

## Original Research Article

### **Studies on Growth, Yield and Economics of SUNFLOWER (*Helianthus annuus* L.) var. KBSH – 1 as influenced by Nitrogen and Spacing**

#### **ABSTRACT**

A field experiment was conducted during *kharif season* of 2022, at crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj to study the effect of nitrogen and spacing on growth, yield and economics of Sunflower (*Helianthus annuus* L.) Var. KBSH - 1 with 10 treatments of which treatments (T<sub>1</sub>-T<sub>9</sub>) with different combination of nitrogen along with spacing and T<sub>10</sub> is control which are replicated thrice. The result revealed that application of 70 kg N/ha + 45 X 20 cm recorded maximum seed yield (2102 kg/ha). Stover yield (4287.92) highest net return (88.737x 10<sup>3</sup> INR/ha) and benefit: cost ratio (2.37).

**Key words-** Sunflower, Nitrogen, Spacing, Growth, Yield, Economics

#### **INTRODUCTION**

Sunflower is one of the most important oil seed crop grown in temperate countries. It is a major source of vegetable oil in the world. In India it has gained popularity due to the national priority of vegetable oil production. India is one of the largest producers of oilseed crop in the world. Oilseeds occupy an important position in the Indian agricultural economy. It is an important oil seed crop contributes 14% of the total oilseed production from other major oil seed crops. Sunflower oil is considered as premium when compared to other vegetable oils. Sunflower is the oil of preference among the consumers the world over due to its health appeal and in India too, sunflower oil is the largest selling oil in the branded oil segment. Sunflower oil content varies from 48-53% and it is premium oil with pale yellow in colour used for cooking and margarine. Sunflower is a rich source of linoleic acid (64%) which helps in reducing cholesterol deposition in the coronary arteries of the heart. Oil contains high level of alpha tocopherol, a form of vit. E. Sunflower is also a crop of choice for farmers due to its wider adaptability, high yield potential, shorter duration and profitability.

Among nutrients, nitrogen plays an important role in growth and yield of sunflower. Nitrogen is the most important limiting nutrient which helps early growth, better assimilation of carbohydrates and synthesis of proteins and as such must be supplied throughout the growth period of the crop. It also affects the seed quality by increasing protein content and decreasing oil concentration (**Gudade et al.2009**).

The plant spacings is an important factor, Spacing may affect the utilization of light, water and nutrients, thus, the growth and achene yield of sunflower will increase. **Metz et al.(1984)** suggested that the optimum achene yield might be obtained when intra and inter-row spacings are about the same at any given plant density. Hence, an experiment was planned to study the influence of Nitrogen and spacing on productivity of sunflower.

Plant spacing effects are highly pronounced in sunflower because there is no possibility of covering gaps between plants by branching or tillering. Thus, an optimum plant stand helps in harnessing the natural resources in efficient manner towards achieving high crop yields. Beside this, spacing influences crop yield through its influence on light interception, rooting pattern and moisture extraction pattern. The high-density planting system (HDPS) is now being conceived as an alternate production system having a potential for improving productivity, profitability, efficiency, reducing input costs and minimizing the risks associated with crop production system.

## MATERIALS AND METHODS

A field experiment was conducted during kharif season of 2022, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the effect of nitrogen and spacing on growth and yield of Sunflower (*Helianthus annuus* L.). The experiment was laid out in Randomized Block Design comprising of 10 treatments which are replicated thrice. Each treatment net plot size is 3m × 3m. The treatments are categorized as with recommended dose of Nitrogen through Urea, Phosphorus through DAP and Potash through Muriate of Potash, in addition with sulphur when applied in combinations as follows, (T<sub>1</sub>) 50 kg N/ha + 45 X 20 cm, (T<sub>2</sub>) 50 kg N/ha + 55 X 20 cm, (T<sub>3</sub>) 50 kg N/ha + 65 X 20 cm, (T<sub>4</sub>) 60 kg N/ha + 45 X 20 cm, (T<sub>5</sub>) 60 kg N/ha + 55 X 20 cm, (T<sub>6</sub>) 60 kg N/ha + 65 X 20 cm, (T<sub>7</sub>) 70 kg N/ha + 45 X 20 cm, (T<sub>8</sub>) 70 kg N/ha + 55 X 20 cm, (T<sub>9</sub>) 70 kg N/ha + 65 X 20 cm, (T<sub>10</sub>) Control. The sunflower crop was harvested treatment wise at harvesting maturity stage. Growth parameters viz. plant height (cm), dry matter accumulation g plant<sup>-1</sup> were recorded manually on five randomly selected representative plants from each plot of each replication separately and after harvesting, seeds were separated from each net plot and were dried under sun for three days. Later winnowed, cleaned and grain yield per ha was computed and expressed in kgs per hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in kgs per hectare. The data was computed and analysed by following statistical method of **Gomez and Gomez (1984)**. The benefit: cost ratio was worked out after price value of seed with stover and total cost included in crop cultivation.

## RESULTS AND DISCUSSIONS

### Effect on growth parameters:

#### Plant height

It is evident from Table 1. that plant height measured increased with advancement in crop growth. At 80 DAS maximum plant height of 150.36 cm was recorded with treatment of 70 kg N/ha + 55 X 20 cm. However, treatment of 60 kg N/ha + 55 X 20 cm, control recorded statistically at par with 70 kg N/ha + 55 X 20 cm. The increase in plant height with higher levels of nitrogen was probably due to its beneficial effect on cell elongation which might have resulted in internodal elongation. Thus, adequate supply of nitrogen might have helped the plants to grow taller in comparison to 50 and 60 kg N ha. Similar findings were also reported by **Taha et al. (2001)** and **Sarkar and Mallick (2009)**. Plant height increased with decrease in plant density. Taller plant height in 55 X 20 cm spacing might be due to competition between space, light, carbon dioxide, oxygen and humidity which forced the

plants to grow vertically rather than horizontally. The present findings are in accordance with **Nawaz *et al.* (2001)**.

### **Dry matter accumulation**

At 80 DAS highest plant dry weight was found in treatment of 70 kg N/ha + 55 X 20 cm (60.53 g). However, treatment of 60 kg N/ha + 55 X 20 cm was found to statistically at par with treatment 70 kg N/ha + 55 X 20 cm. The dry weight of sunflower increased significantly due to application of nitrogen. Dry matter production related to grain productivity contributes an important factor in source – sink relationship. Higher dry matter production attributed to enhanced photosynthesis accumulation. Wider row spacing provided more space around each plant resulting in better vegetative growth which ultimately resulted in plant dry weight. These results are in conformity with those reported by **Reddi Ramu and Maheshwara Reddy (2003)** and **Sarkar and Mallick (2009)**, **Ravichandran and Srinivasan (2017)**.

### **Yield and Yield Attributes:**

#### **Capitulum diameter (cm)**

Significant effect was observed by the statistical analysis of Capitulum diameter. Treatment 70 kg N/ha + 55 X 20 cm resulted in significantly highest capitulum diameter (15.13 cm). However, 60 kg N/ha + 55 X 20 cm was found to be statistically on par with 70 kg N/ha + 55 X 20 cm. Significant increase in Capitulum diameter was favoured by higher levels of nitrogen. Improved stem elongation and accumulated photosynthates as manifested by higher LAI and dry matter might have been responsible for larger head (Capitulum) diameter. Thus, higher Photosynthetic activity with adequate nitrogen fertilization enabled the plant to accumulate more dry matter and greater translocation of photosynthates to the developing head resulting in larger flower heads. Similar results were also obtained by **Reddy *et al.* (2002)**, **Reddi and Reddy (2003)** and **Sarkar and Mallick (2009)**. Maximum head diameter was observed in spacing (55 X 20 cm), it might be due to less competition exerted for light, moisture and nutrients, Sufficient interception of sunlight promotes efficient photosynthesis activities and ultimately greater accumulation of photosynthates under wider spacing. Narrow spacing with dense plant population resulted in the lower value of yield attributes. The reduction in yield at with increase in plant density could be attributed to keen competition for moisture, photosynthesis and solar radiation. In wider spacing might be attributed to relatively less inter plant competition because of more space availability to individual plant. Similar results were also obtained by **Sen *et al.* (2002)**, **Kumar *et al.* (2004)**, **Ali *et al.* (2011)**.

#### **Seed yield**

Seed yield was significantly influenced with different combinations of Nitrogen and Spacing along with Phosphorus and Potassium The highest seed yield was obtained with the treatment of 70 kg N/ha + 45 X 20 cm (2102 Kg), however no other treatment was found to be statistically on par with of 70 kg N/ha + 45 X 20 cm. Higher seed yield under higher nitrogen application was due to good growth and availability of adequate nitrogen might lead to increased accumulation of amino acid and amide substance and their translocation to the reproductive organs has improved the seed yield through increased seed setting and filling. It was evident that plant spacing increased up to 45 X 20 cm showed highest seed yield but

increased spacing beyond this decreased the seed yield per plant to noticeable extent. The results are similar with results obtained by **Seshadri Reddy et al. (2002)**, **Reddi Ramu and Maheswara Redy (2003)** and **Sarkar and Mallick (2009)**, **Kumar et al. (2004)**, **Ali et al. (2011)**.

### **Stover yield**

The stover yield of sunflower was also influenced by the application of nitrogen and spacing. Highest stover yield (4287.9 kg/ha) was recorded for the treatment 70 kg N/ha + 45 X 20 cm, however, no other treatment was found to be statistically at par with 70 kg N/ha + 45 X 20 cm. Higher stover yield under higher nitrogen application was due to good growth and availability of adequate nitrogen might lead to increased accumulation of amino acid and amide substance and their translocation to the reproductive organs has improved the seed yield through increased seed setting and filling. It was evident that plant spacing increased up to 45 X 20 cm showed highest stover yield but increased spacing beyond this decreased the stover yield per plant to noticeable extent. The results are similar with results obtained by **Seshadri Reddy et al. (2002)**, **Reddi Ramu and Maheswara Redy (2003)** and **Sarkar and Mallick (2009)**, **Kumar et al. (2004)**, **Ali et al. (2011)**.

### **Economics:**

Among the different combination of nutrient source treatment 70 kg N/ha + 45 X 20 cm recorded highest net return ( $88.737 \times 10^3$  INR/ha) and benefit: cost ratio (2.37).

### **CONCLUSION**

The results revealed that application of 70 kg N/ha + 45 X 20 cm recorded highest seed yield (2102 kg/ha), gross return ( $126.120 \times 10^3$  INR/ha), highest net return ( $88.737 \times 10^3$  INR/ha) and benefit: cost ratio (2.37) which may be more preferable for farmers since it is economically more profitable and also achieved no statistical parity regarding seed yield of sunflower var. 'KBSH - 1'.

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UNDER PEER REVIEW

**Table 1. Effect of Nitrogen and Spacing on growth parameters of Sunflower var. 'KBSH - 1'**

S.No	T.No.	Treatments	Plant height (cm)	Dry matter accumulation (g plant/ha)
1	T <sub>1</sub>	50 kg N/ha + 45 X 20 cm	141.19	52.16
2	T <sub>2</sub>	50 kg N/ha + 55 X 20 cm	142.03	53.83
3	T <sub>3</sub>	50 kg N/ha + 65 X 20 cm	139.73	50.15
4	T <sub>4</sub>	60 kg N/ha + 45 X 20 cm	143.00	54.49
5	T <sub>5</sub>	60 kg N/ha + 55 X 20 cm	147.67	59.37
6	T <sub>6</sub>	60 kg N/ha + 65 X 20 cm	140.73	51.17
7	T <sub>7</sub>	70 kg N/ha + 45 X 20 cm	144.82	56.51
8	T <sub>8</sub>	70 kg N/ha + 55 X 20 cm	148.48	60.53
9	T <sub>9</sub>	70 kg N/ha + 65 X 20 cm	141.43	53.29
10	T <sub>10</sub>	Control	147.34	57.69
		SEm (±)	1.00	0.53
		CD (P 0.05)	2.97	1.56

**Table 2. Effect of Nitrogen and Spacing on yield and yield attributing characters of Sunflower var. 'KBSH - 1'**

S. No	T. No	Treatments	Capitulum diameter (cm)	Seed Yield (kg/ha)	Stover Yield (kg/ha)
1	T <sub>1</sub>	50 kg N/ha + 45 X 20 cm	12.70	1883.35	3830.76
2	T <sub>2</sub>	50 kg N/ha + 55 X 20 cm	13.30	1692.81	3448.24
3	T <sub>3</sub>	50 kg N/ha + 65 X 20 cm	12.03	1394.07	2855.08
4	T <sub>4</sub>	60 kg N/ha + 45 X 20 cm	13.67	2003.72	4067.13
5	T <sub>5</sub>	60 kg N/ha + 55 X 20 cm	14.67	1812.11	3642.39
6	T <sub>6</sub>	60 kg N/ha + 65 X 20 cm	12.37	1514.87	3085.84
7	T <sub>7</sub>	70 kg N/ha + 45 X 20 cm	14.03	2102.00	4287.92
8	T <sub>8</sub>	70 kg N/ha + 55 X 20 cm	15.13	1918.65	3818.31
9	T <sub>9</sub>	70 kg N/ha + 65 X 20 cm	13.00	1638.20	3310.80
10	T <sub>10</sub>	Control	14.47	1646.63	3293.34
		SEm (±)	0.18	29.60	59.60
		CD (P 0.05)	0.53	87.95	177.07

**Table 3. Effect of Nitrogen and Spacing on economics of Sunflower var. ‘KBSH - 1’**

<b>S.No</b>	<b>T.No.</b>	<b>Treatments</b>	<b>Cost of cultivation (x 10<sup>3</sup> INR ha<sup>-1</sup>)</b>	<b>Gross return (x 10<sup>3</sup> INR ha<sup>-1</sup>)</b>	<b>Net return (x 10<sup>3</sup> INR ha<sup>-1</sup>)</b>	<b>Benefit: Cost ratio</b>
1	T <sub>1</sub>	50 kg N/ha + 45 X 20 cm	37.122	113.001	75.879	2.04
2	T <sub>2</sub>	50 kg N/ha + 55 X 20 cm	36.722	101.569	64.847	1.77
3	T <sub>3</sub>	50 kg N/ha + 65 X 20 cm	36.447	83.644	47.197	1.29
4	T <sub>4</sub>	60 kg N/ha + 45 X 20 cm	37.253	120.223	82.970	2.23
5	T <sub>5</sub>	60 kg N/ha + 55 X 20 cm	36.853	108.726	71.873	1.95
6	T <sub>6</sub>	60 kg N/ha + 65 X 20 cm	36.578	90.892	54.314	1.48
7	T <sub>7</sub>	70 kg N/ha + 45 X 20 cm	37.383	126.120	88.737	2.37
8	T <sub>8</sub>	70 kg N/ha + 55 X 20 cm	36.983	115.119	78.136	2.11
9	T <sub>9</sub>	70 kg N/ha + 65 X 20 cm	36.708	98.292	61.584	1.68
10	T <sub>10</sub>	Control	35.384	98.798	63.414	1.79

**#Data not subjected to statistical analysis.**