Original Research Article

Studies on Growth, Yield and Economics of SUNFLOWER (*Helianthusannuus*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, Prayagrajto study the effect of nitrogen and spacingon growth, yield and economics of Sunflower (*Helianthus annuus*L.) Var. KBSH - 1with 10 treatments of which treatments(T_1-T_9) withdifferent combination of nitrogen along withspacing and T_{10} 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 10^3INR/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 amajor source of vegetable oil in the world. InIndia it has gained popularity due to thenational priority of vegetable oil production. India is one of the largest producers of oilseedcropintheworld.Oilseedsoccupyanimportantpositionin theIndianagriculturaleconomy.It is an important oil seed crop contributes 14% of the total oilseed productionfrom other major oilseed crops. Sunfloweroilisconsideredaspremiumwhencomparedtoothervegetableoils.Sunfloweristheoilofp referenceamongtheconsumerstheworldoverduetoitshealthappealandinIndiatoo,sunfloweroilisth elargestsellingoilinthebrandedoilsegment.Sunfloweroil content varies from 48-53% and it is premium oil with pale yellow in colour used forcooking and margarine. Sunflower is a rich source of linoleic acid (64%) which helps inreducing cholesterol deposition in the coronary arteries of the heart.Oilcontains high levelof alpha tocopherol, a formof vit. E.Sunfloweris also a crop of choicefor farmers due toitswideradaptability,highyieldpotential,shorterdurationandprofitability.

Among nutrients, nitrogen playsan 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 (**Gudadeetal.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. **Metzetal.(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.

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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 resourced 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 duringkharif season of 2022, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagrajwhich 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 treatment arecategorized as with recommended dose of Nitrogen through Urea, Phosphorus through DAP and Potash through Muriate of Potash, in addition withsulphurwhen applied in combinations as follows, (T_1) 50 kg N/ha + 45 X 20 cm, (T_2) 50 kg N/ha + 55 X 20 cm, (T_3)50 kg N/ha + 65 X 20 cm, (T_4) 60 kg N/ha + 45 X 20 cm, (T_5) 60 kg N/ha + 55 X 20 cm, (T_6) 60 kg N/ha + 65 X 20 cm, (T_7) 70 kg N/ha + 45 X 20 cm, (T_8) 70 kg N/ha + 55 X 20 cm, (T_9) 70 kg N/ha + 65 X 20 cm, (T_{10}) Control. The sunflowercrop washarvested treatment wise at harvesting maturity stage.Growth parameters viz. plant height (cm), dry matter accumulation g plant^{-1} were recorded manually on five randomly selected representative plants from each plot of each replication separately andafter harvesting, seeds were separated from each netplot and were dried under sun for three days. Laterwinnowed, cleaned and grain yield per ha was computed and expressedin kgsper hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in kgs per hectare. Thedata was computed and analysed by following statisticalmethod of **Gomez** and **Gomez** (**1984**). The benefit: costratio was worked out after price value of seed with stoverand total cost included in crop cultivation.

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RESULTS AND DISSCUSIONS

Effect on growth parameters:

Plant height

It is evident from Table1.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 **Tahaetal**. (**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, carbondioxide, oxygen and humidity which forced the plants to grow vertically rather than horizontally. The present findings are in accordance with **Nawaz*etal*.** (**2001**).

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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 productionattributed 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 **ReddiRamu** and **MaheshwaraReddy** (**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 diameterwas 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 **Reddyetal**. (**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*etal*.** (**2002**), **Kumar*etal*.** (**2004**), **Ali*etal*.** (**2011**).

Seed yield

Seed yield was significantly influenced with different combinations of Nitrogen and Spacing alongwithPhosphorus and PotassiumThe highest seed yield was obtained with the treatment of70 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 **SeshadriReddyetal**. (**2002**), **ReddiRamu** and **MaheswaraRedy** (**2003**) and **Sarkar** and **Mallick** (**2009**), **Kumar*etal***. (**2004**)**, Ali*etal***. (**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. Higherstover 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 **SeshadriReddyetal**. (**2002**), **ReddiRamu** and **MaheswaraRedy** (**2003**) and **Sarkar** and **Mallick** (**2009**), **Kumar*etal***. (**2004**)**, Ali*etal***. (**2011**).

Economics:

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

CONCLUSION

The results revealed that application of70 kg N/ha + 45 X 20 cm recorded highest seed yield (2102 kg/ha), gross return (126.120x 10^3INR/ha), highest net return (88.737 x 10^3INR/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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Table 1. Effect ofNitrogen and Spacingon growth parameters of Sunflower var. 'KBSH - 1'

S.No	T.No.	Treatments	Plant height (cm)	Dry matter accumulation (g plant/ha)
1	T_1	50 kg N/ha + 45 X 20 cm	141.19	52.16
2	T_2	50 kg N/ha + 55 X 20 cm	142.03	53.83
3	T_3	50 kg N/ha + 65 X 20 cm	139.73	50.15
4	T_4	60 kg N/ha + 45 X 20 cm	143.00	54.49
5	T_5	60 kg N/ha + 55 X 20 cm	147.67	59.37
6	T_6	60 kg N/ha + 65 X 20 cm	140.73	51.17
7	T_7	70 kg N/ha + 45 X 20 cm	144.82	56.51
8	T_8	70 kg N/ha + 55 X 20 cm	148.48	60.53
9	T_9	70 kg N/ha + 65 X 20 cm	141.43	53.29
10	T_{10}	Control	147.34	57.69
		SEm (±)	1.00	0.53
		CD (P 0.05)	2.97	1.56

Table 2.Effect of Nitrogen and Spacingon 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_1	50 kg N/ha + 45 X 20 cm	12.70	1883.35	3830.76
2	T_2	50 kg N/ha + 55 X 20 cm	13.30	1692.81	3448.24
3	T_3	50 kg N/ha + 65 X 20 cm	12.03	1394.07	2855.08
4	T_4	60 kg N/ha + 45 X 20 cm	13.67	2003.72	4067.13
5	T_5	60 kg N/ha + 55 X 20 cm	14.67	1812.11	3642.39
6	T_6	60 kg N/ha + 65 X 20 cm	12.37	1514.87	3085.84
7	T_7	70 kg N/ha + 45 X 20 cm	14.03	2102.00	4287.92
8	T_8	70 kg N/ha + 55 X 20 cm	15.13	1918.65	3818.31
9	T_9	70 kg N/ha + 65 X 20 cm	13.00	1638.20	3310.80
10	T_{10}	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. EffectofNitrogen and Spacingon economics of Sunflower var. 'KBSH - 1'

S.No	T.No.	Treatments	Cost of cultivation (x 10^{3} INR ha^{-1})	Gross return (x 10^{3} INR ha^{-1})	Net return (x 10^{3} INR ha^{-1})	Benefit: Cost ratio
1	T_1	50 kg N/ha + 45 X 20 cm	37.122	113.001	75.879	2.04
2	T_2	50 kg N/ha + 55 X 20 cm	36.722	101.569	64.847	1.77
3	T_3	50 kg N/ha + 65 X 20 cm	36.447	83.644	47.197	1.29
4	T_4	60 kg N/ha + 45 X 20 cm	37.253	120.223	82.970	2.23
5	T_5	60 kg N/ha + 55 X 20 cm	36.853	108.726	71.873	1.95
6	T_6	60 kg N/ha + 65 X 20 cm	36.578	90.892	54.314	1.48
7	T_7	70 kg N/ha + 45 X 20 cm	37.383	126.120	88.737	2.37
8	T_8	70 kg N/ha + 55 X 20 cm	36.983	115.119	78.136	2.11
9	T_9	70 kg N/ha + 65 X 20 cm	36.708	98.292	61.584	1.68
10	T_{10}	Control	35.384	98.798	63.414	1.79

#Data not subjected to statistical analysis.