STUDIES ON MANIPULATION OF SOURCE-SINK RELATIONSHIP FOR IMPROVING SEED YIELD AND QUALITY OF MALE PARENTAL LINE (RHA 6D-1) OF KBSH-1 SUNFLOWER HYBRID

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SUMMARY

The seed yield and quality of male parental line (RHA 6D 1) of KBSH 1 sunflower hybrid is poor due to its multiheaded nature. Field studies were conducted for 2 years at Bangalore during summer and rainy seasons of 1994 to improve the seed yield and quality of R-line through manipulation of source-sink relationship by means of axillary bud nipping/growth regulators spray, integrated with plant population dynamics. The results indicated that nipping of axillary buds to retain only main head significantly improved seed yield (1414 kg/ha) as compared to no nipping (972 kg). The effect of nipping reflected mainly on 100-seed weight (4.55 g) compared to no nipping (3.61 g) which in turn resulted in significantly higher seed recovery (80.42%) on processing (1149 kg/ha) as compared to no nipping (51.61% and 559 kg ha^{-1} respectively) leading to higher B:C ratio (4.77). Nipping resulted in higher head diameter (13.38 cm) mainly due to increased dry matter partition to the main head (47.8 g). Nipping improved the seed quality parameters like vigour index (2415) as a consequence of significant improvement in seed size, germination (90.04%) and seedling dry weight (26.96 mg/plant) as compared to no nipping. Nipping also resulted in higher net returns (Rs. 37772 ha^{-1}) and B : C ratio (4.77).

Variation in plant density (55,555 and 74,074 plants ha^{-1}) did not cause much difference in seed yield (1250 - 1291 kg ha^{-1}) although, the seeds obtained from 55,555 plants per ha showed better seed quality in terms of 100-seed weight (4.56 g) and vigour index (2097). Growth hormone mixture (TIBA 240 ppm + NAA 50 ppm) spray on head at rayfloret opening stage did not much help in improving the seed yield (1270-1320 kg/ha) but showed better seed quality in terms of vigour index (2060). Thus, the study inferred that, nipping axillary bud to retain only main head with a population of 55,555 plants/ha (60 x 30 cm) is optimum for higher seed yield and quality of RHA 6D 1 sunflower male parent.

INTRODUCTION

In India hybrid sunflower cultivation started in 1980, with the release of first sunflower hybrid (BSH-1), developed at the University of Agricultural Sciences, Bangalore, using cytoplasmic male sterility (CMS) and fertility restoration (R) system (Seetharam, 1980). The seed quality as well as recovery in the R-line (RHA 6D-1) of KBSH-1 sunflower, a recently released superior public hybrid was poor mainly due to its multiheaded nature leading to production of under sized and poor vigor seeds. The branching in sunflower R-lines varies with the genotype, crop environment and their interactions. Mcintyre (1977) noticed that the growth of lateral buds is influenced by relative humidity, light intensity and nitrogen supply. Kannababu (1992) found lesser number of branches in sunflower R-line RHA-274 when planted at high population density leading to decrease seed yield. Similarly, Ross (1939) reported a negative correlation between number of branches and the seed yield. Based on the experience of research carried out on crops like catton and caster which confirmed that removal of lateral branches can stimulate the growth of the main branch and some of the preliminary works conducted by Channakrishnaiah *et al.* (1992) on sunflower, an experiment was conducted to study the effect of axillary bud nipping, plant density and growth hormone mixture spray (Tri-idobenzoic acid + Napthalene acetic acid) on seed yield and quality of R-line (RHA 6D-1) of KBSH-1 hybrid sunflower.

MATERIAL AND METHODS

A field study was conducted during summer and rainy season of 1994 at the farmers field and GKVK farm respectively using factorial RCBD with three replications. The experimental plot had sandy loam to red sandy clay loam soils with soil pH ranging from 5.8 to 7.2. The soils were medium with respect to available nitrogen and phosphorus and rich in potassium. The climatic conditions were generally normal during the crop growth period. The crop growth was satisfactory during both the seasons, except that the rainy season crop was mildly affected with *Alternaria* leaf spot during the reproductive phase due to a cloudy weather with high relative humidity. The crop was fertilized with an NPK dose of 60:90:60 kg/ha and was irrigated to field capacity level as and when required. Plant protection measures were taken for rainy season crop. Each treatment had a gross plot size of 5.4 x 3.0 m. The treatments consisted of three levels of axillary bud nipping, two levels of plant density and two levels of growth hormone mixture spray. The observations were collected on five randomly selected plants from the sample rows. The seed recovery was recorded by hand sieving using the recommended sieve size for R-line (1.85 mm slotted). The seed quality parameters were recorded as per the standard procedures of ISTA (Anon., 1985). The vigor index was computed as the product of germination and seedling dry weight (Abudul Baki and Anderson, 1973).

RESULTS AND DISCUSSION

Effect of axillery bud nipping

The results indicated that retaining main head alone by removing all the axillary buds before they develop significantly improved the seed yield (1414 kg ha^{-1}) as well as seed recovery (80.42%) on processing (1149 kg ha^{-1}) as compared to no nipping (972 and 558 kg ha^{-1} respectively). However, nipping to retain main head plus one secondary head along with main head, caused seed yield (1425 kg ha^{-1}) on par with the superior treatment, although the latter resulted in lower processed seed yield (1089 kg ha^{-1}). Channakrishnaiah *et al.* (1992), Suresh Bhat (1994) and Venkappa, (1994) also reported improvement in seed yield of sunflower due to nipping of axillary buds.

The higher seed yield and seed recovery due to axillary bud nippling was mainly due to significant improvement of seed yield per plant (24.31-24.39 g) which in turn was a consequence of improvement in 100-seed weight (4.53-4.55 g) as compared to no nipping which recorded lowest values (Table 1). The higher seed yield in nipped plants was due to increased partition of dry matter to the single main head (47.8 g/plant) as compared to its distribution into several heads (45.06 g/plant) in non nipped plants. The seed recovery in non-nipped plants were poor due to more number of smaller seeds. Similar observations of improved source sink relationship in sunflower have been reported by Il'yashuk *et al.* (1982) and Merrien *et al.* (1983). The improved source sink relationship due to nipping also reflected in higher seed quality parameters. The germination (83-88%), dry weight per seedling (24.56-26.96 mg) and the vigour index (2126-2415) were superior in seeds of nipped plants as compared to non-nipped plants. Nipping of axillery buds also resulted in highest net returns (Rs. 35786.37772/ha) and B : C ratio (4.66-4.77) as compared to no nipping (Table 2).

Effect of plant densities

The efforts made to manuplate the source sink relationship through altered plant density (55,555 and 74,074 plants ha^{-1}) following a spacing of 60 x 30 and 45 x 30 cm respectively, did not much help in improving the yield (1250-1291 kg ha^{-1}) and seed recovery, although lower plant density resulted in better seed quality parameters like, 100-seed weight (4.56 g), dry matter per seedling (24.42 mg) and vigour index (2097) indicating that 60 x 30 cm spacing is optimum for better seed yield and quality.

Effect of growth hormone mixture spray

The efforts made to improve source sink relationship through growth hormone mixture (TIBA 240 ppm + NAA 50 ppm) sprayed on head at the time of ray floret opening did not help in improving the seed yield and its recovery but exhibited favorable effect on seed quality parameters like dry matter per seedling (24.13 mg) and vigor index (2060). Growth hormone spray resulted in lower net returns (Rs. 289264/ha) and B : C ratio 93.87) as compared to no spray (Rs.31472/ha and 4.27 respectively) due to higher cost of the growth hormones and its application.

Thus, the study inferred that nipping axillary buds to retain only main head and a population of 55,555 plants ha^{-1} (60 x 30 cm) is optimum for higher seed yield and quality of RHA 6D-1 sunflower male parent. The study also gave an indication that the crop performance was superior during summer season as indicated by the higher average seed yield (1606 kg ha^{-1}) as compared to rainy season (935 kg ha^{-1}) due to favorable weather condition. However, the trend of results did not vary much between the seasons. Thus, the mean values of the pooled data also represent the normal results.

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Table 1. Growth and yield components in male parental line (RHA 6D-1) of KBSH 1 sunflower hybrid as influenced by axillary bud nipping, plant density and growth hormone mixture spray (Mean of two seasons, 1994).

Treatments	Dry matter distribution at maturity				Head dia at maturity (cm)	No.of filled seeds/ plant	Per cent seed filling	Seed yield/ plant (g)	Seed yield/ ha.(kg)	Harvest index
	Leaf	Stem	Head	Total						
Axillary bud nipping										
N_0 : No nipping	25.95	47.02	45.06 (27.60)	180.6	8.92 (2.26)	650 (328)	75.54	17.25 (8.78)	972 (499)	0.140
N_1 : To retain only main head	25.35	44.05	47.80	117.23	13.38	516	78.92	24.31	1414	0.202
N_2 : To retain main head + one secondary head	24.91	42.26	49.89 (10.18)	117.03	13.00 (4.80)	599 (160)	78.33	24.39 (4.23)	1425 (258)	0.205
S.Em ±	0.49	0.76	1.17	1.42	0.23	24	0.63	0.67	43	0.004
CD (P = 0.05)	NS	2.16	3.33	NS	0.66	68	1.79	1.91	119	0.011
Plant density										
S_1 : 55,555 Plants/ha	26.28	46.66	54.84	127.77	12.58	646	77.31	25.33	1250	0.195
S_2 : 74,075 Plants/ha	24.53	42.23	40.33	107.12	10.94	531	77.89	18.63	1291	0.170
S.Em ±	0.40	0.62	0.96	1.32	0.19	20	0.51	0.55	35	0.003
CD (P = 0.05)	0.11	1.77	2.73	3.80	0.54	57	NS	1.57	NS	0.009
Growth hormone spray										
G_0 : No hormonal spray	25.23	44.92	45.25	115.40	11.72	577	76.33	20.71	1220	0.175
G_1 : Spraying TIBA + NAA	25.58	43.97	45.92	119.50	11.81	599	78.86	23.25	1320	0.190
S.Em ±	0.40	0.62	0.96	1.32	0.19	20	0.51	0.55	35	0.003
CD (P = 0.05)	NS	NS	2.73	3.80	NS	NS	NS	NS	NS	0.009

Note : Figures in paranthesis refers to contribution from secondary heads.

Table 2. Processed seed yield, seed recovery, seed quality parameters and economics of seed production in male parental line (RHA 6D-1) of KBSH-1 sunflower hybrid as influenced by auxillery bud nipping, plant density and growth hormone mixture spray (Mean of two seasons, 1994).

Treatments	Processed seed yield (kg/ha)	Per cent seed recovery	100-seed weight (g)	Seed germination (%)	Dry matter per seedling (mg)	Vigour index	Seed oil content (%)	Seed protein content (%)	Net returns (Rs./ha)	B:C ratio
Axillary bud nipping										
N_0 : No nipping	558	57.61	3.61 (1.50)	79.44	18.81	1484	40.23	13.73	16046	2.79
N_1 : To retain only main head	1149	80.42	4.53	90.04	26.96	2415	37.11	15.32	37772	4.77
N_2 : To retain main head + one secondary head	1089	76.51	4.55 (2.75)	87.27	24.56	2126	38.73	15.39	35786	4.66
S.Em ±	31	0.55	0.04	0.34	0.18	19	0.23	0.14	-	-
CD (P = 0.05)	87	0.78	0.11	0.98	0.51	54	0.66	0.40	-	-
Plant density										
S_1 : 55,555 Plants/ha	930	72.65	4.56	85.90	24.42	2097	38.49	14.76	29718	4.07
S_2 : 74,075 Plants/ha	934	70.37	3.90	85.26	22.47	1920	38.89	14.86	30018	4.04
S.Em ±	26	0.45	0.03	0.27	0.15	16	0.40	0.11	-	-
CD (P = 0.05)	NS	1.28	0.09	NS	0.43	46	NS	NS	-	-
Growth hormone spray										
G_0 : No hormonal spray	895	70.98	4.07	85.19	22.76	1922	38.81	14.82	31472	4.27
G_1 : Spraying TIBA + NAA	968	72.04	4.40	85.97	24.13	2060	38.58	14.79	28264	3.87
S.Em ±	26	0.45	0.03	0.27	0.15	16	0.40	0.11	-	-
CD (P = 0.05)	NS	NS	NS	NS	0.43	46	NS	NS	-	-

Note : Figures in paranthesis refers to contribution from secondary heads.