

**Studies on yield and economics of sesame (*Sesamum indicum* L.)  
as influenced by spacing and foliar application of zinc**

**ABSTRACT**

The objective of the present experiment was to analyze the influence of spacing and application of zinc using foliar method on growth, yield and economics of Sesame (*Sesamum indicum* L.) Var. G-1 during *kharif* season of 2021. The experiment was designed with varying combination of spacing and zinc using the Randomized Block Design which produced nine treatments with three replicates each. The combination, T<sub>9</sub>, with spacing 40 X 10 cm and 0.75% ZnSO<sub>4</sub> resulted in largest number of capsules per plant (54.60), number of seeds per capsule (60.50), seed yield (1.20 t/ha), harvest index (31.89 %). This treatment recorded higher net return (52,016 INR/ha), gross return (78,217 INR/ha) and benefit: cost ratio (1.99) as well.

**Key words-** Economics, Sesame, Spacing, Zinc, Yield

**INTRODUCTION**

Oilseed crops are a diverse group of plants grown in communities for the purpose of obtaining oil. As a result, oilseed production in India is extremely important to the country's economy, as they not only serve a vital part in the industrial sector and indirectly meet the needs of the people, but they also serve as a valuable source of foreign cash. These multipurpose commodities, such as oils and oilcakes, benefits humans, machines and animals, and the economy of our country in one way or another (Weiss, 1983).

Sesame (*Sesamum indicum* L.) is an ancient oil seed crop (*Sesamum indicum* L.) know by different names such as til, gingelly, simsim, gergelim etc. This crop is a part of Pedaliaceae family and has its lineage from East Africa and India. India and China are the topmost producer proceeded by Myanmar, Uganda, Pakistan, Sudan, Ethiopia, Tanzania, Nigeria, Turkey, Guatemala. Sesame seeds are popular as “Seed of Immortality” and are resistance to rancidity as the percentage of stable unsaturated fatty acids including oleic and linoleic acid is greater than 80%. The by-product of oil milling industry, sesame cake, is an abundant source of protein, niacinamide and minerals (Ca and P). With 25% protein content, this oilseed crop has the maximum oil content (46.64%) (Thanunathan *et al.* 2002). It can be cultivated all year round being a photo-insensitive and a short-term crop with versatile adaptability. The widest use of sesame is its use as an edible oil.

Space plays a pivotal part in growth, development and ultimately the yield Increase in plant populace per unit area leads to competition amongst plants for natural resources subsequently producing frailer plants and acute lodging. Thus, in order for the crop to efficiently and maximally employ these resources and prevent overcrowding, it is crucial to manage row spacing during cultivation. A direct relationship has been established between crop yield and plant density until the resources turn limiting (Norsworthy and Emerson, 2005). Contrary to overcrowding, low-density populace results in a greater number of branches carrying fertile

Pods and hence, delaying the development phase for seed. Further, the plant productivity is influenced based on planting conformation as it changes the canopy geometry in turn impacting light interception and CO<sub>2</sub> assimilation (**Brar et al., 1998**). For these reasons, spacing plays a paramount role as it affects the yield of sesame oilseed crop.

For crop feeding, the present-day method includes foliar mode of application where the liquid micronutrients are sprayed directly to the leaves (**Nasiri et al., 2010**). This method is superior as opposed to soil application as it provides specific and quick response.

The enzymatic and physiological functions of the plant are influenced on the use of zinc, a vital micronutrient. The different functions of zinc include production of growth hormones, starch and chlorophyll, seed development and water absorption regulation. Its deficiency is depicted as delayed photosynthesis and N metabolism, less flower and fruit development and lengthened growth period which consequently causes interveinal chlorosis, short internodes, khaira disease in rice. There is “rosette” manifestation, retarded maturity, poor yield and produce quality in plant as well. (**Alloway B.J. 2008**).

## MATERIALS AND METHODS

The present field research was carried at Crop Research Farm of Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj at the beginning of *kharif* season (2021). The geographic coordinates were as follows: 25°24'42"N latitude and 81°50'56"E longitude being 98 m above the sea level. The objective included to study the influence of spacing and foliar application of zinc on growth, yield as well as economics of Sesame (*Sesamum indicum* L.) Var. G-1. The experiment was designed with varying combination of spacing and zinc using the Randomized Block Design which produced nine treatments with three replicates each. The average plot size for individual plot size was 3m X 3m. Based on the suggested dose of Nitrogen through urea, Phosphorus through DAP, Potash through Muriate of Potash and Zinc through Zinc Sulphate, a total of 9 treatments were established as follows: T<sub>1</sub> – 25 cm X 15 cm + 0.25% ZnSO<sub>4</sub>, T<sub>2</sub> – 25 cm X 15 cm + 0.50% ZnSO<sub>4</sub>, T<sub>3</sub> – 25 cm X 15 cm + 0.75% ZnSO<sub>4</sub>, T<sub>4</sub> – 35 cm X 15 cm + 0.25% ZnSO<sub>4</sub>, T<sub>5</sub> – 35 cm X 15 cm + 0.50% ZnSO<sub>4</sub>, T<sub>6</sub> – 35 cm X 15 cm + 0.75% ZnSO<sub>4</sub>, T<sub>7</sub> – 40 cm X 10 cm + 0.25% ZnSO<sub>4</sub>, T<sub>8</sub> – 40 cm X 10 cm + 0.50% ZnSO<sub>4</sub>, T<sub>9</sub> – 40 cm X 10 cm + 0.75% ZnSO<sub>4</sub>. Upon reaching the maturity age, each treatment-wise crop was harvested. From each plot, five replicates were selected randomly to study and record the parameters of growth such as height of plant (cm) and dry matter accumulation (g/plant). The seeds were gathered from plots after the harvesting to be dried in sunlight for three days. After winnowing and cleaning, yield per hectare (t/ha) was computed. Stover yield (t/ha) was computed as well after drying the seeds for 10 days. For statistical analysis, **Gomez and Gomez (1984)** method was adopted. The cost of seed with stover value and total cost was used to determine the benefit: cost ratio.

## RESULTS AND DISCUSSIONS

### Yield and Yield Attributes:

#### Number of Capsules/plants

There was significant difference in the result for number of capsules per plant. Amongst all the treatments, T<sub>9</sub> had the largest value for number of capsules per plant (54.60). This result was

similar to that of T<sub>8</sub>. With wider spacing, there is less competition for light, moisture and nutrients which results in improved yield attributing characteristics including number of capsules per plant. Another advantage of broader spacing is adequate sunlight to the plants which results in increase in photosynthesis and thus, more photosynthates. On the other hand, narrow spacing with dense plant population resulted in the lower values of yield attributes. The increase in number of capsules/plant due to zinc might be due to adequate supply of zinc during early growth is considered important in promoting vegetative growth by influencing cell division and elongation in meristematic cell, thereby increasing the sink in terms in of number of capsules per plant. Results akin to present study have been documented by **Kumar et al. (2011)**, **Yadav et al. (2007)**, **Shekh et al. (2014)** and **Patel (2012)**.

#### **Number of Seeds/capsules**

A significant difference was noted for number of seeds per capsule. Amongst all the treatments, T<sub>9</sub> had the largest number of seeds per capsule (60.50) and similar result was recorded for T<sub>8</sub> as well. With wider spacing, there is less competition for light, moisture and nutrients which results in improved yield attributing characteristics including number of seeds per capsule. Another advantage of broader spacing is adequate sunlight to the plants which results in increase in photosynthesis and thus, more photosynthates. On the other hand, narrow spacing with dense plant population resulted in the lower values of yield attributes. The increment for number of seeds per capsule due to zinc might be due to adequate supply of zinc during early growth is considered important in promoting vegetative growth by influencing cell division and elongation in meristematic cell, thereby increasing the sink in terms in of number of seeds per capsule. . Results akin to present study have been documented by **Kumar et al. (2011)**, **Yadav et al. (2007)**, **Shekh et al. (2014)** and **Patel (2012)**.

#### **Grain yield**

The varied combination of spacing and foliar method for application of Zinc along with Nitrogen, Potassium and Phosphorus had significant effect on grain yield where the greatest value was recorded for T<sub>9</sub> which was similar to T<sub>8</sub>. Spacing and level of applied zinc was directly proportional to the grain yield. With increase in spacing, there is improved utilization of resources such as nutrients, light and water, giving optimal plant height. The results are in concurrence with those of **Shinde et al., (2011)**. Zinc plays a fundamental part in carbohydrate synthesis, photosynthesis and cell elongation and thus, positively effects yield characteristics and grain yield. Comparable findings have been published by **Kumar et al. (2011)**, **Paraye et al. (2009)**, **Deosarkar et al. (2001)** for soybean.

#### **Stover yield**

Amongst all the treatments, for stover yield T<sub>9</sub> resulted in highest value (2.57 t/ha) which was similar to T<sub>8</sub> and T<sub>6</sub>. Spacing and level of zinc applied had significant increasing effect and were directly proportional to stover yield. With increase in spacing, there is improved utilization of resources such as nutrients, light and water, resulting in optimal plant height. Zinc plays a fundamental part in carbohydrate synthesis, photosynthesis and cell elongation and thus, positively effects stover yield. Different operations in plants such as water uptake, radicle growth, transpiration, stomatal working and turgor maintenance are influenced by Zn and its role in water economy and crop growth. This is advantageous during water stress and drought tolerance. Parallel results have been published by **Kumar et al. (2011)**, **Paraye et al. (2009)**, **Deosarkar et**

*al.* (2001) in soybean.

#### **Economics:**

Out of all the different treatment combinations, T<sub>9</sub> was the most economically sound combination with greatest net return (52,016 INR/ha), gross return (78,217 INR/ha) and benefit: cost ratio (1.99).

#### **CONCLUSION**

Different treatment combinations based on spacing and foliar application of Zinc were designed to analyze their effect on growth, yield as well as economics of Sesame. Amongst all the treatments, T<sub>9</sub> had the highest results for yield characteristics such as grain yield (1.20 t/ha), gross return (78,217.00 INR/ha), net return (52,016.00 INR/ha) and benefit: cost ratio (1.99). However, this research was based on experiments done for one season and could be repeated further for different seasons.

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**Table 1. Effect of Spacing and Foliar application of Zinc on yield and yield attributing characters of Sesame**

S. No	Treatment combinations	No. of capsules/plant	No. of seeds/capsule	Seed Yield (t/ha)	Stover Yield(t/ha)
1	25 cm X 15 cm + ZnSO <sub>4</sub> – 0.25 %	42.60	53.60	1.04	2.44
2	25 cm X 15 cm + ZnSO <sub>4</sub> – 0.50 %	44.40	54.53	1.06	2.47
3	25 cm X 15 cm + ZnSO <sub>4</sub> – 0.75 %	47.67	54.93	1.09	2.49
4	35 cm X 15 cm + ZnSO <sub>4</sub> – 0.25 %	45.60	56.43	1.11	2.50
5	35 cm X 15 cm + ZnSO <sub>4</sub> – 0.50 %	48.07	56.83	1.12	2.52
6	35 cm X 15 cm + ZnSO <sub>4</sub> – 0.75 %	51.47	57.30	1.17	2.54
7	40 cm X 10 cm + ZnSO <sub>4</sub> – 0.25 %	49.53	58.60	1.14	2.51
8	40 cm X 10 cm + ZnSO <sub>4</sub> – 0.50 %	53.87	59.37	1.19	2.56
9	40 cm X 10 cm + ZnSO <sub>4</sub> – 0.75 %	54.60	60.50	1.20	2.57
	<b>F test</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	<b>S.Em (±)</b>	0.60	0.55	0.01	0.01
	<b>CD (P&lt;0.05)</b>	1.77	1.64	0.03	0.04

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**Table 2. Effect of Spacing and Foliar application of Zinc on economics of Sesame**

S.No	Treatment Combinations	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	Benefit: Cost ratio
1	25 cm X 15 cm + ZnSO <sub>4</sub> – 0.25 %	25,856.00	67,817.00	41,961.00	1.62
2	25 cm X 15 cm + ZnSO <sub>4</sub> – 0.50 %	25,856.00	68,683.00	42,827.00	1.66
3	25 cm X 15 cm + ZnSO <sub>4</sub> – 0.75 %	25,856.00	70,850.00	44,994.00	1.74
4	35 cm X 15 cm + ZnSO <sub>4</sub> – 0.25 %	25,846.00	72,367.00	46,521.00	1.80
5	35 cm X 15 cm + ZnSO <sub>4</sub> – 0.50 %	25,846.00	72,583.00	46,737.00	1.81
6	35 cm X 15 cm + ZnSO <sub>4</sub> – 0.75 %	25,846.00	76,050.00	50,204.00	1.94
7	40 cm X 10 cm + ZnSO <sub>4</sub> – 0.25 %	26,201.00	73,883.00	47,682.00	1.82
8	40 cm X 10 cm + ZnSO <sub>4</sub> – 0.50 %	26,201.00	77,133.00	50,932.00	1.94
9	40 cm X 10 cm + ZnSO <sub>4</sub> – 0.75 %	26,201.00	78,217.00	52,016.00	1.99

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

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