80%) as against simultaneous planting of parental bulbs (29.54%). Hybrid seed yield per plant was also highest in delayed planting of C lines by one week after planting A lines (15g) as against simultaneous planting of parental bulbs (0.38g).

The superiority of delayed planting of C lines by one week after planting A lines results in higher fruit-set and seed yield per plant and calls for planned dates of planting and flowering of parental lines for ensuring synchrony at peak flowering time.

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