Effect of Nitrogen and Spacing on growth and yield of Sunflower

(*Helianthus annuus* L.)

ABSTRACT

A field experiment was carried out during *kharif season* of 2022, at crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj in North Eastern plains of Eastern Uttar Pradesh, India with the objective to study the effect of nitrogen and spacing on growth, yield and economics of Sunflower (*Helianthus annuus* L.)with 10 treatments of which treatments (T_1-T_9) with different combination of nitrogen along with spacing and T_{10}The soil experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1) The result revealed that application of 70 kg N/ha + 55 X 20 cm recorded Maximum plant height (148.48 cm), plant dry weight (60.53 g), test weight (41.40 g), capitulum diameter (15.13 cm).

Keywords: Economics , Growth , Sunflower , Nitrogen(N), Spacing , yield

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 oil seed crop in the world. Oil seeds 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". (Chandu et. Al., 2022)

"Among nutrients, nitrogen plays an important role in growth and yield of sunflower. Nitrogen is crucial for growth and development while, sulphur fertilization is most critical for oil and protein synthesis besides seed yield enhancement. The nitrogen requirement for sunflower is high. Oil content in sunflower seed is also affected by changes in the proportion of nitrogen. Nitrogen deficiency reduces vegetative and generative growth ,thereby potentially reducing yields" (**Narwal** and **Malik1985**,). "Increasing Nitrogen increase number of seeds per head seed mass and overall oil yield (**Abbadi et al**., **2008 Connor** and **Sadras**,**1992**) is a major essential element and is responsible for increasing the photosynthetic surface area and in turn increases the translocation of photosynthates to sink and results in increase in productivity". "low application of nitrogen enhanced the duration but decreased leaf expansion and distribution of dry matter" (**Steer et al. 1986**).

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The plant spacing is an important factor, the optimum plant population should be maintained in the field for getting higher yield per unit area. **Diepenbrock et al. 2001** reported that achene yield increased with increasing row spacing .Overcrowding effects sunflower yield and achenes oil percentage (**Basha2000Allam et al**.,). The number of seeds per head and the mean seed weight decrease significantly with an increasing plant density (**Barros et al. 2004**) Sunflower crop express its full potential when it is also backed up by plant density. Optimum plant density provides better conditions for proper light interception throughout the crop growth period. Further, it is important to realize that plant density should be defined not only in terms of number of plants per unit area but also in terms of arrangement of these plants on the ground (planting geometry/spatial arrangement) as it helps in efficient harvesting of solar energy with least

competition.

"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". (Chandu et. Al., 2022) 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, Praygraj 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 treatment 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_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 sunflower crop was harvested treatment wise at harvesting maturity stage. Growth parameters viz. plant height (cm), dry matter accumulation g plant/ha 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 DISSCUSIONS

Effect on yield of Sunflower

The observation related to yield attributing parameters were shown inTable1.Treatment of 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 at par with 70 kg N/ha + 55 X 20 cm. The statistical analysis on test weight was found to be significant. However, highest test weight (41.40 g) was recorded with treatment of 70 kg N/ha + 55 X 20 cm and whereas treatment of 60 kg N/ha + 55 X 20 cm, control (41.40 and 40.33 g respectively) was found to be statistically at par with treatment of 70 kg N/ha + 45 X 20 cm.

Significant increase in Capitulum diameter and test weight 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". (Chandu et. Al., 2022) Similar results were also obtained by **Reddy et al. (2002), Reddy** and **Reddy** (**2003**) and **Sarkar** and **Mallick** (**2009**). Maximum head diameter and test weight 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**).The seed and stover yield showed increasing trend with the application of nitrogen in sunflower. The highest seed yield was obtained with the treatment 70 kg N/ha + 45 X 20 cm (2102 Kg), however no other treatment was found to be statistically on par with 70 kg N/ha + 45 X 20 cm. Highest stover yield (4287.9 kg/ha) was recorded 70 kg N/ha + 45 X 20 cm, however, no other treatment was found to be statistically on par with 70 kg N/ha + 45 X 20 cm.

The data showed significant difference in harvest index, however, 70 kg N/ha + 45 X 20 cm recorded highest value of (33.45 %) and lowest value (32.81 %) was recorded 50 kg N/ha + 65 X 20 cm. "Higher seed and 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". (Chandu et. Al., 2022) It was evident that plant spacing increased up to 45 X 20 cm showed highest seed and stover yield but increased spacing beyond this decreased the seed and stover yield per plant to noticeable extent. The results are similar with results obtained by **Seshadri Reddy et al**. (**2002**), **ReddiRamu** and **Maheswara Reddy** (**2003**) and **Sarkar** and **Mallick** (**2009**), **Kumar *et al*.** (**2004**)**, Ali *et al*.** (**2011**).

Effect on economics of Sunflower

The observation related to economics were shown inTable2.Treatment 70 kg N/ha + 45 x 20 cm recorded highest net return (88.737 x 10^3 INR / ha), gross return (126.120 x 10^3 INR/ha) and benefit: cost ratio (2.37). While lowest gross return (INR 83.644) , Net return (INR 47.197) and benefit cost ratio 1.29 was recorded in T_3 with application of 50 kg N/ha + 65 x 20 cm spacing.

CONCLUSION

It was concluded that Treatment of 70 kg N/ha + 55 X 20 cm recorded Maximum plant height (148.48 cm) , plant dry weight (60.53 g) , test weight (41.40 g), capitulum diameter (15.13 cm) and Number of seeds/capitulum which may be more preferable for farmers .since it is economically more profitable.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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Chandu Lakshmi Deepika, Rajesh Singh and Ekta Singh. Effect of nitrogen and sulphur levels on growth and yield of sunflower (Helianthus annuus L.). The Pharma Innovation Journal 2022; 11(3): 2049-2052

Table1.Effectof Nitrogen levels and Spacing on yield and yield attributes of Sunflower

S.NO	Treatments	Capitulum diameter (cm)	Test weight (g)	Seed yield (Kg/ha)	Stover yield (Kg/ha)	Harvest index (%)
1	50 kg N/ha + 45 X 20 cm	12.70	36.27	1883.35	3830.76	32.96
2	50 kg N/ha + 55 X 20 cm	13.30	38.60	1692.81	3448.24	32.93
3	50 kg N/ha + 65 X 20 cm	12.03	35.22	1394.07	2855.08	32.81
4	60 kg N/ha + 45 X 20 cm	13.67	39.12	2003.72	4067.13	33.00
5	60 kg N/ha + 55 X 20 cm	14.67	40.33	1812.11	3642.39	33.22
6	60 kg N/ha + 65 X 20 cm	12.37	35.52	1514.87	3085.84	32.93
7	70 kg N/ha + 45 X 20 cm	14.03	39.25	2102.00	4287.92	32.89
8	70 kg N/ha + 55 X 20 cm	15.13	41.40	1918.65	3818.31	33.45
9	70 kg N/ha + 65 X 20 cm	13.00	38.36	1638.20	3310.80	33.10
10	Control	14.47	39.81	1646.63	3293.34	33.33
	SEm(±)	0.18	0.64	29.60	59.60	0.04
	CD (5%)	0.53	1.90	87.95	177.07	0.12

Table2. Effect of Nitrogen and Spacing on economics of Sunflower

S.NO	Treatments	Gross return ($x 10^3$ INR/ha)	Net return ($x 10^3$ INR/ha)	Benefit : Cost ratio
1	50 kg N/ha + 45 X 20 cm	113.001	75.879	2.04
2	50 kg N/ha + 55 X 20 cm	101.569	64.847	1.77
3	50 kg N/ha + 65 X 20 cm	83.644	47.197	1.29
4	60 kg N/ha + 45 X 20 cm	120.223	82.970	2.23
5	60 kg N/ha + 55 X 20 cm	108.726	71.873	1.95
6	60 kg N/ha + 65 X 20 cm	90.892	54.314	1.48
7	70 kg N/ha + 45 X 20 cm	126.120	88.737	2.37
8	70 kg N/ha + 55 X 20 cm	115.119	78.136	2.11
9	70 kg N/ha + 65 X 20 cm	98.292	61.584	1.68
10	Control	98.798	63.414	1.79

***Economics not subjected to data analysis**