STUDIES ON AGRONOMIC MANIPULATIONS FOR IMPROVING THE SEED YIELD AND QUALITY OF KBSH-1 SUNFLOWER HYBRID SEED PRODUCTION

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SUMMARY

Field investigations were conducted for two years (1993-94) on red sandy clay loam soils at GKVK farm during rainy season under protective irrigation to standardise the agro-techniques for improving the seed yield and quality of KBSH-1 hybrid sunflower through agronomic manipulations to achieve better flowering synchrony of parental lines besides optimising the planting system of parental lines. The results indicated that sowing the male parent (RHA 6D 1) 8 days earlier the female (CMS 234A) resulted in best flowering synchrony leading to significantly highest seed yield (833 kg/ha) followed by 4 days staggering (687 kg/ha) as compared to simultaneous sowing (475 kg/ha). Staggering resulted in higher dry matter partition to head (47 g/plant), higher per cent seed filling and more number of seeds per plant (488), consequently highest per plant yield (22.65 g) as compared to simultaneous sowing (12.76 g).

Higher nitrogen dose (90 kg/ha) to male parent resulted in 2 days early flowering leading to higher seed yield (692 kg/ha) than recommended N dose of 60 kg/ha (635 kg/ha). However, early staggering of male (8 days) with recommended N resulted in highest seed yield (851 kg/ha). Block planting of male and female (3:9 ratio) although resulted in marginal increase in seed yield (679 kg/ha) over conventional planting of 1:3 row ratio (648 kg/ha), was more convenient for staggered sowing and other cultivation practices. Staggering treatment recorded moderate values for seed quality parameters (100-seed weight, vigour index) which were within the acceptable limits of seed standards coupled with highest seed yield. Staggering also recorded highest net returns (9,903 Rs/ha) and Benefit:Cost ratio (2.40). Thus, the study indicated that early staggering (8 days) of male with recommended N dose to male (60 kg/ha) and block planting (3:9) was optimum for KBSH-1 hybrid sunflower seed production. However, flowering manipulation through higher N dose can be used as a contingent measure to adjust flowering dates by 2-3 days.

INTRODUCTION

The discovery of cytoplasmic male sterility (Leclercq, 1969 in France) and fertility restorer lines (Kinman, 1970 in USA) have led to the development of hybrids, which are under commercial cultivation in several sunflower growing countries including India. Sunflower hybrids are preferred over open pollinated varieties as the ensure homogeneity and stability in production. Among the public hybrids, KBSH-1 released for general cultivation in India during 1992 from University of Agricultural Sciences, Bangalore has been showing superior performance both for grain and oil yield compared to other released hybrids. Nevertheless, the spread of this superior hybrid is restricted for want of production and supply of quality seeds. The non-synchrony of flowering between parental lines of KBSH-1 has been one of the major constraint for improving the productivity. In the context of growing demand for quality seeds, there is much scope for improving productivity as well as quality of hybrid seeds by adopting suitable agro-techniques. Thus, a study was conducted at University of Agricultural Sciences, Bangalore to develop suitable agro-techniques to improve the performance of hybrid seed production plots in terms of productivity as well as seed quality.

MATERIALS AND METHODS

Field investigations were conducted for two years (1993-94) at Bangalore during rainy season under protective irrigation using factorial random block design with three replications. The treatments included three staggered sowing dates and two nitrogen levels to male parent (RHA 6D-1) and two planting patterns viz., row planting (1:3 i.e one row of male parental line followed by 3 rows of female parent) and block planting (3:9 i.e 3 rows of male followed by 9 rows of female). The soil of the experimental site was represented by red sandy clay loam in texture, slightly acidic pH, low in available phosphorus (37.5-39.0 kg ha^{-1}) and medium to high in available potassium (200-350 kg ha^{-1}). The crop growth was generally satisfactory except that mild incidence of alternaria leaf spot, observed during reproductive phase due to cloudy weather with high relative humidity. The crop was protected from pests and diseases by taking timely plant protection. The crop was commonly fertilized with a NPK dose of 60:90:60 kg/ha except for the treatment of higher N dose for male parent. Each treatment had a gross plot size of 7.2 x 3 m and the crop was raised following a spacing of 60 x 30 cm. In 1:3 ratio planting, pollination was done by hand while in block planting (3 :9) the pollens were collected in a Petri plate and sprinkled on the female flowers using a fine camel hair brush. Supplementary hand pollination was carried out every day morning between 9 to 11 a.m. The observations on growth and yield components were recorded on five randomly selected plants. The seed quality parameters were recorded according to the ISTA procedure (Anon., 1985). The seed vigour was determined as a product of germination and seedling dry weight (Abdul Baki and Anderson, 1973).

RESULTS AND DISCUSSION

Effect of staggering of parental lines

The observations on flowering behaviour of the parental lines of KBSH-1 sunflower hybrid viz., CMS 234A and RHA 6D-1 indicated that they differed in number of days taken for flowering with a gap of 6-7 days. The female flowered earlier (55-56 days) than male (62-63 days) parent. The duration of anthesis in male parent lasted for 6-7 days. The difference in the flowering of parental lines may be attributed to the effect of genotype, environment, crop management and their interactions as reported by several workers (Goyne and Hammer, 1988; Ujjanaiah *et al.*, 1988 and Kempegowda, 1992). Thus, the male parental line planted eight days earlier to female resulted in higher hybrid seed yield (833 kg/ha) followed by four days staggering (682 kg ha^{-1}) and the lowest yield was observed with simultaneous sowing (476 kg ha^{-1}). The increased seed yield in eight days staggered sowing was mainly due to better flowering synchrony resulting in higher per cent seed filling leading to higher seed yield per plant (22.65 g) and higher number of filled seed per plant (488). The same treatment also showed increased partition of dry matter to the head (47 g/plant). Since the total dry matter accumulation did not vary much between the staggering treatments, so also the other growth components (Table 1).

The seed quality parameters like 100-seed weight (5.32 g) vigour index (4306) were although found to be superior with simultaneous sowing of parental lines, the hybrid seed yield was lowest. On the contrary, the eight days staggering recorded moderate values for all the seed quality parameters which were well within the acceptable limits of seed standards and with higher hybrid seed yield. The eight days staggering treatment also recorded higher net returns (9903 Rs./ha) and B : C ratio of 2.4 (Table 2).

Effect of N nutrition to male parent

Application of higher dose of N (90 kg ha^{-1}) to the male parent (RHA 6D-1) over the recommended dose (60 kg ha^{-1}) resulted in 2 days early flowering leading to better flowering synchrony as reflected in higher seed yield (692 kg/ha) as compared to recommended N (635 kg/ha). The early flowering of sunflower due to higher N nutrition may be attributed to the «nitropositivity» of the crop as observed in case of sorghum. Early flowering in sunflower due to nitrogen nutrition in sunflower has been reported by few workers (Maheswarappa, 1983 and Anon., 1996). The mechanism of early flowering due to «nitropositivity» is yet to be understood. However, early staggering of male (8 days) with recommended N resulted in highest seed yield (851 kg/ha) indicating that N manipulation technique to achieve flowering synchrony may be useful for adjusting narrow flowering gaps of 2-3 days which can be used as a contingent measure.

Effect of planting pattern of parental lines

The results indicated that block planting of parental lines in 3:9 (male to female) ratio resulted in marginally higher hybrid seed yield (679 kg ha^{-1}) over the conventional planting pattern of 1:3 row ratio (648 kg ha^{-1}). Block planting although required additional labour cost of 60 per cent higher than conventional planting for pollination, the cost was more than compensated by the additional seed yield and was found to be more convenient for staggered planting and for following other cultivation practices.

Thus the study inferred that the staggered sowing of male eight days earlier to female parental line with recommended N dose (60 kg ha^{-1}) to male and following block planting method is optimum for higher seed yield and quality in KBSH-1 sunflower hybrid seed production during rainy season.

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Table 1. Growth and yield components of female parental line (cms 234 A) of KBSH-1 sunflower hybrid, as influenced by staggered sowing; N nutrition to male and planting pattern (mean of 1993-94).

Treatments	Dry matter production to distribution at maturity (g)				No. of filled seeds/plant	Per cent seed filling	Seed yield/ plant (g)	Hybrid seed yield/ha	Harvest index
	Leaf	Stem	Head	Total					
Male parent staggering									
S_1 : Simultaneous sowing	19.57	41.12	35.58	96.25	238	35.5	12.76	467.0	0.132
	(20.33)	(42.72)	(36.95)						
S_2 : Four days early	18.73	35.84	41.38	95.95	385	51.4	18.62	682.0	0.194
	(19.52)	(37.35)	(45.13)						
S_3 : Eight days early	16.94	31.99	46.55	95.06	488	66.7	22.65	833.0	0.239
	(17.82)	(33.65)	(48.53)						
S.Em±	0.26	0.46	0.61	0.60	6	0.5	0.18	12.7	0.002
CD (P = 0.05)	0.74	1.31	1.74	NS	17	1.4	0.51	36.2	0.006
N Nutrition to male parent									
N_1 : Recommended N (60 kg/ha)	18.40	37.61	31.53	95.54	349	49.0	17.20	635.0	0.180
	(20.16)	(39.37)	(40.47)						
N_2 : Additional N (90 kg/ha)	18.43	35.03	42.81	95.97	391	53.4	18.82	692.0	0.197
	(19.20)	(36.50)	(44.30)						
S.Em±	0.63	0.38	0.49	0.49	5	0.4	0.15	10.4	0.001
CD (P = 0.05)	NS	1.08	1.4	NS	13	1.1	0.43	29.6	0.003
Planting pattern (Male : Female)									
P_1 : Row planting (1:3 ratio)	18.69	36.22	40.46	95.35	358	50.3	17.51	648.0	0.184
	(19.60)	(37.99)	(42.41)						
P_2 : Block planting (3:9 ratio)	18.14	36.42	41.88	96.16	382	52.1	18.51	679.0	0.193
	(18.66)	(37.87)	(43.27)						
S.Em±	0.63	0.38	0.49	0.49	5	0.4	0.15	10.4	0.001
CD (P = 0.05)	NS	NS	NS	NS	13	1.1	0.43	29.6	0.003

Note : Figures in parenthesis indicate the per cent distribution of dry matter in different plant parts.

Table 2. Seed quality parameters and economics of seed production of KBSH-1 hybrid sunflower seeds produced in female parental line as influenced by staggered sowing, N nutrition to male parent and planting pattern (mean of 1993-94).

Treatments	Germi-nation (%)	Dry matter/ seedling (mg)	Vigour index	Husk content (%)	Oil content (%)	Protein content (%)	Net returns (Rs/ha)	B : C ratio
Male parent staggering								
S_1 : Simultaneous sowing	91.10	47.3	4306	23.35	38.70	16.19	2676	1.37
S_2 : Four days early	90.30	42.8	3865	22.43	37.70	16.06	6827	1.97
S_3 : Eight days early	90.40	42.2	3823	21.58	36.40	16.29	9903	2.40
S.Em±	0.30	0.4	43	0.08	0.40	0.32	-	-
CD (P = 0.05)	NS	1.1	126	0.23	1.10	NS	-	-
N Nutrition to male parent								
N_1 : Recommended N (60 kg/ha)	90.70	44.4	4023	22.52	37.9	15.99	6022	1.87
N_2 : Additional N (90 kg/ha)	90.50	43.8	3965	22.39	37.3	16.23	6882	1.96
S.Em±	0.20	0.3	35	0.07	0.3	0.26	-	-
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	-	-
Planting pattern (Male : Female)								
P_1 : Row planting (1:3 ratio)	90.50	44.2	4001	22.42	37.0	16.14	6278	1.91
P_2 : Block planting (3:9 ratio)	90.70	44.0	3392	22.49	38.2	16.09	6626	1.92
S.Em±	0.20	0.3	35	0.07	0.3	0.26	-	-
CD (P = 0.05)	NS	NS	NS	NS	0.9	NS	-	-