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Response of sulfur and zinc on yield attributes, yield and oil and protein content in linseed (*Linum usitatissimum* L.) crop

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Abstract
A pot experiment was carried out to study the effect of sulfur and zinc on yield attributes, yield and quality of linseed (*Linum usitatissimum* L.) crop on sandy loam soil, with each of four levels of sulphur i.e. 0, 20, 40 and 60 ppm and zinc i.e., 0, 2.5, 5.0 and 7.5 ppm, during rabi season, 2014-15, in pot culture house of Department of Soil Science and Agricultural Chemistry, C.S. Azad University of Agriculture and Technology, Kanpur. The experiment was conducted in CRBD with four replications. The results indicated that application of 40 ppm S pot^{-1} and 5.0 ppm Zn pot^{-1} improved the yield components *viz* number of capsules plant^{-1} (55.80 & 54.47), number of seeds capsules^{-1} (8.40 & 8.35), 1000-seed weight (8.60 & 8.55 g), seed (14.33 & 13.91 g pot^{-1}) and stover (20.75 & 20.45 g pot^{-1}) yield as compared to other treatments. However, the yield values were statistically at par at 40 and 60 ppm S levels and 5.0 and 7.5 ppm Zn levels. The results also exhibited that oil and protein content of seed increased with the application of sulfur and zinc upto their highest levels. The oil and protein contents in seeds increased upto 60 ppm S (40.85 & 20.12 %) and 5.0 ppm Zn (40.70 & 19.87 %) respectively.

Keywords: Linseed, oil and protein content, sulfur and zinc, yield attributes and yield

Introduction
Linum usitatissimum (Linn.), commonly known as flaxseed or linseed belongs to the family Linaceae. Linseed is an important *Rabi* oilseed crop. Seed of linseed contain about 35- 47% oil. Linseed has been playing a major role in the field of diet and disease research due to its potential health benefits associated with high content of 35-70% linolenic acid, which is an essential omega-3-fatty acid, the factor which reduces blood cholesterol concentration and cardiovascular benefits by affecting prostaglandins and leukotrienes related to blood clotting and inflammatory disorder like rheumatoid arthritis (Srivastava, 2010) [10]. Linseed is a natural source of lignin which has anti-carcinogenic properties and also provide protection against certain form of cancer due to estrogenic and anti-estrogenic activities inside the body (Srivastava, 2010) [10]. Moreover, due to high content of unsaturated fatty acids and it is being used as an excellent drying oil for use in paints, varnishes, printing ink, coating oils, oil cloths, lanolin and soap industries and similar other products. Introduction of high yielding cultivars, increased cropping intensity, application of sulphur and zinc free fertilizers and limited addition of organic manures have caused sulphur and zinc deficiency in most of the soils in India. This necessitates rational application of these elements as they have becoming limiting factor for obtaining higher yields of several oil seed crops including linseed crop. Judicious use of fertilizers has played a vital role in increasing the production of oil seed crops. Oil seed crops particularly belonging to "Cruciferae" have relatively higher sulphur requirement owing to their high content of sulphur containing amino acids and essential oil (Aulakh *et al.* 1980) [2]. It plays a vital role in formation of chlorophyll, activation of enzymes and improvement in both crop yield and oil yield. Sulfur is involved in the synthesis of chlorophyll and is also required for the synthesis of oil. Zinc application also influences the oil content in oil seed crop (Muralidharudue and Singh 1990) [7].

The present study was undertaken to evaluate the effect of sulphur and zinc on yield attributes, yield and oil and protein content in Linseed (*Linum usitatissimum* L.).

Materials and Methods

The experiments to evaluate the effect of sulfur and zinc on yield attributes, yield and oil and protein content of linseed were conducted during rabi season 2014-15 on sandy loam soil at pot culture house of the department of soil Science and Agricultural Chemistry, C.S. Azad University of Agriculture and Technology, Kanpur. The treatments comprising of four levels of sulfur (0, 20, 40 and 60 ppm through gypsum) and four levels of zinc (0, 2.5, 5.0 and 7.5 ppm through ZnO) replicated four times in a randomized complete block design. All the sixteen treatments were given uniform recommended doses of N, P and K (80 kg N, 60 kg P_2O_5 and 40 kg K_2O). Sulfur and zinc were applied as per treatment through gypsum (at the time of sowing) and zinc oxide as solution form taken at 15 days after sowing. After maturation, drying plants were thrashed manually. Soil of experimental site was taken and analyzed as per standard method. The yield attributing characters *i.e.* number of capsules plant^{-1}; number of seeds capsules^{-1}, 1000- grains weight, seed and stover yield were recorded at maturity. The recorded data were subjected to statistical analysis appropriate to randomized complete block design by using M. Stat. (Freed and Smith, 1986). Means were compared for significance at 5% probability level using LSD (Steel and Torrie, 1980). The oil content in seeds estimated by Nuclear Magnetic Resonance (NMR) Spectrophotometer (Conway and Earle, 1962) [4]. The nitrogen content was estimated by modified Kjeldahl's method. The protein content was calculated by multiplying the nitrogen content (%) with a factor 6.25 (Tai and Young, 1974) [12].

Results and Discussion

Yield attributes

Table 1 clearly shows that the influence of different levels of sulfur and zinc on yield attributes i.e. number of capsules plant^{-1}; number of seeds capsules^{-1}, 1000- grains weight, seed and stover yields of linseed crop. The yield attributed and yield increased concordantly with increase in both sulfur and zinc levels. Among the sulfur levels, application of 40 ppm S registered the highest number of capsules plant^{-1} (55.80), number of seeds capsules^{-1} (8.40), and test weight (8.60 g). It was significantly superior over 20 ppm S and control levels. The increase in yield attributes on addition of sulfur might be due to its deficiency in experimental soil. The crop receiving 40 ppm sulfur might have been helped in vigorous root growth and developments, formation of chlorophyll, resulting in higher photosynthesis. Similar results were report by Tripathi *et al.,* (2010) [13] and Charan *et al.,* (2013) [3]. Likewise, sulfur, zinc application also enhanced the yield attributes in the linear order upto 5.0 ppm zinc level. However, in general, these values of yield attribute at 5.0 ppm and 7.5 ppm levels where recorded statistically at par. This beneficial effect might be due to the interaction effect of sulfur and zinc and their role in the synthesis of IAA, metabolism of auxin and formation of chlorophyll synthesis. It has been also reported by a number of research workers that zinc application has positive effect on yield attributes Singh and Pal (2011) [9].

Yield

On an average, the seed and stover yield increase upto 40 ppmlevels of sulfur and 5.0 ppm levels of zinc. However, the yield values were statistically at par at 40 and 60 ppm S levels and 5.0 and 7.5 ppm Zn levels. It has been observed that, on an average, the highest seed and stover yield of 14.33 g pot^{-1} and 20.75 g pot^{-1} at 40 ppm S were found 28.40% and 28.48% higher in comparison to lowest seed and stover yield of 11.16 g pot^{-1} and 16.15 g pot^{-1} at control, respectively. Likewise, the seed and stover yield on an average, 13.91 g pot^{-1} and 20.45 g pot^{-1} recorded at 5.0 ppm Zn were computed 17.68% and 18.21% higher in comparison to lowest seed and stover yield of 11.82 g pot^{-1} and 17.30 g pot^{-1} are recorded at control (0 ppm Zn) (Table 1). The results are in conformity with the findings of Kumar *et al.,* (2014) [6].

Oil content

The table 2 clearly showed that the application of sulfur increased the oil content in seed in linear order; being lowest at control and highest at 60 ppm sulfur level is 40.85% was recorded. On an average, an increase of 4.53% in oil content was recorded at 60 ppm sulfur in comparison to control. The increase in oil content on addition of sulfur might be associated with increase in Aceyl-CoA and carboxylase activity through the enhancement of Acetyl-CoA concentration Ahmad *et al.,* (2000) [1]. On the other hand, though the zinc application also increased the oil content in the seed but increase was not remarkable as like sulfur, the increase was observed only upto 5.0 ppm and thereafter, decreased at 7.5 ppm level. The increase in oil content of seed on addition of zinc is supported by the findings of Trivedi *et al.,* (2013) [14]. The combined application of sulfur and zinc had significant influence on oil content. Application of 40 ppm sulfur + 5.0 ppm zinc was recorded in the highest oil content (41.23%) over the other treatments. This may be due to the positive interaction effect of S × Zn. Zinc involved in the synthesis of oil in plant and also enzyme activity in the plant cell.

Protein content

Results revealed (Table 2) that S and Zn application increased the protein content in seed significantly as comparison to control. Though, the protein content increased in linear order with the increasing both sulfur and zinc levels being highest at 60 ppm S and 5.0 ppm Zn levels but the increasses were found non- significant. This is might be due to role of sulfur in protein synthesis. Sulfur is a contituent of essential amino acids *viz.* methionine, cysteine and cystine. It also helps in conversion of these amino acids into high quality protein. Appropriate structure is essential for protein formation and sulfur provides di-sulfide chains and thus helps in increasing the protein content of linseed. Similar increase in protein content of seed on addition of sulfur has also been reported by Prasad and Singh (2004) [8]. Likewise, zinc is a constituent of essential component of variety of dehydrogenase, proteinases, which might have resuled in increasing protein content of seed. The increase in protein content on addition of zinc is agreeable with the findings of Verma *et al.* (2012) [15].

Table 1: Effect of sulfur and zinc on yield attributes and yields of linseed

Treatments	No. of capsules plant $^{-1}$	No. of seeds capsules $^{-1}$	1000 seed wt. (g)	Yield (g pot^{-1})	
				Seed	Stover
S - levels (ppm)					
S_0	46.02	7.05	7.19	11.16	16.15
S_{20}	52.67	8.07	8.5	13.26	19.20
S_{40}	55.80	8.40	8.60	14.33	20.75
S_{60}	54.50	8.27	8.50	13.84	20.70
CD (5%)	1.876	0.384	0.317	0.730	1.001
Zn – levels (ppm)					
Zn_0	48.62	7.52	7.55	11.82	17.30
$Zn_{2.5}$	52.43	8.00	8.15	13.29	19.31
$Zn_{5.0}$	54.47	8.35	8.55	13.91	20.45
$Zn_{7.5}$	53.60	7.95	8.09	13.56	19.74
CD (5%)	1.876	0.384	0.317	0.730	1.001

Table 2: Effect of sulfur and zinc on its oil and protein content (%)

Treatments	Oil content (%)	Protein content (%)
S - levels (ppm)		
S_0	39.08	19.06
S_{20}	40.32	19.62
S_{40}	40.80	20.06
S_{60}	40.85	20.12
CD (5%)	0.198	0.233
Zn – levels (ppm)		
Zn_0	39.56	19.43
$Zn_{2.5}$	40.26	19.73
$Zn_{5.0}$	40.70	19.87
$Zn_{7.5}$	40.53	19.82
CD (5%)	0.198	0.233

References

1. Ahmad A, Khan I, Abdin MZ. Effect of sulfur fertilization on oil accumulation, Acetyl-CoA concentration and Acetyl-CoA carboxylase activity in the developing seeds of rapeseed (*B. compestris* L.) Austr J Agric Res. 2000; 51:1023-1029.
2. Aulakh MS, Pasricha NS, Sahota NS. Yield nutrient concentration and quality of mustard crop as influenced by nitrogen and sulphur fertilizers. Journal of Agricultural Science Cambridge. 1980; 94:545-49.
3. Charan K, Kumar V, Pal M. Effect of sulfur levels under various sowing method on growth and yield of Indian mustard (*Brassica juncea* L.) Prog Res. 2013; 8:575-579: (Special issue).
4. Conway TF, Earle FR. J Am Oil Chem Soc. 1962; 40:265-268.
5. Freed RD, Smith ESP. Mstat microcomputer statistically program. Michigan State University agriculture, Michigan, Lansing, USA, 1986.
6. Kumar A, Kumar S, Kumar P, Arya S. Effect of zinc and iron application on yiel and acqisition of nutrient on mustard crop (*Brassica juncea* L.) Int. J Agric Sci. 2014; 10:797-800.
7. Muralidharudue Y, Singh M. Effect of iron and zinc application on yield, oil contents their uptake by sesame. Journal of the Indian Society of Soil Science. 1990; 38:171.
8. Prasad D, Singh MM. Response of Indian mustard to nitrogen and sulfur. Ann Pl. 2004; 6:222-223.
9. Singh SP, Pal MS. Effect of integrated nutrient management on productivity, quality, nutrient uptake and economics of mustard. Ind. J Agron. 2011; 56:381-387.
10. Srivastava RL. Technology for increasing production, project coordinated Unit (Linseed), Kanpur, India, 2010.
11. Steel RGD, Torrie JH. Principles and procedures of sytatistics a biometrical approach. McGraw Hill Book Co Inc. New York, 1980.
12. Tai YP, Young GP. Variation in protein percentage in different properties of peanut cotyledons. Crop Sci. 1974; 14:222-229.
13. Tripathi HC, Tripathi S, Singh R, Pathak RK. Effect of sulfur levels on linseed genotype. Ann Pl and Soil Res. 2010; 12:135-136.
14. Trivedi SK, Pachauri RK, Sharma G, Joshi BS, Rajput B. Effect of moisture regimes, N, P, K & Zn levels on growth, yield, quality, nutrient uptake & economics of mustard (*Brassica juncea*). J Soils and Crops. 2013; 23:78-85.
15. Verma CK, Prasad K, Yadav DD. Studies on response of sulfur, zinc and boron levels on yield, economics and nutrients uptake of mustard L [*Brassica juncea* (L.) Czern & Coss.] Crop Res Hisar. 2012; 44:75-78.