# Effect of Planting Ratios and Staggered Sowing on Seed Yield and Quality in KBSH-1 Sunflower Hybrid Seed Production

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## Abstract

Flowering synchrony and planting ratios of parental lines are key factors which decide the hybrid seed yield. Field study conducted during rainy season to study the effect of male to female planting ratios of 1:3, 1:4 and 3:9 blocking under three staggered sowing viz., simultaneous, three and five days early sowing of male, indicated that planting ratios of 1:3, 1:4 and 3:9 blocking recorded seed yield (849-887 kg $ha^{-1}$) and yield attributes which were statistically on par, but these were significantly superior over 1:5 ratio (713 kg $ha^{-1}$). Sowing of pollen parent five days earlier to female was found to be optimum for highest seed yield (941 kg $ha^{-1}$). However, numerically higher seed yield (1030 kg $ha^{-1}$) was observed with 1:4 ratio with five days staggering of pollen patent. Seed quality parameters like test weight, germination and vigour index were found not influenced by planting ratios. Simultaneous sowing although recorded highest seed quality parameters, resulted in significantly lowest seed yield as compared to moderate values with five day staggering treatment which recorded highest seed yield.

Key words : Flowering synchrony, Staggering, Blocking, Planting ratio.

## Introduction

With the development of hybrid sunflowers in India, the crop has made a significant advancement in the vegetable oil seed front in terms of area (2.7 m ha) and production (1.4 m.t). The demand for quality seed calls for improvement of both

productivity and quality in hybrid seed plots. The sunflower hybrid KBSH-1 is one of the superior hybrid recently released for commercial cultivation in India. The productivity of hybrid seed production plots of KBSH-1 was limited by lack of flowering synchrony and optimum plant stand which are considered to be the key factors of production. A preliminary field study was therefore conducted at Bangalore during rainy season (1992) under protective irrigation, on red sandy loam soils to study the influence of planting ratios and staggered sowing of male on hybrid seed yield and quality in KBSH-1 hybrid seed production.

## Material and Methods

The parental lines viz., CMS 234A (female) and RHA 6D-1 (male) were grown in different row proportions of male to female (1:3, 1:4, 1:5 and 3:9 blocking) under three staggered sowings of male (simultaneously, two and five days earlier to female). The experiment was laid out in split plot design with planting ratios in main plot and staggered sowings as sub-plot treatments, replicated thrice. Each plot was adjusted to 3 m width and 8.4 m long irrespective of planting ratios. The crop was fertilized with 30 N : 90 $P_2O_5$ : 60 $K_2O$ kg $ha^{-1}$ as basal dose and 30 kg N $ha^{-1}$ top dressed at 40 days after sowing. Seeds were hand dibbled following a spacing of 60 x 30 cm as per the treatment combinations. Supplimentary hand pollination was done in the morning hours (8-11 A.M.) on alternate days in case of row ratios while in case of 3:9 blocking it was done every day by collection of pollen and dusting on the female using a camel hair brush, during the flowering period. Isolation requirement for the seed plot was achieved by following time isolation. Rogueing of off types and pollen shedders was done well in time to prevent contamination. The female heads were harvested separately from the net plot, threshed, cleaned and dried to record the yield. The yield components and other ancillary characters were recorded on five randomly selected female plants. Germination percentage was recorded for

the $F_1$ seed following standard germination test between paper method (ANON., 1985), after 50th day of harvest and seedling vigour index was computed by multiplying the grmination (%) and seedling dry weight (mg) (ABDUL BAKI and ANDERSON, 1973). Statistical analysis of the data was conducted following the "Fishers analysis of variance technique".

## Results and Discussion

The results (Table 1) indicated that the row ratios viz., 1:3, 1:4 and 3:9 blocking did not differ statistically in hybrid seed yield (849-887 kg $ha^{-1}$) although 1:4 ratio recorded numerically higher seed yield (887 kg $ha^{-1}$), but all these were significantly superior to 1:5 row ratio (713 kg $ha^{-1}$). The higher seed yield with lower row ratios was mainly a consequence of significantly highest per cent seed set and number of filled seeds per head as compared to 1:5 row ratio. The row ratio of 1:5 although had higher number of female plants per unit area, failed to record higher seed yield mainly due to low percentage of seed set (24.39) as compared to lower row proportions. The poor seed set with 1:5 row ratio may be attributed to insufficient pollen movement and inadequate pollen supply. PATEL and VAISHNANI (1976) reported similar findings in hybrid castor seed plots. SEETHARAM and SATHYANARANA (1983) observed that the per cent seed set in BSH-1 hybrid seed plot decreased significantly beyond third row when male and female was planted in the proportion of 1:4 and 1:5. Thus they suggested that the row ratio of 1:3 would be optimum. Similarly UJJINAIAH (1985) also observed that the number of filled seeds were significantly highest with 1:3 row ratio than 1:4 in BSH-1 hybrid seed plot. In the present study, the seed yield and yield attributes were found statistically on par between 1:3 row ratio (849 kg $ha^{-1}$) or 3:9 blocking (860 kg $ha^{-1}$). This may be due to no change in the proportion of male to female, except that the male was planted in separate block and pollinated manually every day. Since there is a staggering requirement to achieve

flowering synchrony in KBSH-1 seed production, blocking would be more advantageous in terms of convenience for staggered sowing, efficient management of male parent and better utility of pollen. However, blocking involves a iittle additional labour cost for collection of pollen and pollination.

Nevertheless, the accurate and estimates of the effect of planting ratio in hybrid seed production experriments, probably could be assessed only over large areas with suitable isolation between the plots having different row ratios. However separating the plots of each ratio would introduce excess soil heterogenity and environmental effects. Since honey bees are major pollinating agents in sunflower, it would be difficult to check their movement between plots of different ratios and hence may require larger isolation distances upto 500 meters or above (RAI and SINGH, 1977). Yet another consideration is that of availability of pollen for pollination. The estimate that sunflower can produce 125-250 million pollen grains per plant (DEODIKAR et al., 1977) indicate that pollen availability may not be a problem but the movement of pollen from male to female decides the seed set percentage. In the present experiment the observations on foraging behaviour of honey bees indicate that, the rock bees (Apis dorseta) which was a major visitor, preferred to visit male parent at all times of the day between 7 to 18 hours giving an indication that pollen shortage would occur due to pollen stealing. The bees were found to give frequent visits to male parent for collection of honey and pollen and limited visits to female parent (Fig. 1). Thus the study gives an indication that hand pollination is very essential irrespective of the row proportions adopted. The seed quality parameters was found to be not affected by the planting ratios.

Staggered sowing of male parent five days earlier to female resulted in highest seed yield (941 kg $ha^{-1}$). The seed yield increased significantly from zero to two and five days irrespective of planting ratios. This was mainly due to better flowering

synchrony between parental lines when male was sown five days earlier to female as evident by significant increase in number of filled seeds per head (439) and highest seed set percentage (48.13) as compared to other staggering treatments. However the low seed set percentage (48.3%) in 5 days staggering gives an indication of further scope to enhance the staggering period to improve the seed set. VRANCENU (1980) reported, two to six days difference in flowering of parental lines of six sunflower hybrids and suggested early sowing of male parent upto 10 days to ensure higher degree of pollination. The seed quality parameters like test weight and vigour index were found to be significantly higher with zero day staggering followed by two day staggering although they recorded significantly lowest seed yield. This may be a consequence of better translocation of photosynthates to limited sink available leading to development of bold seeds. However, the five day staggering resulted in relatively moderate values for seed quality parameters together with highest seed yield which would be otherwise desirable.

The interaction effects for seed yield although was not significant, numerically higher seed yield (1030 kg $ha^{-1}$) was observed when parental lines were planted in 1:4 ratio with five day staggering. Thus it can be concluded from the study that, a planting ratio of 1:3 or 1:4 with five day staggering of male parent would be optimum for KBSH-1 hybrid sunflower seed production. However, blocking system of planting in 1:3 ratio (3:9), would offer more advantage for staggering and better management of hybrid seed plot in situations, where there is no much scarcity for manual labour. Since bee activity in hybrid seed plot has limited role, the success of the seed production depends on timely hand pollination utilizing the available pollen well in advance of the bee visit.

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Table 1. Effect of planting ratio and staggered sowing of parental lines on seed yield and its attributes.

| Treatment | Hybrid seed yield (kg/ha) | Seed yield/ plant (g) | Seed set (%) | No.of filled seeds/ plant | 100-seed weight (g) | Germi-nation (%) | Vigour index |
|---|---|---|---|---|---|---|---|
| Planting ratios | | | | | | | |
| $r_1$ (1:3 ratio) | 848.80 | 17.93 | 35.66 | 326 | 5.69 | 98.60 | 5940 |
| $r_2$ (1:4 ratio) | 887.30 | 17.33 | 35.51 | 334 | 5.60 | 97.78 | 5856 |
| $r_3$ (1:5 ratio) | 713.00 | 14.87 | 24.39 | 235 | 5.70 | 98.33 | 5926 |
| $r_4$ (3:9 blocking) | 859.90 | 17.97 | 33.79 | 323 | 5.61 | 98.22 | 5911 |
| S.Em ± | 21.04 | 0.11 | 0.60 | 15.38 | 0.03 | 0.19 | 44.26 |
| CD at 5% | 74.91 | 0.38 | 2.07 | 53.21 | NS | NS | NS |
| Staggered sowing of male | | | | | | | |
| $d_1$ (simultaneously) | 708.80 | 12.51 | 21.36 | 196.0 | 6.01 | 98.67 | 6087 |
| $d_2$ (2 days early) | 832.20 | 16.23 | 27.52 | 279.0 | 5.73 | 98.92 | 5945 |
| $d_3$ (5 days early) | 940.70 | 22.33 | 48.13 | 439.0 | 5.23 | 97.08 | 5693 |
| S.Em ± | 21.22 | 0.16 | 0.64 | 7.40 | 0.03 | 0.26 | 21.69 |
| CD at 5% | 63.63 | 0.47 | 1.91 | 22.20 | 0.09 | 0.79 | 65.04 |
| Interaction | | | | | | | |
| $r_1d_1$ | 730.50 | 13.18 | 21.91 | 182.0 | - | - | 6143 |
| $r_1d_2$ | 838.70 | 16.83 | 31.84 | 342.0 | - | - | 6021 |
| $r_1d_3$ | 977.40 | 23.77 | 53.23 | 454.0 | - | - | 5657 |
| $r_2d_1$ | 729.20 | 12.66 | 22.25 | 205.00 | - | - | 6036 |
| $r_2d_2$ | 902.90 | 16.42 | 30.38 | 291.00 | - | - | 5924 |
| $r_2d_3$ | 1030.10 | 22.90 | 53.91 | 507.00 | - | - | 5608 |
| $r_3d_1$ | 638.90 | 10.91 | 18.44 | 179.00 | - | - | 6030 |
| $r_3d_2$ | 722.20 | 14.84 | 21.34 | 208.00 | - | - | 5947 |
| $r_3d_3$ | 777.80 | 18.86 | 33.40 | 317.00 | - | - | 5801 |
| $r_4d_1$ | 736.80 | 13.29 | 22.85 | 216.00 | - | - | 6141 |
| $r_4d_2$ | 865.30 | 16.84 | 26.54 | 273.00 | - | - | 5888 |
| $r_4d_3$ | 877.40 | 23.79 | 51.99 | 480.00 | - | - | 5703 |
| SEm sub v/s main plot | 42.45 | 0.31 | 1.27 | 14.81 | - | - | 43.49 |
| SEm Main v/s sub plot | 40.86 | 0.28 | 1.20 | 19.56 | - | - | 56.69 |
| CD at 5% sub v/s Main plot | NS | 0.94 | 3.82 | 44.40 | - | - | NS |
| CD at 5% Main v/s sub plot | NS | 0.86 | 3.73 | 64.23 | - | - | NS |

* Significant at P = 0.05, NS = Non-significant

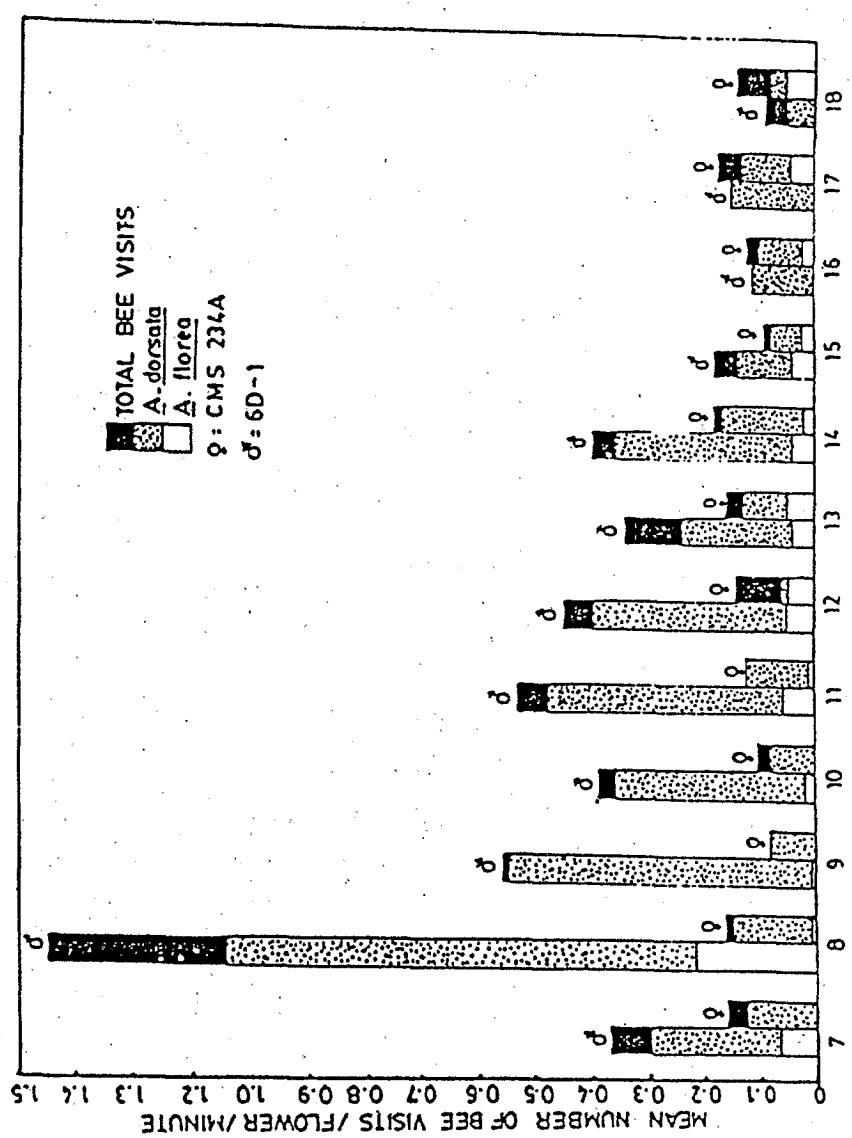


Fig. 1. FREQUENCY OF BEE VISITS (mean) PER FLOWER PER MINUTE RECORDED AT DIFFERENT HOURS OF THE DAY DURING FLOWERING IN PARENTAL LINES OF SUNFLOWER HYBRID KBSH-1 DURING KHARIF-1991