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Evaluation of High Yielding Sunflower Hybrids with Fertilizer Levels for Tamil Nadu

Selvakumar T, Rajendran L, Manivannan N, Chandirakala R, Sasikala R and Viswanathan PL

Department of Oilseeds, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu, India

ABSTRACT

The present study aimed to assess the high-yielding sunflower hybrids responding to various fertilizer levels. The experiment was conducted . with treatments that includes five genotypes in factor A (H_1: COH 3, H_2: DRSH-1, H_3: KBSH-74, H_4: KBSH-44, and H_5: CO 2) and three fertilizer levels in factor B (F_1: 50 percent RDF, F_2: 100 percent RDF and F_3: 150 percent RDF) in a three replications factorial randomized block design The study revealed that plant height and days to maturity of sunflower showed significant differences among the hybrids and different levels of fertilizer. Days to 50 per cent flowering significantly differed among the hybrids and not by the NPK level. The newly developed sunflower hybrid COH 3 recorded a higher yield (2194 kg ha^{-1}) with high oil content (39.8 percent) and oil yield of 875 kg ha^{-1}. Hybrid COH 3 registered a higher gross return of Rs. 70,208/- per ha with a net return of Rs.28,202/- and a cost-benefit ratio of 1.60. Among fertilizer levels, the 150 percent RDF recorded the highest yield, which was on par with the 100 per cent RDF. In monetary terms, rupee return per rupee investment was greater than 100 percent. As a result, in the Tamil Nadu region, sunflower hybrid COH 3 cultivation with 100% fertilizer, i.e., 60:90:60 kg NPK ha^{-1}, was shown to be economical with better oil yields.

Keywords: *Sunflower; COH 3; Fertilizer; Yield; Oil content*

INTRODUCTION

Sunflower (*Helianthus annuus* L.) plays an important role in global vegetable oil production, contributing up to 12 per cent. India is the largest producer of oilseed crops in the world and oilseed crop-based sector occupies a key position in the country's economy (Kolar *et al.,* 2020). The area under oilseed crops occupied in India is 12-15 per cent of global oilseeds cultivated area with 6-7 per cent of global vegetable oil production and 9-10 per cent of the total edible vegetable oils consumption (NABARD, 2020). The oilseeds scenario in the country had undergone a significant change in the last two decades, while India changed from a net importer in the 1980s to a net exporter status during the early 1990s. It has reverted to net importer status, and depend on more than 40% of its annual edible oil requirements.

Russia and Ukraine have the largest share of about 52% in area and 53% in total sunflower production in the world. The national average yield of sunflower was around 714 kg ha^{-1} as against the world average of 1948 kg ha^{-1}. India holds 17th position in area (2.8 lakh ha), 22nd in production (2.0 lakh tonnes) and 66th position in productivity (714 kg ha^{-1}) in sunflower (www.indiastat.com). As of 2019-2020, Telangana state holds 1st among the state average yield of sunflower and registers higher than the world average yield (1948 kg ha^{-1}). Karnataka has the first position in sunflower area (1.29 lakh ha) and production (1.03 lakh tonnes). Tamil Nadu holds 9th place in area (4.25 thousand ha), 11th place in production and 10th place in productivity (902 kg ha^{-1}) of sunflower (www.indiastat.com). A maximum area of 26.7 lakh ha was achieved under sunflower during 1993-94 in the country. After that, the area under sunflower declined to 2.8 lakh ha during 2019-20. However, sunflower productivity in India increased over the years. The increase in productivity in India is due to the introduction of improved hybrids and by the adoption of cost effective agro-techniques with optimal use of fertilizer.

Sunflower is a photo and thermo-insensitive, short-duration, deep-rooted, drought-resistant, widely adaptable crop (Meena *et al*., 2018). It offers potential for its cultivation to boost oilseed production. Sunflower hybrid development is gaining significance, based on its highly self-fertile, stable, high yielding and

uniformity under different climatic conditions (Manivannan *et al.*, 2017). Hybrid variety has some desirable advantages *viz*., faster growth, adaptation to stress, higher yield, and disease resistance. Farmers prefer hybrids compared to varieties for their higher productivity, uniformity, and even at maturity (Sasikala *et al*., 2020).

The addition of crop nutrients at optimal doses is essential for safe and affordable food security for the developing population. Since the adoption of high yielding hybrid under the irrigated situation, the addition of plant nutrients is essential to meet the requirement of high yielding hybrid to achieve its potential. Suzer (1998) reported that appropriate fertilization is vital for getting high productivity. Mortvedt *et al.* (2003) observed that fertilizing soil is an essential component for the effective commercial production of sunflower. Application of complete fertilizers *i.e*., having nutrients like nitrogen, phosphorous and potash will improve sunflower growth and sustain the yield (Cechin and Fumis, 2004 and Sadras, 2006).

Based on the above scenario, the present investigation was carried out to assess the high yielding sunflower hybrids with different fertilizer levels for Tamil Nadu.

MATERIAL AND METHODS

A field experiment was conducted at Oilseeds farm of Tamil Nadu Agricultural University, Coimbatore during *kharif*, 2016. Sowing was taken in ridges and furrows on 01.08.2016, and harvesting was carried out on 03.11.2016. Location is geographically situated at 11.02° N latitude, 76.93° E longitude and an altitude of about 443 m above mean sea level with a semi-arid and tropical climate. During the cropping period, the crop received a total rainfall of 79.60 mm on 4 rainy days. The mean maximum and minimum temperature were 32.3 ^{o}C and 22.9 ^{o}C respectively. The mean relative humidity (RH) ranged from 85.5% to 54.7% at forenoon and afternoon respectively. During the study period, the average bright sunshine hour was 6.2 hours per day with an average solar radiation of 386 cal cm^{-2} min^{-1}. The experimental soil was sandy clay loamy soil with 7.8 pH, 0.6 dS/m electrical conductivity, 0.35 % organic carbon content, low in available nitrogen (279 kg ha^{-1}), low in available phosphorus (9.7 kg ha^{-1}), and high in available potassium (475 kg ha^{-1}).

A set of treatments comprising five genotypes in Factor A *viz*., H_1- COH 3, H_2 - DRSH-1, H_3 - KBSH-74, H_4 - KBSH-44 and H_5 - CO 2 hybrid, and three levels of fertilizer in Factor B *viz*., F_1 - 50 % RDF, F_2 - 100 % RDF and F_3 - 150 % RDF which replicated thrice and laid out in factorial randomized block design. The gross plot size was 5.4 m × 4.8 m with a net plot of 4.8 m X 3.6 m. Hybrid seeds of sunflower were sown in the ridges at 60 x 30 cm spacing @ two seeds per hill and later it was thinned leaving one healthy seedling per hill to maintain 100 percent plant population. Urea, single super phosphate, and muriate of potash fertilizers were used to meet the fertilizer requirement of the sunflower crop based on the recommended NPK dose @ 60:90:60 kg ha^{-1} as per the treatment of Factor B and all the fertilizers were applied as basal as per the recommendation.

The cost of cultivation for various treatments was estimated based on prevailing rates in Coimbatore for hiring charges of implements, input costs, and labour charges. Gross returns were calculated by multiplying the yield of sunflower by price and the net returns were calculated by subtracting the total cost of cultivation from gross returns. The data collected were analyzed as per the analysis of variance (ANOVA) for factorial randomized block design at 0.05 probability (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Growth parameters

The plant height of sunflower varied significantly and among the different hybrids KBSH-44 and DRSH-1 recorded higher plant heights. The highest plant height was obtained from 150% RDF treatment (90:135:90 Kg NPK ha^{-1}) which was on par with the 100% RDF treatment (60:90:60 Kg NPK ha^{-1}) and is in accordance with the findings of Bakht *et al*. (2015). Days to 50 per cent flowering significantly differed among the hybrids and not by the NPK level. However, numerically days to attain 50 per cent flowering of a sunflower plant are earlier when provided with a higher dose of fertilizer. Another study showed that increasing NPK dose would accelerate vegetative growth, which is responsible for the delay in flowering (Sadiq *et al*., 2000). The interaction effect between hybrids and fertilizer dose was not significant for all characters.

On the other hand, sunflower hybrids have a wide range of days to maturity due to their efficient use of solar energy. The maturation of KBSH-44 was delayed. When the fertilizer dose was reduced, it fastened the maturity due to less availability of nutrient support to the crop plant. A similar finding was reported that the

different NPK levels significantly affected the days to maturity by Handayati and Sihombing (2019). The head diameter of the sunflower also significantly differed among the hybrids and fertilizer levels. COH 3 sunflower hybrid registered a significantly higher head diameter (15.4 cm). The increase in NPK levels also significantly increased sunflower head diameter. The same positive response of the sunflower crop toward increasing NPK levels was observed by Bakht *et al*. (2010).

Yield Parameters and Yield

In the present study, all the yield parameters, , as well as quality, differed among hybrids. Among hybrids, the newly developed COH 3 sunflower hybrid registered higher yield attributes *viz*., 100 seed weight (5.3 g), seed volume weight (41.9 g/100 mL), number of grains / capitulum (875 nos.) than the other hybrids. Manivannan *et al.* (2021) also observed that the COH 3 sunflower hybrid, developed from a cross between a male sterile line COSF 6A and multi-head restorer line IR6 was superior over other hybrids due to its high yielding ability coupled with high oil content and high-volume weight. COH 3 sunflower hybrid recorded a higher yield of 2194 kg ha^{-1} with a higher oil content of 39.8 per cent and oil yield of 875 kg ha^{-1}.

Application of nutrients (NPK) at different levels prominently influences the yield attributes and yield of sunflower hybrids such as 100 seed weight, seed volume weight, number of grains/ capitulum, seed yield (kg ha^{-1}), oil content (%), and oil yield (kg ha^{-1}) (Table 2). The interaction effect of hybrids and fertilizer dose was non-significant for all traits except for volume weight. This study observed that reduction of nutrients from ample NPK supplement affected constant reduction in yield parameter, yield, and quality. These observations show that fertilization with a higher dose of N, P, and K can increase the size of the head diameter, which consequently increases the number of grains/capitulum up to 953 numbers with a higher volume weight of 40.9 g/ 100 mL and 100-grain weight of 5.0 g. Grain numbers per capitulum increased with increasing NPK levels. It might be due to the fact that higher growth characteristics occurred with a higher NPK dose, which favors yield and its attributes. The same result was reported by Sadiq *et al*. (2000) that NPK levels significantly affected the number of grains per disc. These findings were substantiated by the outcomes of Rondanini *et al.* (2007) and Cantagallo *et al.* (2009) who reported that the reduction of N affects the development and growth of both source and sink, and the number of seeds/ capitulum.

Furthermore, the same findings were reported and supported by several authors that N application affects dry matter accumulation and partitioning into various parts for growth and development (Khaliq and Cheema, 2005). Phosphorus is also more prone to fixation and is non-available to plants through interaction and reactions with soil and other elements. The application of potassium fertilizer also responded effectively with respect to yield formation in sunflowers (Amanullah and Khan, 2011).

Economics

Economics of sunflower cultivation revealed that the cost for production of sunflower for 1 ha is around Rs. 42,000/- and varied based on the quantity of fertilizer used. The gross return of sunflowers was worked out based on the prevailing market cost of sunflower in the past one year (Rs. 32 /kg) by multiplying with yields.

Based on the yield of sunflower, gross return varied accordingly from Rs. 60,704 to Rs. 70,208. Hybrid COH 3 registered a higher gross return of Rs. 70,208/- per ha with a net return of Rs.28,202/- and cost-benefit ratio of 1.67. By adopting different levels of nutrients, the gross return varied from Rs. 50,720 to 74,080 accordingly. Fertilizer application of 150 per cent RDF registered a higher gross return of Rs. 74,080/- per ha with a net return of Rs.28,734/-. However, rupees return per rupee investment was reduced to 1.63 when the fertilizer level was increased to 150 percent, whereas 100 per cent level registered 1.67. It is clear that the addition of fertilizer may enhance sunflower production, but not in a cost-effective manner.

CONCLUSION

COH 3 sunflower hybrid produced the highest yield of 2194 kg ha^{-1} with a good monetary return. The best yielding fertilizer level was 150 percent RDF, although the rupee return per rupee investment was greater than 100 percent. As a result, in the Tamil Nadu region, sunflower hybrid COH 3 cultivation with 100% fertilizer, i.e., 60:90:60 kg NPK ha^{-1}, was found to be economical with better oil yield.

Table 1. Effect of new hybrids and fertilizer levels on growth and yield parameters of sunflower

Treatments	Plant height (cm)	Days for 50% flowering	Days to maturity	Head diameter (cm)
Factor A: New Hybrids				
H_1-COH 3	162	55.1	85	15.4
H_2-DRSH-1	185	55.8	89	14.6
H_3-KBSH-74	166	51.9	83	13.5
H_4-KBSH-44	185	55.2	90	13.8
H_5-CO 2 hybrid	172	55.7	86	13.7
SEm±	6.8	0.4	0.4	0.6
CD (P=0.05)	18.9	1	1.1	1.6
Factor B: Fertilizer levels				
F1- 50% RDF	163	55.0	86	13.7
F2- 100% RDF	177	54.8	87	14.0
F3 -150% RDF	183	54.4	87	14.9
SEm±	5.3	0.3	0.3	0.4
CD (P=0.05)	14.6	NS	0.8	1.2
H x F				
SEm±	11 .8	0. 6	0. 7	1.0
CD (P=0.05)	NS	NS	NS	NS

Table 2. Effect of new hybrids and fertilizer levels on yield, oil content and oil yield of sunflower

Treatments	100 seed wt (g)	Volume wt (g/100 ml)	Number of grains/capitulum	Seed yield (kg ha^{-1})	Oil Content (%)	Oil Yield (kg ha^{-1})
Factor A: New Hybrids						
H_1-COH 3	5.3	41.9	875	2194	39.8	875
H_2-DRSH-1	4.9	41.0	821	1897	39.4	746
H_3-KBSH-74	5.0	39.9	857	2028	37.6	761
H_4-KBSH-44	4.9	38.0	867	2111	32.0	678
H_5-CO 2 hybrid	4.9	40.4	836	1927	36.3	699
SEm±	0.03	0.27	30.8	83	0.4	34.1
CD (P=0.05)	0.08	0.75	NS	231	1.2	94.7
Factor B: Fertilizer levels						
F1- 50% RDF	4.9	39.6	700	1585	37.0	585
F2- 100% RDF	5.0	40.2	918	2195	37.2	815
F3 -150% RDF	5.0	40.9	953	2315	36.9	855
SEm±	0.02	0.21	23.8	65	0.3	26.4
CD (P=0.05)	0.06	0.58	66.2	179	NS	73.3
H x F						
SEm±	0.0 5	0.4 7	53.3	14 4	0.7	59.1
CD (P=0.05)	NS	1.3	NS	NS	NS	NS

Table 3. Effect of new hybrids and fertilizer levels on economics of sunflower

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross Return (Rs. ha^{-1})	Net Return (Rs. ha^{-1})	B:C ratio
Factor A: New Hybrids				
H_1-COH 3	42006	70208	28202	1.67
H_2-DRSH-1	42006	60704	18698	1.45
H_3-KBSH-74	42006	64896	22890	1.54
H_4-KBSH-44	42006	67552	25546	1.61
H_5-CO 2 hybrid	42006	61664	19658	1.47
Factor B: Fertilizer levels				
F_1- 50% RDF	38666	50720	12054	1.31
F_2- 100% RDF	42006	70240	28234	1.67
F_3 -150% RDF	45346	74080	28734	1.63

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