

## Influence of sources of sulphur and zinc on growth and yield of Sesame (*Sesamum indicum* L.)

### Abstract:

Background: A field experiment was conducted during kharif 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experiment was laid out in Randomized Block Design with nine treatments and control which are replicated thrice on the basis of one year experimentation. The treatments consisted of 3 levels of source of sulphur (Gypsum 300 kg/ha, Single super phosphate 20 kg/ha, Sulphur 40 kg/ha) and zinc (5, 10, 15 kg/ha) as a Basal application and a control. The application of Gypsum 300 kg/ha + Zinc 15 kg/ha recorded significantly maximum number of Capsules/plant (51.40), Seeds/capsules (55.47), Test weight (2.70 g), Seed yield (1.07 t/ha), stover yield (2.59 t/ha), Harvest index (29.30), Gross returns (89,889.00 INR/ha), Net returns (60,180.00 INR/ha), B:C ratio (2.03 INR/ha) were recorded with the treatment of Gypsum 300 kg/ha + Zinc 15 kg/ha.

**Keywords:** *Sesame, Gypsum, single super phosphate, sulphur, zinc, yield and economics.*

### Introduction:

Sesame ranks first for having oil content of 46-64% and 6355 k cal/kg dietary energy in seeds (Sanjay kumar & Goel, 1994). Seeds of sesame is also rich source of protein (20-28%), sugar (14-16%) and minerals (5-7%). This oil has 85% unsaturated fatty acid viz., highly stable and has washing effect on cholesterol & prevents coronary heart disease. Sesame as a valued oil seed appears to have numerous industrial applications. The forecasted results showed for area, production and productivity of Sesame crop for the year 2020-21 to be 51.66 thousand hectare, 17.64 thousand tonnes and 323.43 in kg/hectare respectively. 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. The crop is grown in almost all parts of the country. More than 85% production of sesame comes from West Bengal, Madhya Pradesh, Rajasthan, Uttar Pradesh, Gujarat, Andhra Pradesh and Telangana (Priyanka 2020).

SSP is an excellent source of three plant nutrient ( $P_2O_5$  16%, Calcium 20%, Sulphur 12%). The P

**Comment [u1]:** Please provide reference for this data

**Comment [u2]:** Please give the full form of SSP when it is first mention in the manuscript. Suggestion : " Single Super Phosphate (SSP) is an excellent source .....

component reacts in soil similarly to other soluble fertilizers. The presence of both P and sulfur (S) in SSP can be an agronomic advantage where both of these nutrients are deficient. In agronomic studies where SSP is demonstrated to be superior to other P fertilizers, it is usually due to the S and/or Ca that it contains. When locally available, SSP has found wide-spread use for fertilizing pastures where both P and S are needed. As a source of P alone, SSP often costs more than other more concentrated fertilizers, therefore it has declined in popularity.

**Comment [u3]:** Please give reference

Zinc is an indispensable micronutrient for crop growth, an important component of carbonic anhydrase and a stimulator of aldolase, which are involved in carbon metabolism (Tsonev 2012) Zn is also an integral component of several biomolecules such as lipids, proteins and co-factor of auxins, and, therefore, it plays an important role in plant nucleic acid metabolism. Zn application has been proved beneficial in improving crop yield and quality [Chattha 2017], while its deficiency reduces yield and deteriorates crop quality. Moreover, higher Zn contents have toxic effects on plants and lead to the suppression of cell division and elongation, affecting biomass production.

**Comment [u4]:** Please add one paragraph that consist of the problem statement of your research. Why do you want to do the research about the influence of the sources of sulphur and zinc on growth and yield of sesame? Please state clearly what problem that you want to overcome with your research. And in the end of the paragraph please state the aim of the research.

## Material and Methods:

The experiment was conducted to know the **Influence of sources of sulphur and zinc on yield of Sesame (*Sesamum indicum* L.)** was carried out at Crop Research Farm of Sam Higginbottom University, Prayagraj, Uttar Pradesh during 2022. The experiment was laid out in a RBD consisting of Ten treatments including Control with 3 replications, with the treatment combinations (T<sub>1</sub>) Gypsum 300 kg/ha+Zinc 5 kg/ha, (T<sub>2</sub>) Gypsum 300 kg/ha+Zinc 10 kg/ha, (T<sub>3</sub>) Gypsum 300 kg/ha+Zinc 15 kg/ha, (T<sub>4</sub>) Single super phosphate 20 kg/ha+Zinc 5 kg/ha, (T<sub>5</sub>) Single super phosphate 20 kg/ha+Zinc 10 kg/ha, (T<sub>6</sub>) Single super phosphate 20 kg/ha+Zinc 15 kg/ha, (T<sub>7</sub>) Sulphur 40 kg/ha+Zinc 5 kg/ha, (T<sub>8</sub>) Sulphur 40 kg/ha+Zinc 10 kg/ha, (T<sub>9</sub>) Sulphur 40 kg/ha+Zinc 15 kg/ha, (T<sub>10</sub>) Control.

**Comment [u5]:** I suggest to put this sentence in introduction section (as the aim of the research)

**Comment [u6]:** Please add more information about the climate and soil condition of the location of the research, such as rainfall, temperature, altitude, and soil type. It will give the reader more information about the condition if the experiment.

## Results

### Yield

The perusal of the data of Number of Capsules/plants was recorded at harvest, is presented in Table 1. The data reveals that there was significant effect among different treatments on Number of Capsules/plants. Significantly Maximum Number of Capsules/plants (51.40) was recorded with the treatment of application Gypsum 300 kg/ha+Zinc 15 kg/ha over all the treatments and minimum was recorded in (37.40) control. However, treatment Gypsum 300 kg/ha+Zinc 10 kg/ha (50.67) was found to be statistically at par with Gypsum 300 kg/ha+Zinc 15

**Comment [u7]:** Please describe the method of the planting more clear and detail, particularly about the planting method of sesame, the size of the plot, the planting space. Also give the information about the observed parameters and how you recorded it. As for example you already mentioned in results section that number of capsules/plants was recorded at harvest. I recommend you to also mention it in materials and methods. Give explanation how to record test weight and stover yield, and how you convert it become t/ha. Give the data analysis method. What statistic method that used for significance determination and the post hoc test to measure the significant differences. Explain the economic analysis method and the reference.

kg/ha.

Significantly Maximum test weight (2.70 g) was recorded with the treatment of application Gypsum 300 kg/ha + Zinc 15 kg/ha over all the treatments and minimum was recorded (2.27 g) in control. However, treatment Gypsum 300 kg/ha + Zinc 10 kg/ha (2.67 g) was found to be statistically at par with Gypsum 300 kg/ha + Zinc 15 kg/ha.

Significantly Maximum Number of seeds per capsules (55.47) was recorded with the treatment of application Gypsum 300 kg/ha + Zinc 15 kg/ha over all the treatments and minimum was recorded (45.20) in control. However, treatment Gypsum 300 kg/ha + Zinc 10 kg/ha (54.40) was found to be statistically at par with Gypsum 300 kg/ha + Zinc 15 kg/ha.

Significantly Maximum seed yield (1.07 t/ha) and stover yield (2.59 t/ha) was recorded with the treatment of application Gypsum 300 kg/ha + Zinc 15 kg/ha over all the treatments and minimum was recorded (0.88 t/ha) in control. However, treatment Gypsum 300 kg/ha + Zinc 10 kg/ha (1.06 t/ha) was found to be statistically at par with Gypsum 300 kg/ha + Zinc 15 kg/ha.

Significantly maximum harvest index (29.30%) was recorded with the treatment of application of Gypsum 300 kg/ha + Zinc 15 kg/ha over all the treatments and minimum was recorded in Control (40:60:40 kg/ha) (26.40%) and there was significant difference in between the treatments.

### **Economics**

Higher Gross returns have been recorded with the Gypsum 300 kg/ha + Zinc 15 kg/ha (89,889) over rest of the treatments followed by Gypsum 300 kg/ha + Zinc 15 kg/ha (57,731).

Higher net returns have been recorded with the Gypsum 300 kg/ha + Zinc 15 kg/ha (60,189) over rest of the treatments followed by Gypsum 300 kg/ha + Zinc 15 kg/ha (58,531).

Higher Benefit ratio have been recorded with the Gypsum 300 kg/ha + Zinc 15 kg/ha (2.03) over rest of the treatments followed by Gypsum 300 kg/ha + Zinc 15 kg/ha (2.00) whereas minimum Benefit ratio was recorded with Control (1.77).

### **Discussions:**

Sulphur through gypsum might have promoted the uptake and translocation of food assimilates from source to sink effectively, resulting in higher yield attributes viz., no. of capsules/plant, weight of capsules/plant leading to higher seed yield. These results are in agreement with the findings of **Duhoon et al. (2005)** and **Ramakrishna (2013)** in sesame. The increase in yield might be attributed to easy availability of sulphate (SO<sub>4</sub>) sulphur present in gypsum compared to sulphide form in elemental sulphur, which essentially requires its oxidation to be converted into SO<sub>4</sub> prior to its absorption by the plants. Among sources of sulphur gypsum proved

significantly superior to other sources for seed yield have been reported by **Chaurasia et al. (2009)** and **Ramakrishna (2013)**. Zinc plays as an activator of several enzymes in plants and it is directly involved in the biosynthesis of growth substances such as auxin thereby producing more plant cells and enhanced dry matter (**christopher et al., 2019**).

#### **Conclusion:**

It was concluded that for obtaining higher yield components with better quality of Sesame application of Gypsum 300 kg/ha + Zinc 15 kg/ha was recorded significantly higher number of Capsules/plant, Seeds/capsules, seed yield, stover yield, harvest index and benefit cost ratios compared to other treatments. Since, the finding based on the research done in one season.

#### **Comment [u8]:**

Please add more discussion about the finding in the result which stated that there were no significant differences between treatment number 2 and 3, and relate it with the economic analysis.

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**Table 1: Effect of sulphur and zinc on yield parameters of Sesame.**

S.no	Treatments	No. of Capsules/ plant	No. of seed/capsules	Test weight(g)	Seed yield(t/ha)	Stover yield(t/ha)
1.	Gypsum 300 kg/ha + Zinc 5 kg/ha	46.33	51.60	2.57	1.01	2.54
2.	Gypsum 300 kg/ha + Zinc 10 kg/ha	50.67	54.40	2.67	1.06	2.58
3.	Gypsum 300 kg/ha + Zinc 15 kg/ha	51.40	55.47	2.70	1.07	2.59
4.	Single super phosphate 20 kg/ha + Zinc 5 kg/ha	39.40	46.60	2.40	0.91	2.46
5.	Single super phosphate 20 kg/ha + Zinc 10 kg/ha	41.20	47.53	2.43	0.93	2.49
6.	Single super phosphate 20 kg/ha + Zinc 15 kg/ha	43.07	49.47	2.50	0.98	2.52
7.	Sulphur 40 kg/ha + Zinc 5 kg/ha	42.53	47.93	2.47	0.96	2.51
8.	Sulphur 40 kg/ha + Zinc 10 kg/ha	44.87	51.33	2.53	0.99	2.53
9.	Sulphur 40 kg/ha + Zinc 15 kg/ha	48.27	53.27	2.60	1.04	2.56
10.	Control (RDF 40:60:40 NPK kg/ha)	37.40	45.20	2.27	0.88	2.45
	F- Test	S	S	NS	S	S
	SEm (±)	0.61	0.51	0.08	0.01	0.01
	CD (p=0.05)	1.82	1.52	-	0.03	0.03

**Comment [u9]:** Please add the comparison analyses such as Duncan Multiple Range test and give the letter after the number in every column to give more information about the result in the table

**Table 2 :InfluenceofsulphurandzinconEconomicsofsesame**

<b>S.no</b>	<b>Treatments</b>	<b>Cost of cultivation (INR/ha)</b>	<b>Gross returns (INR/ha)</b>	<b>Net returns (INR/ha)</b>	<b>B:C ratio</b>
1.	Gypsum 300 kg/ha + Zinc 5 kg/ha	28700	83581	54881	1.91
2.	Gypsum 300 kg/ha + Zinc 10 kg/ha	29200	87731	58531	2.00
3.	Gypsum 300 kg/ha + Zinc 15 kg/ha	29700	89889	60189	2.03
4.	Single super phosphate 20 kg/ha + Zinc 5 kg/ha	27100	75779	48679	1.80
5.	Single super phosphate 20 kg/ha + Zinc 10 kg/ha	27600	76941	49341	1.79
6.	Single super phosphate 20 kg/ha + Zinc 15 kg/ha	28100	81589	53489	1.90
7.	Sulphur 40 kg/ha + Zinc 5 kg/ha	30500	79680	49180	1.61
8.	Sulphur 40 kg/ha + Zinc 10 kg/ha	31000	81921	50921	1.64
9.	Sulphur 40 kg/ha + Zinc 15 kg/ha	31500	86320	54820	1.74
10.	Control (RDF 40:60:40 NPK kg/ha)	26400	73040	46640	1.77

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