Effect of basal application of sulphur and foliar application of micro-nutrients on growth and yield of summer Sesame (*Sesamum indicum* L.)

ABSTRACT

A field experiment was conducted during *Zaid* season of 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) India. The aim of this was to study the response~~To study the Response~~ of basal application of sulphur and micronutrients on the growth and yield of summer sesame. The treatments consist of the applicationSulphur10,20,30 kg/ha and micro nutrients (0.5 % Zinc,0.5% Iron, 0.2% Boron) as a foliar spray.There were 10 treatments each replicated thrice. The soil of the experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%) available N (163.42 kg/ha), available P (21.96 kg/ha) and available K (256.48 kg/ha). Results revealed that the higher plant height (95.1 cm), higher plant dry weight (20.48 g/plant), higher crop growth rate (11.79g/m^2/day)maximum number of Capsules/plant (52.9), a higher number of seeds/Capsule (63.2), maximum Test weight (3.26g), Higher Seed yield (1.41 t/ha), Stover yield (6.44 t/ha) and Harvest index (17.92 %) were recorded with the treatment Sulphu 30kg/ha + Zinc 0.5%.

Keywords: *summer sesame, sulphur, micro~~o~~-nutrients, growth parameters, yield attributes.*

INTRODUCTION

Sesame (*Sesamum indicum* L.) is a long-cultivated oilseed crop. It ranks right up there with peanuts and rapeseed-mustard as a significant edible oilseed crop. The sesame seed was referred to as the "queen of oilseeds" in ancient literature, and sesame oil is one of the oldest known oils~~.~~f~~F~~or Man's consumption (**Prasad, 2017**). It is One of the oil seed crops that originated in South West Africa is sesame (*Sesamum indicum* L.), which belongs to the Pedaliaceae family. Oil makes up 46–64% of its composition, whereas protein makes up 15%–16%. A little more than 73% of the nation's sesame production is used for oil extraction, 14.5% for domestic uses like making candies and sweets for cooking and confectionary products, 8.3% for hydrogenation, and 4.2 percent for industrial uses like making paints, perfumed oils, pharmaceuticals, and insecticides.**(shiny and dawson 2021)**

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Oilseed crops require more Sulphur (S) than cereal crops, and S deficiency hampers N metabolism in plants as well as synthesis of S-containing amino acids, and thus exerts adverse effects on both seed and oil yield. The S is essential for the plant growth and development, plays a key role in plant metabolism, synthesis of essential oils, and formation chlorophyll (**Ajai Singh *et al.*, 2000**). It also enhances cell development, cold resistance, and drought hardness (**Patel and Shelke, 1995**), and constituent of a number of organic compounds (**Shamina and Imamul, 2003**), oil storage organs particularly oil glands (**Jaggi*et al.*, 2000**) and vitamin B1 (**Thirumalaisamy*et al.*, 2001**).

Zinc (Zn) being one of the essential micronutrients, plays significant role in various enzymatic and physiological activities of the plant body. It is also essential component of synthetic and natural organic complexes in plants. There are estimates that more than 30% of agricultural soils at global level are low in available Zn leading to deficiency in crops cultivated on these soils (**Alloway 2008**). Therefore, Zn malnutrition has become a major health concern among the resource poor people (**Singh, 2011**). In India, Zn is one of the multi-nutrient deficiencies causing poor crop yields.

Boron is one of the essential micro-nutrients required for the normal growth of the crops. Its deficiency causes great loses in crop production both qualitatively and quantitatively. The primary function of boron is to maintain cell wall integrity, also needed for cell expansion and hydrogen ions transport ion regulation. In oil seeds it is important for pollen tube growth, flowering, fruit -setting and seed development. It plays a vital role in the transportation of nutrients and water to newly growing plant parts and in the translocation of photosynthes from source to sink. It regulates the opening of stoma and imparts drought resistant to crop. (*The hand book of agriculture* **2019;** *Agronomy facts for competition by* **meena and sihag 2021**)

Iron plays a role in the formation of plant chlorophyll.Iron containing plant haemoglobins are another promising target for altering Fe content in plant-based foods. Plant Haemoglobin is similar to the human haemoglobin,with Fe binding capacity and is most commonly found in nodulatinglegumes (nitrogen fixing pl ants)**(kundu*et al.*,2003).**

MATERIALS AND METHODS

A field experiment was conducted during *zaid*season 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, sam Higginbottom University of agriculture technology and sciences, prayagraj (U.P.) India. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%)., The treatments consist ofsulphur 10 kg/ha +Zinc foliar 0.5%,sulphur 10 kg/ha +Iron foliar 0.5%,sulphur 10 kg/ha +Boron 0.2%,sulphur 20 kg/ha +Zinc foliar 0.5%,sulphur 20 kg/ha +Iron foliar 0.5%,sulphur 20 kg/ha +Boron 0.2%, sulphur 30 kg/ha +Zinc foliar 0.5%,sulphur 30 kg/ha +Iron foliar 0.5%,sulphur 30 kg/ha +Boron 0.2%,control. The experiment was laid out in Randomized Block Design, with 10 treatments replicated thrice. In the period from germination to harvest several plant growth parameters were recorded those parameters are growth parameters, plant height and plant dry weight are recorded.The yield parameters like No. Capsules/plant,No.Seeds/Capsule,Test weight (g), seed yield (t/ha),Stover yield(t/ha) and harvest index (%). The data were subjected to statistical analysis by analysis of variance method **(Gomez and Gomez, 1976).**

RESULT AND DISCUSSION

GROWTH PARAMETERS

Plant height –At harvest significantly higher plant height (95.1 cm) was observed in treatment-7 (sulphur 30 kg/ha +Zinc foliar 0.5%). However, treatment-8 (sulphur 30 kg/ha +Iron foliar 0.5%) was statistically at par with treatment-7 (sulphur 30 kg/ha +Zinc foliar 0.5%).The significantly higher plant height might be due to with the application of sulphur30 kg/ha. The presence of Sulphur plays vital role in increased metabolic uses of sulphur in plants which seems to have promoted meristematic activities resulting in higher apical growth and expansion of photosynthetic surface. The results were in accordance to **Paul *et al.* (2019).** Along with the application of zinc has also, show significant improvement on plant height Increase in plant height might be the involvement of zinc in differentphysiological processes like enzyme activation, electron transport, chlorophyll formation,stomatal regulation, etc.With the increase in levels of zinc the plant height graduallyincreased, which might be attributable to greater photosynthetic activity and chlorophyllsynthesis due to zinc fertilization resulting into better vegetative growth.Similarresultswerereportedby**Shehu (2014).**

Plant dry weight - At harvest significantly higher plant dry weight (20.48gm/plant) was observed in treatment-7 (sulphur 30 kg/ha +Zinc foliar 0.5%). However, treatment-8 (sulphur 30 kg/ha + Iron foliar 0.5%) was statistically at par with treatment-7 (sulphur 30 kg/ha +Zinc foliar 0.5%). The increase in plant dry weight might be influence with the application of sulphur30kg/ha. With, increase in sulphur application, This, might be due to more synthesis of amino acids, increase in chlorophyll content in growing region and improving the photosynthetic activity, ultimately enhancing cell division and thereby increased the crop growth rate. Adequate supply of sulphur results in higher production of photosynthates and their translocation to sink these results are conformity with **Dev and Sarawgi. (2004)**. Along with that applicationofZnonanenhanced branching in sesame and mainly attributed to promotion of shoot development by theauxins whereas Zn application ultimately increased the availability of other nutrients andacceleratedthetranslocationofphotoassimilates which ultimately helped in increase of plant dry weight of sesame. Similarresultswerereportedby **Kumar *et al.* (2014).**

YIELD ATTRIBUTES

Number of Capsules/Plant - Significantly higher Number of Capsules/Plant (52.9) was recorded with the treatment treatment-7 (30Kg/ha Sulphur + 0.5 % Zinc foliar)which is superior over all the treatments. However, treatment - 930Kg/ha Sulphur + 0.2 % Boron foliar were found to be statistically at par with treatment - 7(30Kg/ha Sulphur + 0.5 % Zinc foliar).The increase in number of capsules per plant was due to the significant improvement in the application ofsulphur this could be ascribed to overall improvement in vigour and crop growth as a consequence balanced nutritional environment as discussed above. Supply of sulphur in adequate amount also helps in the development of floral primordial i.e., reproductive parts, which results in the development of capsules and seeds in plants. Similar findings have also been reported earlier by **Tripathi and Rajput (2007).**

Number of seeds/capsule - Significantly higher Number of Seeds/Capsules (63.2) was recorded with the treatment treatment-7 (30Kg/ha Sulphur + 0.5 % Zinc foliar)which is superior over all the treatments. However, treatment - 930Kg/ha Sulphur + 0.2 % Boron foliar were found to be statistically at par with treatment - 7(30Kg/ha

Sulphur + 0.5 % Zinc foliar).The increment in number of seeds/capsule with increasing dose of sulphur application might be better for root growth, cell multiplication, elongation and cell expansion in the plant body by higher dose of sulphur application, which ultimately increased the seed yieldsimilar results were conformity with **Murmu*et al.*** **(2015).**

Test weight - Significantly higher Number of higher test weight (3.26 gm) was recorded with the treatment treatment-7 (30Kg/ha Sulphur + 0.5 % Zinc foliar)which is superior over all the treatments. However, treatment - 930Kg/ha Sulphur + 0.2 % Boron foliar were found to be statistically at par with treatment - 7(30Kg/ha Sulphur + 0.5 % Zinc foliar).Application of Zinc on sesame crop generally improves capsule growth bysynthesizing tryptophan and auxin. The enhancement effect on seeds/capsule and capsules/plantattributed to the favourable influence of the Zn application to crops on nutrient metabolism,biologicalactivityandgrowthparametersandhence,appliedzincresultedintallerandhigherenzyme activity which in turn encouraged more seeds/capsule, capsules/plant and seeds test weight. Similar findingshave been reported earlier by**Ram*et al.*** **(2021).**

Seed yield -Significantly higherSeed yield (1.41 t/ha) was recorded with the treatment treatment-7 (30Kg/ha Sulphur + 0.5 % Zinc foliar)which is superior over all the treatments. However, treatment - 930Kg/ha Sulphur + 0.2 % Boron foliar were found to be statistically at par with treatment - 7 (30Kg/ha Sulphur + 0.5 % Zinc foliar).This might bedue to the stimulatory effect of Sulphur in cell division, cell elongation and setting of cell structure and also higher dose may be responsible for increased leaf area and chlorophyll content causing higher photosynthesis and assimilation, metabolic activities responsible for overall reproductive phase and ultimately improved the seed yield. The results were found in resonance with **Khan *et al.*** **(2021).**Zincplaysavitalroleinincreasingseedyieldbecausezinctakes placeinmanyphysiologicalprocessofplantsuchaschlorophyllformation,stomatalregulation, starchutilizationwhichenhanceseedyield.Zincalsoconvertsammoniatonitratein crops which contribute to yield.These results are in confirmatory with the work of**Jahan*et al.*** **(2019)**.

Stover yield - Significantly higher Stover yield (6.30 t/ha) was recorded with the treatment treatment-7 (30Kg/ha Sulphur + 0.5 % Zinc foliar)which is superior over all the treatments. However, treatment - 9(30Kg/ha Sulphur + 0.2 % Boron foliar) were found to be statistically at par with treatment - 7 (30Kg/ha Sulphur + 0.5 % Zinc foliar). With the application of sulphur and the bioactivity of sulphur might have played important role in improving yield attributes like capsule per plant, length of capsule and there by ultimately increase in seed and stalk yield similar results were conformity with **Raja *et al.*, (2007).**

Harvest Index(%) – significantly Maximum Harvest index (17.92%) was recorded with the treatment -7 (30kg/ha Sulphur + 0.5% Zinc foliar) which is superior over all the treatments.However, the treatments Treatment 4 -20kg/ha Sulphur +0.5% Zinc foliar (17.41 %), Treatment 8 – 30kg/ha Sulphur + 0.5% Iron foliar (17.65%) and Treatment 9 – 30kg/ha Sulphur + 0.2% Boron foliar (17.91%) which was found to be statistically at par with Treatment 7 – 30kg/ha Sulphur+ 0.5% Zinc foliar.

CONCLUSION

It was concluded that with the application of Sulphur30 kg/ha along with the Zinc0.5% was recorded significantly higher seed yield (1.41t/ha) as compared to the other treatments. Since ~~T~~thefindings based on the research done in one season , further trials may be required to confirm the results.

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Table-1. Effect of sulphur and micro nutrients on growth attributes of sesame.

S. No.	Treatment combinations	Plant height(cm)	Dry weight (g/plant)
1.	Sulphur10Kg/ha + 0.5 % Zinc foliar	93.0	18.68
2.	Sulphur10Kg/ha + 0.5 % Iron foliar	91.4	17.88
3.	Sulphur 10Kg/ha + 0.2 % Boron foliar	92.1	18.34
4.	Sulphur 20Kg/ha + 0.5 % Zinc foliar	93.9	19.74
5.	Sulphur 20Kg/ha + 0.5 % Iron foliar	93.0	19.09
6.	Sulphur 20Kg/ha + 0.2 % Boron foliar	93.6	19.40
7.	Sulphur 30Kg/ha + 0.5 % Zinc foliar	95.1	20.48
8.	Sulphur 30Kg/ha + 0.5 % Iron foliar	94.4	20.01
9.	Sulphur 30Kg/ha + 0.2 % Boron foliar	94.6	20.33
10.	control	89.8	17.23
	F test	**S**	**S**
	S Em.(±)	0.22	0.13
	CD (P=0.05)	0.66	0.41

Table-2. Effect of sulphur and micro nutrients on yieldattributes of sesame.

S. No.	Treatment combinations	Capsules/plant	Seeds/capsule	Test weight(g)	Grain yield(t/ha)	Stover yield (t/ha)	Harvest index(%)
1.	Sulphur10Kg/ha + 0.5 % Zinc foliar	49.4	60.9	2.84	1.07	5.97	15.20
2.	Sulphur10Kg/ha + 0.5 % Iron foliar	48.5	59.1	2.79	0.93	5.62	14.19
3.	Sulphur 10Kg/ha + 0.2 % Boron foliar	49.0	59.9	2.82	0.98	5.75	14.64
4.	Sulphur 20Kg/ha + 0.5 % Zinc foliar	51.3	62.2	3.00	1.32	6.26	17.41
5.	Sulphur 20Kg/ha + 0.5 % Iron foliar	50.2	61.5	2.87	1.16	6.07	15.99
6.	Sulphur 20Kg/ha + 0.2 % Boron foliar	50.8	61.8	2.93	1.25	6.18	16.81
7.	Sulphur 30Kg/ha + 0.5 % Zinc foliar	52.9	63.2	3.26	1.41	6.44	17.92
8.	Sulphur 30Kg/ha + 0.5 % Iron foliar	51.9	62.4	3.07	1.35	6.30	17.65
9.	Sulphur 30Kg/ha + 0.2 % Boron foliar	52.7	62.8	3.14	1.39	6.35	17.91
10.	control	47.7	57.8	2.63	0.83	5.27	13.64
	F test	**S**	**S**	**S**	**S**	**S**	**S**
	S Em.(±)	0.28	0.22	0.05	0.02	0.04	0.24
	CD (P=0.05)	0.85	0.66	0.13	0.06	0.14	0.72