Original Research Article

Effect of Nitrogen and Spacing on growth and yield of Sunflower (*Helianthus annuus* L.)

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 in North Eastern plains of Eastern Uttar Pradesh with the objective to study the effect of nitrogen and spacing on growth, yield and economics of Sunflower (*Helianthus annuus* L.) Var. KBSH - 1 under Randomized block design comprising of 10 treatments of which treatments (T_1-T_9) with different combination of nitrogen along with spacing and T_{10} is control which are replicated thrice. 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) and whereas application of 70 kg N/ha + 45 X 20 cm recorded maximum seed yield (2102 kg/ha). Treatment 70 kg N/ha + 45 X 20 cm recorded highest net return (88.737x 10^3 ₹/ha) and benefit: cost ratio (2.37).

Key words: Economics, Growth, Sunflower, Nitrogen (N), Spacing, yield

INTRODUCTION

Oil seed production ranks second in importance next to food production. The shortage of edible oil has become a chronic economic and dietary problem in India with increasing demographic pressure. To increase the production of existing oilseeds and to bridge the gap between demand and supply, several attempts were made in the country during recent past through horizontal and vertical expansion including introduction of new oilseed crops for enhancing the oilseed production. Sunflower (*Helianthus annuus* L.) crop, native of South America and Mexico was introduced into India in the year 1969 with a view to supplement the yield of traditional oilseed crops. It has established as an efficient oilseed crop and replaced several less profitable crops and also as a contingent crop under adverse climatic conditions, an intercrop and option as a catch crop in multiple cropping systems.

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. The genus Helianthus means Helio = Sun, anthus = flower. Sunflower is known as 'suryajmuki' as it is grown for ornamental purpose. It is the third most important oilseed crop of world after Soyabean, Rapeseed & Mustard. The helio tropic movement is of great importance.

Sunflower is one of the fastest growing oilseed crops in India. Farmers find sunflower asa highly profitable crop, especially in Southern peninsula, consisting of NorthernKarnataka, Marathwada and Rayalaseema, where the crop is largely cultivated under rainfed conditions during late kharif/rabi season. Karnataka accounts for nearly half the area under sunflower in the country and ranks first with respect to area and production followed by AP. The highest productivity was recorded by UP followed by Tamil Nadu.

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. Sunfloweroil 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 playsan 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 plays an important role in increasing the productivity of sunflower. Nitrogen 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.

The plant spacings is an important factor, the optimum plant population should be maintained in the field, for getting higher yield per unit area. Plant density or population affects the height of plant, leaf area, dry matter etc. 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. 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 trial was conducted during the *Zaid* 2022, at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The experimental field's soil is neutral and deep, constituting a part of central Gangetic alluvium. It had sandy loam texture and contained medium nitrogen (N) and low potassium(k). The experiment was set up using Randomized Block Design with ten treatments that were replicated three times viz.,(T_1) 30 kg K/ha + 5 kg Zn/ha, (T_2) 30 kg K/ha + 10 kg Zn/ha, (T_3) 30 kg K/ha + 15 kg Zn/ha, (T_4) 40 kg K/ha + 5 kg Zn/ha, (T_5) 40 kg K/ha + 10 kg Zn/ha, (T_6) 40 kg K/ha + 15 kg Zn/ha, (T_7) 50 kg K/ha + 5 kg Zn/ha, (T_8) 50 kg K/ha + 10 kg Zn/ha, (T_9) 50 kg K/ha + 15 kg Zn/ha and (T_{10}) Farmers practice 80-40-0 kg NPK/ha. The experimental field was thoroughly ploughed, harrowed and brought to fine tilth and 30 plots each of 3.0 m x 3.0 m size were laid out according to layout design. The fertilizers were applied as per treatment combination in the form of urea and SSP entire as basal dose. The seeds of pearl millet (NBH 5863) were sown in lines 45 cm apart at seed rate of 5 kg/ha. Gap filling was done at 8-10 DAS whereas thinning was done at 15 DAS to maintain plant population. The growth parameters such as plant height (cm) and dry weight per plant (g) were recorded at various growth stages was calculated by the methods described by Watson, 1947. The ear head length, number of grains per ear head, grain yield, straw yield and harvest index were recorded at the time of harvest and averages were calculated and data was statistically analysed using ANOVA technique (Gomez and Gomez, 1984).

RESULTS AND DISSCUSIONS

Effect on yield of Sunflower

The observation related to yield attributing parameters were shown in Table 1. 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. The statistical analysis on test weight was found to be significant. However, highest test weight (41.40 g) was recorded with treatment 70 kg N/ha + 55 X 20 cm and whereas treatment 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 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. Similar results were also obtained by Reddy et al. (2002), Reddi 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. 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), Reddi Ramu and Maheswara Redy (2003) and Sarkar and Mallick (2009), Kumar *et al.* (2004), Ali *et al.* (2011).

Effect on economics on Sunflower

The observation related to economics were shown in Table 2. Treatment 70 kg N/ha + 45 X 20 cm recorded highest net return (88.737x 10^3 ₹/ha), gross return (126.120 x 10^3 ₹/ha) and benefit: cost ratio (2.37).

CONCLUSION

It was concluded that Treatment 70 kg N/ha + 45 X 20 cm recorded highest seed yield (2102 kg/ha), gross return (126.120 x 10^3 ₹/ha), highest net return (88.737 x 10^3 ₹/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' and hence, can be recommended to the farmers.

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Table 1. Effect of 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

Table 2. Effect of Nitrogen and Spacing on economics of Sunflower

S.NO	Treatments	Gross return (x 10^3 ₹/ha)	Net return (x 10^3 ₹/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**