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

Abstract:

Background: Afieldexperimentwasconductedduring*kharif*2022 month of August atCropResearchFarm,Department of Agronomy, SHUATS, Prayagraj (U.P). Theexperiment was laid out in Randomized Block Design with nine treatments and control which are replicatedthriceonthebasisofoneyearexperiment.Thetreatments 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. TheapplicationofGypsum 300 kg/ha + Zinc 15 kg/harecordedsignificantly 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 (60,180.00INR/ha), B:C ratio (2.03 INR/ha) was 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:

The experiment was conducted to know the **Influence of sources of sulphur and zinc on yield of Sesame (*Sesamum indicum* L.).** 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 (Priyanka Evangilin 2020).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).

Single Super Phosphate 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 **(Nutrient Source Specifics)**.

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.

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 soil of experimental plot was sandy loam intexture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in a Randomized Block Design consisting of Ten treatments including Control with 3 replications, with the treatment combinations (T_1) Gypsum300 kg/ha+Zinc5 kg/ha, (T_2) Gypsum300 kg/ha+Zinc10 kg/ha, (T_3) Gypsum300 kg/ha+Zinc 15 kg/ha, (T_4) Singlesuper phosphate 20 kg/ha+Zinc5 kg/ha, (T_5) Singlesuper phosphate 20 kg/ha+Zinc10 kg/ha, (T_6) Singlesuper phosphate 20 kg/ha+Zinc 15 kg/ha, (T_7) Sulphur 40 kg/ha+Zinc5 kg/ha, (T_8) Sulphur 40 kg/ha+Zinc10 kg/ha, (T_9) Sulphur 40 kg/ha+Zinc 15 kg/ha, (T_{10}) Control with spacing of row to row 30 cm and plant to plant 10 cm. The sesame crop was harvested treatment wise at harvesting maturity stage. Yield parameters viz. number of capsules per plant, number of seeds per capsules, test weight, stover yield and seed yield 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 seed yield per ha was computed and expressed in tonnes 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.

Results

Yield

The perusalof the dataof Number of Capsules/plantswasrecordedatharvest,ispresented in Table 1. The data reveals that there was significant effect among differenttreatmentson NumberofCapsules/plants. Significantly Maximum Number ofCapsules/plants(51.40) wasrecorded with the treatment ofapplication Gypsum300 kg/ha+Zinc15 kg/ha over all the treatments and minimum was recorded in (37.40) control. However, treatment Gypsum300 kg/ha+Zinc10 kg/ha (50.67) was found to be statistically at par with Gypsum300 kg/ha+Zinc15 kg/ha.

Significantly Maximum test weight(2.70 g) wasrecorded with the treatment ofapplication Gypsum300 kg/ha+Zinc15 kg/ha over all the treatments and minimum was recorded (2.27 g) in control. However, treatment Gypsum300 kg/ha+Zinc10 kg/ha (2.67 g) was found to be statistically at par with Gypsum300 kg/ha+Zinc15 kg/ha.

Significantly Maximum Number ofseeds per capsules(55.47) wasrecorded with the treatment ofapplication Gypsum300 kg/ha+Zinc15 kg/ha over all the treatments and minimum was recorded (45.20) in control. However, treatment Gypsum300 kg/ha+Zinc10 kg/ha (54.40) was found to be statistically at par with Gypsum300 kg/ha+Zinc15 kg/ha.

Significantly Maximum seed yield(1.07 t/ha) and stover yield(2.59 t/ha) wasrecorded with the treatment ofapplication Gypsum300 kg/ha+Zinc15 kg/ha over all the treatments and minimum was recorded (0.88 t/ha) in control. However, treatment Gypsum300 kg/ha+Zinc10 kg/ha (1.06 t/ha) was found to be statistically at par with Gypsum300 kg/ha+Zinc15 kg/ha.

Significantlymaximumharvestindex(29.30%)wasrecordedwiththetreatmentofapplication of Gypsum 300 kg/ha + Zinc 15 kg/ha over all the treatments and minimum wasrecordedinControl(40:60:40kg/ha)(26.40%)andtherewassignificantdifferenceinbetweenthe treatments.

Economics

Higher Grossreturns have been recorded withtheGypsum 300 kg/ha + Zinc 15 kg/ha(89,889)over restof thetreatmentsfollowedby Gypsum300kg/ha+Zinc15kg/ha (57,731).

Higher net returns have been recorded with the Gypsum 300 kg/ha + Zinc 15 kg/ha (60,189)overrest of thetreatmentsfollowed by Gypsum300kg/ha+Zinc15kg/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) whereasminimumBenefit ratio was recorded withControl(1.77).

Discussions:

The observed improvement in plant height due to zinc might be due to biosynthesis of IAA growth hormones, cell enlargement, cell division and multiplication which ultimately led to better plant height of sesame and boosted plant growth. Similar findings were also reported by **Sharma and Jain (2003)** in mustard, **Choudhary et al. (2010)** in sunflower and **Murthy et al. (2011)** in sesame. 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 **(4apsule4her *et al.*, 2019).**

The increase in yield attributes and yield due to the application of Zn might be due to fact that Zn influences on the water economy and crop growth through its effect on water uptake, root growth, maintenance of turgor, transpiration and stomatal behavior, overcomes the adverse effect of water stress and improving the drought tolerance. Similar results were also reported by **Paraye et al. (2009)**, **Deosarkar et al. (2001)** in soybean

Conclusion:

It was concluded that for obtaining higher yield components with better quality of Sesame application of Gypsum300 kg/ha+Zinc15 kg/ha was recordedsignificantly higher number of Capsules/plant, Seeds/capsules, seed yield, stover yield, harvest index and benefit cost ratio as compared to othertreatments.Since, the finding basedon the research donein one season.

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

S.no	Treatments	No. of Capsules/ plant	No. of seed/capsules	Testweight(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

Table 2 : InfluenceofsulphurandzinconEconomicsofsesame

S.no	Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
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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