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

Abstract:

A field experiment was conducted during *kharif* 2022 at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj, (UP). The soil had a sandy loam texture, with a pH of 7.5, organic carbon (0.625%) and EC (0.564 m.m cm^{-1}), Nitrogen (278.48 kg ha^{-1}), Phosphorus (38.2 kg ha^{-1}) and Potassium (240.7 kg ha^{-1}).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, Elementary 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 higher Plant height (110.73 cm), Plant dry weight (15.71 g/plant), number of Capsules/plant (51.40), Seeds/capsules (55.47), Test weight (2.70 g), Seed yield (1.07 t/ha) were recorded with the treatment of Gypsum 300 kg/ha + Zinc 15 kg/ha.

Key words: Sesame, Gypsum, single super phosphate, sulphur, zinc.

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 valuated 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).

Sufficient application of Sulphur fertilizer has been documented to improve sesame seed yield and yield related traits [Raja 2007, Vaiyapuri 2004, Sarkar 2005, Shah 2013], as well as oil and protein content in sesame.

The sesame oilcake is a very good cattle feed since it contains protein of high biological value and appreciable quantities of phosphorus and potassium. The cake is also used as manure (Malik et al., 2003).

Gypsum is a soluble source of the essential plant nutrients, (calcium 29.2% and sulfur 18.6%), and can improve overall plant growth. Gypsum amendments can also improve the physical properties of some soils (especially heavy clay soils). Such amendments promote soil aggregation and thus can help prevent dispersion of soil particles, reduce surface crust formation promote seedling emergence, and increase water infiltration rates and movement through the soil profile. It can also reduce erosion losses of soils and nutrients and reduce concentrations of soluble phosphorus in surface water runoff. Chemical properties improved by application of gypsum include the mitigation of subsoil acidity and aluminum toxicity. This enhances deep rooting and the ability of plants to take up adequate supplies of water and nutrients during drought periods.

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

Elemental sulphur, which usually occurs in the form of eight-member rings, is a relatively nontoxic and chemically inert substance and is insoluble in water and most other liquids. It is solid at ambient temperature and exists in two crystalline and amorphous form

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.

Material and Methods:

The experiment was conducted to know the **Influence of sources of sulphur and zinc on growth and yield of Sesame (Sesamum indicum L.)** was carried out at Crop Research Farm of Sam Higginbottom University, Prayagraj, Uttar Pradesh during 2022, which is located at 25°39' 42''N latitude, 81°67'56" E longitude and 98 m altitude above the mean sea level. The soil had a sandy loam texture, with a pH of 7.5, organic carbon (0.625%) and EC (0.564 m.m cm^{-1}), Nitrogen (278.48 kg ha^{-1}), Phosphorus (38.2 kg ha^{-1}) and Potassium (240.7 kg ha^{-1}).The experiment was laid out in a RBD consisting of Ten treatments with 3 replications, with the treatment combinations (T_1) Gypsum 300 kg/ha + Zinc 5 kg/ha, (T_2) Gypsum 300 kg/ha + Zinc 10 kg/ha, (T_3) Gypsum 300 kg/ha + Zinc 15 kg/ha, (T_4) Single super phosphate 20 kg/ha + Zinc 5 kg/ha, (T_5) Single super phosphate 20 kg/ha + Zinc 10 kg/ha, (T_6) Single super phosphate 20 kg/ha + Zinc 15 kg/ha, (T_7) Sulphur 40 kg/ha + Zinc 5 kg/ha, (T_8) Sulphur 40 kg/ha + Zinc 10 kg/ha, (T_9) Sulphur 40 kg/ha + Zinc 15 kg/ha, (T_{10}) Control.

Results and Discussion:

At Harvest, there was significant difference among the treatments. However, highest plant height (110.73 cm) was recorded with the application of Gypsum 300 kg/ha + Zinc 15 kg/ha, whereas minimum plant height (97.57 cm) control, and Gypsum 300 kg/ha + Zinc 10 kg/ha (109.60 cm) was statistically at par with T3.

At Harvest, there was significant difference among the treatments. However, highest dry weight (15.71 gm) was recorded with the application of Gypsum 300 kg/ha + Zinc 15 kg/ha, whereas minimum dry weight (13.23 gm) control, and Gypsum 300 kg/ha + Zinc 10 kg/ha (15.48 gm) was statistically at par with T3.

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 Maimum 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 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.

The perusal of the data of Test weight was recorded at harvest, is presented in Table 1. The data reveals that there was non significant effect among different treatments on Test weight (g).

Non 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.

Significantly Maximum seed yield (1.07 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.

Discussions:

Sulphur through gypsum might have promoted the uptake and translocation of food assimilates from source to sink effectively, resulting in higher yield attributes vi, 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 Ramakrisha (2013) in sesame. The increase in yield might be attributed to easy availability of sulphate (SO) sulphur present in gypsum compared to sulphide form in elemental sulphur, which essentially requires its ostidation to be converted in to SOS 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 era (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). It has been reported that the Sulphur application not only improves the Sulphur availability itself but also improves availability of other nutrients too, which are essential for growth and development of plant. It has been also reported that Sulphur helps in reducing soil pH, which helps in the greater availability and mobility of nutrients especially P, Fe, Mn, and Zn. Reason for enhancement of growth parameters might be due to adequate ready supply and increased uptake of sulphur which have resulted into larger photosynthesizing surface and accelerated the process of formation and translocation of photosynthates and hence overall development of the plant Higher growth with gypsum source was also reported by Warkad (2018).

Conclusion:

It was concluded that for obtaining higher yield components with better quality of Sesame by application of Gypsum 300 kg/ha + Zinc 15 kg/ha was recorded significantly higher number of Capsules/plant (51.40), Seeds/capsules (55.47), seed yield (1.07 t/ha), as compared to other treatments. Since, the finding based on the research done in one season.

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

Treatments	Plant Height (cm)	Dry weight (g/plant)	No. of capsules/ plant	No. of seeds/ capsule	Test weight (g)	Grain Yield (t ha^{-1})
T1	107.50	14.82	46.33	51.60	2.57	1.01
T2	109.60	15.48	50.67	54.40	2.67	1.06
T3	110.73	15.71	51.40	55.47	2.70	1.07
T4	98.80	13.40	39.40	46.60	2.40	0.91
T5	99.60	13.55	41.20	47.53	2.43	0.93
T6	103.80	14.20	43.07	49.47	2.50	0.98
T7	101.70	13.99	42.53	47.93	2.47	0.96
T8	104.73	14.49	44.87	51.33	2.53	0.99
T9	108.20	15.06	48.27	53.27	2.60	1.04
T10	97.57	13.23	37.40	45.20	2.27	0.88
Sem(±)	0.76	0.09	0.61	0.51	0.08	0.01
CD (p=0.05)	2.27	0.27	1.82	1.52	-	0.03

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