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Impact of Location Change on Hybrid Seed Production in Sunflower

N.M .Shakuntala, S.N. Vasudevan, I. ShankareGoud,B.T. Pujari
University of Agricultural Sciences, Raichur
shakuntalanm@yahoo.co.in

B. S. Vyakarnahal
University of Agricultural Sciences, Dharwad, India

Abstract:*Sunflower is one of the principal oil-seed crops, which has a nice fitting in existing cropping pattern. The extent of seed setting on female lines influenced by male-female ratio, synchronized flowering of male and female parents, nectar production and bee foraging, yielding ability of CMS lines, pollen production of male parents. Synchronization of flowering of parental lines is one of the major constraints in RSFH-130 hybrid seed production. The male parent (R-630) being early in flowering compared to female parent (CMS-104A) is causing problem in realizing higher seed yield in RSFH-130 seed production plots. The experiment was laid in randomised block design with three replications. It consisted of 9 treatment combinations comprising of three main plots (locations) viz., Raichur, Malnur and Gulbarga and three sub-plots (staggered planting) viz., S1: 4 days late planting of pollen parent to seed parent; S_2; 5 days late planting of pollen parent to seed parent and S_3; 6 days late planting of pollen parent to seed parent treatments with seven replications in each treatment and location. The results revealed that the female parent (CMS-104A) is late in 50% flowering by 5 days compared to male parental line (R-630) in all the three locations. In order to achieve better synchronization between parental lines and also to obtain maximum seed set per cent and hybrid seed yield, male parent has to be sown late with two staggered sowings i.e., 5^{th}, and 6^{th} days after sowing of female line with a proportion of 60:40 respectively.*

Keywords:*locations, sunflower, synchronisation, seed yield, staggered sowing.*

1. INTRODUCTION

Production of hybrid seed by cross pollination is the most important factor affecting the bio-economics of seed set on female lines using various production techniques. Raichur is coming under North eastern dry zone (Zone 1 and 2) of Karnataka state , wherein among the major oilseed crops sunflower is grown about 80 per cent of the total cultivable area. This region is blessed with suitable agro-climatic conditions for quality seed production of varieties and hybrids of oilseeds. Hence making available good quality seeds of sunflower assumes greater importance. Recently RSFH-130 (Raichur Sunflower Hybrid-130) was developed at Main Agricultural Research Station, University of Agricultural Sciences, Raichur and released for commercial cultivation during 2009. Further, synchronization of flowering of parental lines is one of the major constraints in RSFH-130 hybrid seed production. The male parent (RSFH-630) being an early in flowering compared to female parent (CMS-104A) is causing problem in getting maximum seed set in female line which results in reduction in hybrid seed yield. However, in the hybrid seed production fields, seed yield and quality attributes can be increased through proper synchronization of flowering of parental lines. Hence, the detailed Seed Technological information in RSFH-130 sunflower hybrid is lacking and thus deserves the attention of understanding the above aspects that would be of much of practical significance to improve the hybrid seed yield. Hence the experiment was planned to take up in three important seed production locations ie.,Raichur, Gulbarga and Malnur. Even though all the locations are coming under same zone but difference in flowering behaviour was noticed. However Five days late sowing of male parent has contributed maximum pollen to the female parent but in order to achieve better synchronization between parental lines and for continuous supply of pollen to the female parent throughout the flowering period and also to obtain maximum seed set per cent and hybrid seed yield, male parent has to be sown late with two staggered sowings i.e., 5^{th}, and 6^{th} days after sowing of female line with a proportion of 60:40 respectively.

2. METHODOLOGY

Seeds of CMS-104A (female parent) and R-630 (male parent) were obtained from the Principal Scientist, Sunflower Breeder, AICRP Sunflower, Main Agricultural Research Station, Raichur. The cultivation practices were followed as per recommendations. Female and male parent seeds were hand dibbled in different treatments in 3:1 ratio following a spacing of 60 cm between rows and 30 cm between plants within a row in seven replications in each location using block method. Seeds of male parent were sown in three staggered dates as per the sub plot treatments *viz.*, sowing of male parent seeds four days later to female parent, five days later to female parent and six days later to female parent. Three locations were considered as main factor. 1000 g female and 500g male parental seeds were treated with imidachloprid @ 5g/kg of seeds to protect the crop from sucking pests before sowing. Male and female parental rows were checked thoroughly for off-types and pollen shedders. Heads of seed parent and pollen parental lines were covered with cloth bags before anthesis up to the completion of flowering. Supplementary pollination was carried out by collecting pollen in petri dishes using brush and smeared on to head of female parent with the help of muslin cloth. The crop was harvested when backside of the capitulum turned to lemon yellow colour. The heads in pollinator rows were collected separately to avoid physical contamination. The capitulum of five earlier tagged plants were harvested and threshed separately for making observations. The days taken for button initiation were taken and the average was calculated as the days taken for button initiation. Number of days taken from sowing to opening of 50% of disc florets in a capitulum was recorded. All the plants in each treatment were observed every day for flowering from 55th day onwards in all the treatments. The day on which 50 per cent of plants showed opening of ray floret was recorded and average was calculated to obtain days to 50 per cent flowering. Other yield parameters like Seed filling percentage, Test weight (g) ,Volume weight of seed (g/cc) , Kernel to hull ratio were also recorded.

The seed filling percentage was calculated by using the seeds obtained per plant were separated into filled and unfilled seeds. The seed filling percentage on number basis was obtained by using the below formula.

$$\text{Filled seeds (\%)} = \frac{\text{Number of filled seeds per head}}{\text{Total number of seeds per head}} \times 100$$

The kernel weight (g) of 100 seeds in each treatment was weighed and recorded in grams after separating the hull from the kernel. Volume weight of seed was calculated by taking Weight of 100 ml seeds in each treatment and weight was expressed in grams. Kernel to hull ratio can be obtained by dividing the kernel weight by respective hull weight of 100 seeds of each treatment. The data was analysed using two factorial Randomised complete Block Design.

3. RESULTS AND DISCUSSION

Synchronization of flowering i.e. shedding of pollen in male parent coinciding with the duration of stigma receptivity is a pre-requisite for successful hybrid seed production. The gap between the above two events in parental lines of sunflower hybrid RSFH-130 usually varies from 5 to 6 days depending upon the agro-climatic conditions. The advancement of flowering in late parent or by delaying flowering in early parent by using growth regulators, chemicals or cultural practices, synchrony of flowering between male and female parents could be achieved when the gap is less. The female parent was taken five to six days more to attain 50 per cent flowering than male parent. The variation in flowering days in parental lines may be attributed to the genetic characteristics of the parents. Similar variation in flowering behaviour of female and male parent has been reported by Vranceanu (1980) and Somashekhar (1997) in sunflower hybrid seed production. The genotypic differences in the flowering may further be revealed to the differences in flower bud initiation, which in turn affected by environmental factors like temperature, photoperiod and their interactions. Staggered planting of male parent four days later attain little synchrony in flowering as the complete opening of the flower takes 7-8 days. The late sowing of male parent resulted in better synchronization of flowering between the parents. These results are in agreement with the findings of Jagadeesh (1996) who suggested that female parental line of

APSH-11 need to be staggered two days earlier to male and also similar findings were obtained by Praveen Kumar *et al.* (1997) in KBSH-53 sunflower hybrid.

Table1.*Effect of synchronization studies on days to button initiation, days to 50% flowering andSeed*

	Days to Button initiation								Days to 50% flowering								Seed filling percentage (%)			
	FEMALE				MALE				FEMALE				MALE				FEMALE			
	S1	S2	S3	MEAN	S1	S2	S3	MEAN	S1	S2	S3	MEAN	S1	S2	S3	MEAN	S1	S2	S3	MEAN
L1	52.8	52.6	52.9	52.8	46.5	46.8	47.5	46.9	66.43	66.43	66.43	66.43	61.45	61.64	61.64	61.50	64.3	78.4	76.6	73.1
L2	54.3	53.9	54.4	54.2	47.4	47.6	48.1	47.7	67.36	67.64	67.71	67.57	62.85	62.43	62.71	62.61	63.1	78.1	76.1	72.4
L3	54.8	55.0	56.2	55.3	49.3	49.6	49.6	49.5	68.00	68.71	68.50	68.40	63.76	63.21	63.79	63.43	67.1	81.6	80.0	76.2
MEAN	54.0	53.8	54.5	54.1	47.7	48.0	48.4	48.0	67.26	67.60	67.55	67.47	MEAN	62.43	62.71	62.51	64.8	79.4	77.6	73.9
	L	S2	LXS		L	S2	LXS			L	S	LXS	L	S	LXS		L	S	LXS	
S.Em±	0.36	0.36	0.62		0.36	0.36	0.63		S.Em±	0.19	0.19	0.33	SEm±	0.19	0.19	0.32	0.11	0.11	0.19	
C.D(0.05)	0.72	NS	NS		0.73	NS	NS		C.D	0.38	NS	NS	C.D	0.37	NS	NS	0.22	0.22	0.38	

L= Location

L1: Raichur L2: Gulbarga L3: Malnur

Table2.*Effect of synchronization studies on Seed Volume (g/cc) ,Test Weight (g) and seed yield/ hectare (q) in parental lines of sunflower hybrid RSFH-130 (Pooled data)*

	Seed Volume (g/cc)				Test Weight (g)				Seed yield/ hectare (q)			
	FEMALE				FEMALE				FEMALE			
	S1	S2	S3	MEAN	S1	S2	S3	MEAN	S1	S2	S3	MEAN
L1	41.41	42.75	42.78	42.31	5.55	5.56	5.58	5.57	7.93	9.16	8.89	8.66
L2	40.51	41.83	41.78	41.37	5.43	5.46	5.48	5.46	6.78	8.86	8.43	8.03
L3	42.27	43.73	43.61	43.20	5.88	5.91	5.92	5.90	7.67	9.28	8.86	8.60
MEAN	41.40	42.77	42.72	42.30	5.62	5.65	5.66	5.64	7.46	9.10	8.73	8.43
	L	S	L XS		L	S	L XS		L	S2	LXS	
S.Em±	0.18	0.18	0.3		0.01	0.01	0.02		0.14	0.14	0.24	
C.D(0.05)	0.35	0.35	NS		0.02	0.02	NS		0.28	0.28	NS	

L= Location

L1: Raichur L2: Gulbarga L3: Malnur

S1- 4 days late sowing of male parent S2- 5 days late sowing of male parent S3- 6 days late sowing of male parent.

The days to button initiation for female was 54.1 days and 48 days for male and days to 50 % flowering was 67.47 days for female and 62.51 days for male (Table1). However the difference was 6 days and 5 days for button initiation and days to 50% flowering respectively. The location effect was significant on flowering behaviour of the crop and effect of different date of sowing was non significant. However the days taken to achieve button initiation and 50% flowering were late in Malnur and Gulbarga compared to Raichur. The seed filling percent, seed volume and test weight were recorded more at Malnur followed by Raichur and Gulbarga. The sowing of male parent by 5 days later to female parental sowing enhanced all the yield attributing parameters like seed filling percentage, seed volume, test weight and seed yield by proper synchronisation of parental lines.

The hybrid seed yield per hectare (kg) and seed weight per plant (g) were found to be significantly high (Table2) when male parent sown five days and six days later than female parent. This increase in seed yield was due to better synchronization of flowering resulted in increase in seed set percentage and number of filled seeds. The lower yield in four days late sowing of pollen parent to seed parent is due to lack of synchrony in flowering of parental lines and non availability of pollens resulting in poor seed set. These results are in conformity with Varshney*et al*. (2006) who reported that sowing of male parent (CML-186) two days later than female (CML-142 x CML-150) was better in narrowing the gap of flowering of parental lines leading to higher seed yield in maize hybrid Shaktiman-1. Contrarily Vranceanu (1980) who reported that two to six days difference in flowering of parental lines of six hybrids caused poor plant yield in sunflower. Further, suggested that early sowing of pollen parents up to ten days to ensure higher rate of pollination. Thus, if the better synchronization of flowering of parental lines is achieved there is a definite scope to increase hybrid seed yield. Sowing of pollen parent five days and six days later (60: 40 proportion respectively) to seed parent resulted in higher seed yield compared to sowing of pollen parent four days later than seed parent. From the present investigation it is evident that, for better synchronization of flowering between the parental lines, male parent has to be sown five to six days later than female parent during *rabi*in obtaining higher seed yield and better quality in sunflower hybrid RSFH-130 seed production programme. Results obtained from this investigation are of immense help to the sunflower hybrid seed producers in general and hybrid sunflower seed growers in particular as it help to increase the hybrid seed yield.

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