

## Original Research Article

### Effect of Spacing and Nitrogen Management on Growth and Yield of Summer Sesame (*Sesamum indicum* L.)

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#### ABSTRACT

A field experiment was conducted during Zaid 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experiment is comprised of three planting geometries viz., 30 cm x 10 cm, 40 cm x 10 cm, 50 cm x 10 cm and Nitrogen management treatments, including 50% of the Recommended Dose of Nitrogen (RDN) through inorganic, 50% of the recommended dose of nitrogen (RDN) through inorganic in combination with 50% of Nitrogen provided through FYM with *azotobacter* seed inoculation and 50% of the recommended dose of nitrogen (RDN) through inorganic in combination with 50% of Nitrogen provided through FYM with *azotobacter* seed inoculation. The experiment was laid in randomized block design with ten treatments replicated thrice. Results revealed that spacing 30x10cm and 50% RDN + 50% N through FYM + Biofertilizer (*azotobacter*) gave maximum plant height (126.23 cm), dry weight (32.69 g), Number of capsules/plant (78.69), number of seeds/capsule (36.39), and seed yield (552.38 kg/ha).

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**Key words:** Sesame, spacing, Recommended Dose of Nitrogen (RDN), Farm yard manure (FYM), *Azotobacter*, Zaid.

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## INTRODUCTION

Sesame (*Sesamum indicum* L.), which is variously known as sesamum, til, simsim, benised, gingelly, gergelim etc. and one of the most important oilseeds crops, extensively grown in India. Sesame plays an important role in agricultural and industrial economics of our country. Sesame stand next to groundnut so far as the production of edible oil is concerned. Sesame “The queen of the oilseed crops” by virtue of the excellent quality of the oil, flavour, taste and softness. Its oil content generally varies from 46 to 52%. In case of sesame proper spacing provides sufficient interaction of light and satisfactory absorption of nutrients and water from the soil due to proper development of root system and results in higher crop yield. Photo-periodically sesame (*Sesamum indicum* L.) is a short-day plant Sesame is extensively cultivated in the states of Gujarat, West Bengal, Tamil Nadu, Maharashtra, Karnataka, Rajasthan and Madhya Pradesh. Gujarat alone accounts for 20 percent of the national production. Despite of being such an important sesame growing country, in India the average productivity is very low in comparison to global as well as national level. Sesame (*Sesamum indicum* L.) is the oldest indigenous oilseed crop, with longest history of cultivation in India. Sesame or gingelly is commonly known as til (Hindi, Punjabi, Assamese, Bengali, Marathi), tal (Gujarati), nuvvulu, manchinuvvulu (Telugu), ellu (Tamil, Malayalam, Kannada), tila/pitratarpa (Sanskrit) and rasi (Odia ) in different parts of India. India ranks first in world with 19.47 Lakh ha area and 8.66 Lakh tonnes production. The average yield of sesame (413 kg/ha) in India is low as compared with other countries in the world (535 kg / ha). The main reasons for low productivity of sesame are its rainfed cultivation in marginal and submarginal lands under poor management and input starved conditions. However, improved varieties and agro production technologies capable of increasing the productivity levels of sesame are now developed for different agro ecological situations in the country. A well managed crop of sesame can yield 1200 - 1500 kg/ha under irrigated and 800 - 1000 kg/ha under rainfed conditions. Among the oilseed crops, sesame (*Sesamum indicum* L.) is one of the world most important and oldest known oil seed crops (AbouGharbia et al., 1997). Sesame is a member of the pedaliaceae plant family. Its cultivation has started since 1500 BC in the Middle East, Asia & Africa (Ali et al., 2007). India is the major producer of sesame (*Sesamum*

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*indicum* L.) and ranks first in both area (1.78 Mha) and production (0.81 Mt) with average productivity of 455 kg ha<sup>-1</sup>. Higher nutritional, medicine and cooking quality has recognized it as 'the queen of oilseeds'. There is a decline in productivity in sesame due to its cultivation in marginal and sub-marginal lands and moreover poor crop management practice.

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## MATERIALS AND METHODS

The experiment was conducted during the Zaid season 2022, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.). The farm is situated at 25° 57'12" N latitudes, 87° 50'12" E longitude and an altitude of 98 meters above mean sea level. (MSL). This area is situated on the right side of the Yamuna river by the side of Prayagraj - Rewa road about 12 km from the city. To assess the effect of Spacing and Nitrogen Management on growth and yield of Summer Sesame (*Sesamum indicum* L.) The experiment was laid out in Randomized Block Design comprising of 10 treatments which are replicated thrice the treatment are categorized as with 3 levels of plant geometry and 3 forms of nitrogen when applied in combinations as follows, T<sub>1</sub>: Spacing 30 cm × 10 cm + 50% RDN + 50% N through FYM, T<sub>2</sub>: Spacing 30 cm × 10 cm + 50% RDN + Biofertilizer (*Azotobacter*), T<sub>3</sub>: Spacing 30 cm × 10 cm + 50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*), T<sub>4</sub>: Spacing 40 cm × 10 cm + 50% RDN + 50% N through FYM, T<sub>5</sub>: Spacing 40 cm × 10 cm + 50% RDN + Biofertilizer (*Azotobacter*), T<sub>6</sub>: Spacing 40 cm × 10 cm + 50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*), T<sub>7</sub>: Spacing 50 cm × 10 cm + 50% RDN + 50% N through FYM, T<sub>8</sub>: Spacing 50 cm × 10 cm + 50% RDN + Biofertilizer (*Azotobacter*), T<sub>9</sub>: Spacing 50 cm × 10 cm + 50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*), T<sub>10</sub>: 10. Spacing 30 cm × 10 cm + 50 : 40 : 30 NPK Kg/ha (Control). The oil crop was harvested treatment wise at maturity stage. Growth parameters viz. plant height (cm), dry matter accumulation (g/plant) 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 kg per hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in tonnes 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.

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## RESULTS AND DISSCUSION

### Effect of Spacing and nitrogen management on growth parameters:

#### Plant height (cm)

It is evident from Table 1. that plant height measured increased with advancement in crop growth. Maximum plant height of 124.48cm was recorded with treatment T<sub>3</sub> (Spacing30cm× 10cm+ 50%RDN + 50%NthroughFYM + Biofertilizer (*Azotobacter*)) whereas treatments Spacing30cm× 10cm+ 50%RDN + Biofertilizer (*Azotobacter*), Spacing40cm× 10cm+ 50%RDN + 50%NthroughFYM + Biofertilizer (*Azotobacter*) recorded statistically at par with the treatment T<sub>2</sub> and T<sub>6</sub>. The plant height of foxtail millet increased significantly due to spacing and nitrogen. Spacing shows the higher plant height, number of seeds/capsule, number of capsule/plant and highest test weight in the sesame. It might be due to better utilization of minerals, nutrients, water, solar radiation etc, tendency of plant to elongate toward light, when insufficient incidental solar radiation is intercepted in the plant canopy particularly lower one. The results are in conformity with those reported by Yadav *et al.*, (2007). Nitrogen is the major constituent of cell and plays a key role in plant metabolism by virtue of being an essential constituent of diverse type of metabolically active compounds like amino acids, proteins, nucleic acids, purines and pyrimidines, nucleotides, enzymes, co-enzymes and alkaloids. Higher organic manure sustained availability of nitrogen due to of organic manure might have resulted into more activities of meristematic tissues of plant, increase in number and size of cell, which have ultimately resulted in plant height. Similar results were also obtained by Ghosh and Sen (1980), and Rao *et al.*, (1990). Ghosh (2000) reported that seed inoculation with *azotobacter* increased plant height in sesame.

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#### Dry matter accumulation (g/plant)

The treatment highest plant dry weight was found in treatment T<sub>3</sub> (Spacing30cm× 10cm+ 50%RDN + 50%NthroughFYM + Biofertilizer (*Azotobacter*)). However, treatment Spacing30cm× 10cm+ 50%RDN + 50%NthroughFYM + Biofertilizer (*Azotobacter*) was found to statistically at par with treatment T<sub>3</sub> (Spacing30cm× 10cm+ 50%RDN + 50%NthroughFYM + Biofertilizer (*Azotobacter*)). The dry weight of Sesame increased significantly due to spacing and nitrogen. Spacing shows the higher dry weight it might be due to better utilization of minerals, nutrients, water, solar radiation etc. Nitrogen is involved in number of physiological processes, protein synthesis and activation of enzymes. Increase in plant dry weight might be due to less plant population of 45cm x 10cm spacing, in which the plants could get adequate nutrients, moisture and space to produce highest dry matter. These results are in conformity with the findings of Patra and Mishra (2000). Nitrogen is an important constituent of chlorophyll and when it applied adequately it stimulates photosynthesis in plants. Consequently, higher nitrogen levels were found to

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increase photosynthetic activity in plants resulting in more synthesis of photosynthate, ultimately increases the dry matter. **Ogundare et al., (2015)** in sesame, also reported increased dry matter accumulation of plant due to increasing dose of nitrogen up to recommended level.

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UNDER PEER REVIEW

## Effect of Spacing and nitrogen management on Yield and Yield Attributes:

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### Number of capsules/ plant

Significant effect was observed by the statistical analysis of number of capsules per plant, Treatment Spacing 30cm × 10cm + (50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*)) resulted in significantly highest number of capsules per plant (78.69). However, Spacing 30cm × 10cm + 50% RDN + Biofertilizer (*Azotobacter*), Spacing 40cm × 10cm + 50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*) were found to be statistically on par with 30cm × 10cm + (50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*)). 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 values of yield attributes.

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### Number of seeds/ capsules

Significantly maximum number of capsules/plant (36.39) was recorded in treatment T<sub>3</sub> (Spacing 30cm × 10cm + 50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*)) which was superior over the treatments whereas, treatment T<sub>2</sub> (Spacing 30cm × 10cm + 50% RDN + Biofertilizer (*Azotobacter*)) and T<sub>8</sub> (Spacing 50cm × 10cm + 50% RDN + Biofertilizer (*Azotobacter*)) was at par with highest treatment T<sub>3</sub> (Spacing 30cm × 10cm + 50% RDN + 50% N through FYM + Biofertilizer (*Azotobacter*)). These results are in conformity with the findings of (Yadav *et al.*, (2007)). Nitrogen is an important constituent of chlorophyll and when it is applied adequately it stimulates photosynthesis in plants. Consequently, higher nitrogen levels were found to increase photosynthetic activity in plants resulting in more synthesis of photosynthate, ultimately increases the dry matter. Shinde *et al.*, (2011) in sesame, also reported increased dry matter accumulation of plant due to increasing dose of nitrogen up to recommended level.

### Seed yield (kg/ha)

The grain yield showed maximum seed yield (552.38 kg/ha) was recorded in treatment T<sub>3</sub> (Spacing 30cm × 10cm + 50%RDN + 50%N through FYM + Biofertilizer (*Azotobacter*) which was superior over the treatments. However, treatment T<sub>2</sub> (Spacing 30cm × 10cm + 50% RDN + Biofertilizer (*Azotobacter*) was at par with highest treatment T<sub>3</sub> (Spacing 30cm × 10cm + 50%RDN + 50%N through FYM + Biofertilizer (*Azotobacter*). It may 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 values of yield attributes. Similar results reported by Patra and Mishra (2000), Ogundare (2015).

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### Stover yield (kg/ha)

The stover yield of sesame was also influenced by the application of spacing and nitrogen management. Maximum stover yield (2052.3 kg/ha) was recorded in treatment T<sub>10</sub> (Control with recommended spacing and RDN) and minimum stover yield (1920.6 kg/ha) was recorded in treatment T<sub>1</sub> (Spacing 30cm × 10cm + 50%RDN + 50%N through FYM). It may 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 values of yield attributes. Potassium is involved in number of physiological processes, protein synthesis and activation of enzymes. Similar results reported by Preeti (2010) and Nayek *et al.*, (2014),

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## CONCLUSION

It can be concluded that sesame should be sown at a spacing of 30cm (row to row) × 10cm (plant to plant) and 50% Recommended dose of nitrogen through inorganic should be met out through 50% Nitrogen through FYM along with *azotobacter* seed inoculation was found more productive (552.38 kg/ha) as well as economically viable (30,221.00 INR/ha).

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UNDER PEER REVIEW

**Table 1. Effect of spacing and nitrogen management on growth attributes of sesamum**

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Treatment combinations	Growth Attributes	
	Plant height (cm)	Dry weight (g/plant)
1. Spacing30cm× 10cm+ 50%RDN + 50% N through FYM	111.26	25.80
2. Spacing30cm× 10cm+ 50%RDN + Biofertilizer ( <i>Azotobacter</i> )	122.89	28.72
3. Spacing30cm× 10cm+ 50%RDN + 50%NthroughFYM+ <i>Biofertilizer</i> ( <i>Azotobacter</i> )	124.48	29.85
4. Spacing40cm× 10cm+ 50% RDN + 50%N through FYM	107.65	24.38
5. Spacing40cm× 10cm+ 50% RDN + Biofertilizer ( <i>Azotobacter</i> )	113.65	27.32
6. Spacing40cm× 10cm+ 50%RDN + 50%NthroughFYM+ <i>Biofertilizer</i> ( <i>Azotobacter</i> )	118.51	27.97
7. Spacing50cm× 10cm+ 50%RDN + 50% N through FYM	102.56	21.36
8. Spacing50cm× 10cm+ 50%RDN + Biofertilizer ( <i>Azotobacter</i> )	104.36	23.49
9. Spacing50cm× 10cm+ 50%RDN + 50%NthroughFYM+ Biofertilizer ( <i>Azotobacter</i> )	109.86	25.49
10. Spacing 30cm × 10 cm + 50 : 40 : 30 NPK Kg/ha (Control)	98.69	20.67
F test	S	S
SEm(±)	1.55	0.45
CD (P=0.05)	4.62	1.34

**Table 2. Effect of spacing and nitrogen management on yield attributes of sesamum.**

Treatment combinations	Yield and Yield Attributes					
	No. of capsules/ Plant	No. of seeds/ capsule	Test Weight (g)	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Harvest Index(%)
1. Spacing 30cm × 10cm + 50% RDN + 50% N through FYM	70.89	32.72	3.34	409.65	1920.6	15.03
2. Spacing 30cm × 10cm + 50% RDN + Biofertilizer ( <i>Azotobacter</i> )	75.61	35.28	3.38	451.64	1980	14.86
3. Spacing 30cm × 10cm + (50% RDN + 50% N through FYM + Biofertilizer ( <i>Azotobacter</i> ))	78.69	36.39	3.38	552.38	2052.3	17.51
4. Spacing 40cm × 10cm + 50% RDN + 50% N through FYM	68.93	29.68	3.31	401.82	2250.6	15.15
5. Spacing 40cm × 10cm + 50% RDN + Biofertilizer ( <i>Azotobacter</i> )	72.54	34.12	3.34	438.69	2271	14.92
6. Spacing 40cm × 10cm + 50% RDN + 50% N through FYM + Biofertilizer ( <i>Azotobacter</i> )	74.69	34.54	3.35	443.26	2501.9	14.76
7. Spacing 50cm × 10cm + 50% RDN + 50% N through FYM	66.73	27.86	3.30	396.89	2560.8	16.70
8. Spacing 50cm × 10cm + 50% RDN + Biofertilizer ( <i>Azotobacter</i> )	68.61	28.73	3.30	399.51	2315.6	16.29
9. Spacing 50cm × 10cm + 50% RDN + 50% N through FYM + Biofertilizer ( <i>Azotobacter</i> )	69.76	31.33	3.32	419.36	2587.9	15.59
10. Spacing 30cm × 10cm + 50 : 40 : 30 NPK Kg/ha (Control)	65.35	25.56	3.29	387.69	2602.6	16.80
F test	S	S	NS	S	S	NS
SEm(±)	0.81	0.48	0.04	8.10	2.60	0.28
CD (P=0.05)	2.40	1.43	-	24.06	7.72	-