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Effect of Varying Levels of Boron and Sulphur on Yields and Nutrient Uptake of Linseed (*Linum usitatissimum L.*) Grown in a Mollisol

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A greenhouse experiment was conducted to study the effect of effect of varying levels of boron and sulphur on yield and nutrient uptake of linseed (*Linum usitatissimum* L.) grown in a Mollisol. The experiment was conducted under factorial completely randomized design with three replications and consisted of six levels of each of boron (0, 0.5, 1.0, 1.5, 2.0 mg kg^{-1}soil and two foliar sprays of 0.2% boron) and sulphur (0, 10, 20, 30, 40 and 60 mg kg^{-1}soil). The different doses of sulphur and boron and their interaction had significant effect on seed and stover yields, B and S concentrations and uptake by linseed crop indicating a differential requirement of boron and sulphur by the crop. The highest seed yield was recorded under the combined application of 2 mg B kg^{-1} soil and 60 mg S kg^{-1} soil.

Keywords: Boron; sulphur; linseed; yields; nutrient uptake.

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1. INTRODUCTION

Among the oilseed crops grown during *rabi*, linseed is next to rapeseed−mustard both in area as well as in production. Every part of the linseed plant is utilized commercially, either directly or after processing. Seed contains 33 to 47% of oil. On a very small scale, the seed is directly used for edible purpose. Linseed is globally cultivated for the fibre and is called as flax. Fibres are used for the manufacture of linen. The oil is edible and due to its quick drying property, it is also used for the preparation of paints, varnishes, printing ink, oil cloth, soap and waterproof fabrics. The oilcake left after the oil is pressed out is a most valuable feeding cake perhaps the most favorite cattle feed. It is good in taste and contains 36 per cent protein. Flax seeds contain 23% 18:3 Omega−3 fatty acids and 6% 18:2 Omega−6 fatty acids. Flaxseed oil contains 53% 18:3 Omega−3 fatty acids and 13% 18:2 Omega−6 fatty acids.

The use of sulphur is one of the most important factors in increasing yields of oilseeds. Sulphur plays an important role in the formation of amino acids, synthesis of proteins, chlorophyll and oil [1-2]. Sulphur and boron play important roles in improving the production phenology of mustard (number of siliqua/plant and test weight of seeds) and the crop also responded well to application of 20 kg S ha^{-1} and 1 kg B ha^{-1} [3]. Boron also plays a vital role in cell wall synthesis, root elongation, glucose metabolism, nucleic acid synthesis, lignification and tissue differentiation [4]. Arvind *et al.* [5] also reported that soil application of @ 50 kg S and 2 kg B ha^{-1} along with recommended dose of NPK fertilizers produced higher yield of sesame grown in an upland red soil of Vindhyan zone of eastern part of Uttar Pradesh which was highly deficient in S and B. Kalaiyarasan *et al.* [6] also noted that application of 60 kg S + 1 kg B ha^{-1} resulted the highest growth, yield attributes and yield, quality and nutrient uptake of hybrid sunflower (cv. Sunbred). Since only meager information is available on the interaction between sulphur and boron in relation to response of Linseed crop, the present investigation was undertaken to investigate the effect of interaction between sulphur and boron on the yield and their uptake by linseed crop.

2. MATERIALS AND METHODS

A greenhouse experiment was conducted during *rabi* season of 2018. Surface (0-15 cm) soil was collected from E1 plot of Norman Borlaug Crop Research Centre of the University. The experimental soil was a Typic Hapludoll with sandy loam texture, 7.3 pH, 7.8 g organic carbon kg^{-1} soil [7], 24.2 kg Olsen's P ha^{-1} [8] , 225.4 kg ammonium acetate extractable K ha^{-1}, 0.30 mg hot water soluble B [9] 3.5 mg 0.15% $CaCl_2$ extractable S kg^{-1} soil [10]. From soil fertility point of view, the experimental soil was rated as low in S, medium in P, K, B but high in organic C.

Four kg of processed soil was filled in each of the 108 plastic pots of five kilograms capacity. A basal dose of 26.78 mg N , 13.39 mg P_2O_5 and 26.78 mg K_2O kg^{-1} soil was applied in solution form using urea and NPK. The treatments consisted of all 36 combinations of 6 levels of boron (0, 0.5, 1.0, 1.5, 2.0 mg B kg^{-1} soil and two foliar sprays of 0.2% borax solution and 6 levels of sulphur (0, 10, 20, 40, 60, 80 mg S kg^{-1} soil. These combinations were applied through borax and elemental sulphur. Treatments were replicated thrice and the experiment was laid out in factorial completely randomized design. After fertilizer application, all the pots were irrigated with water and left for equilibration. When the soil moisture was near field capacity, six healthy seeds of linseed were sown in each pot and after the establishment of the seedlings, only three plants were maintained till harvest. At maturity, plants were harvested close to surface. The plants were thoroughly washed and dried in an electric oven at 60^{o} C for 48 h and weighed to record total dry matter yields. Plants were separated into seeds and stover and weighed. Finely ground seed and stover samples were digested in di-acid (3:1 HNO_3 and $HClO_4$, v/v) and estimated for S concentration by turbidimetry [11]. For the estimation of boron, plant samples were dry ashed in a muffle furnace at 550 °C and ash was dissolved in 2*N* HCl acid and used for estimating B concentration by azomethine–H method [12].

The statistical analysis of the experimental data was done with the help of Standard Computer Programs (STPR) software [13]. The test of significance was conducted at 5 % level of significance ($p \leq 0.05$).

3. RESULTS AND DISCUSSION

3.1 Dry Matter Yield

The data on dry matter yield of linseed are presented in Table 1. The results indicated that the dry matter yield of linseed increased with increasing levels of boron and sulphur. The mean dry matter yield of linseed increased from 3.93 g pot^{-1} in control to 5.85 g pot^{-1} at 2 mg kg^{-1} B. Similarly, it significantly increased from 4.35 to 5.54 g pot−1 with increasing levels of sulphur from 0 to 60 mg kg^{-1} soil. The interaction effect between B and S significantly and synergistically influenced the dry matter yield of linseed and the highest yield was observed at 2 mg B and 60 mg S kg^{-1}soil. The per cent increase in dry matter yield of linseed with application of boron was about 48.9 and with that of sulphur it was about 27.4. Karthikeyan and Shukla [14] also found that B and S significantly and synergistically influenced the dry matter and seed yields of sunflower and mustard, which were observed at 60 mg kg $^{-1}$ of S in conjunction with 2 mg kg $^{-1}$ of boron. The higher and positive response to added sulphur and boron may be assigned to low status of available S and B of the soil under study and due to the stimulating effect of applied S in the synthesis of chloroplast and greater photosynthesis efficiency, which resulted in increased dry matter yield of plants.

3.2 Seed Yield

The data on seed yield of linseed have been presented in Table 2. The mean seed yield of linseed increased from 1.36 g pot^{-1} under control to 2.03g pot^{-1} at 2 mg kg^{-1} B application. Similarly, the seed yield significantly increased from 1.46 to 1.92 g pot^{-1} with increasing levels of sulphur from 0 to 60 mg kg^{-1} soil. The interaction effect between B and S significantly and synergistically influenced the seed yield of linseed which was the highest at 2 mg kg^{-1} of applied B in conjunction with 60 mg kg^{-1} S. The per cent increase in seed yield of linseed with application of boron was about 49.3 and with that of sulphur it was about 31.5. Saxena and Nainwal [15] studied the effect of sulphur and boron on yield and yield attributes of Soybean and concluded that the effect of different doses of sulphur and boron application on seed yield of soybean was significant and its interaction effect was also significant indicating that there was a differential requirement of sulphur and boron to maximize the yield. They reported that on mean performance basis, the application of 30 kg S ha^{-1} gave the maximum yield. Boron application resulted into the highest yield at 1.5 kg B ha^{-1}. Kalaiyarasan *et al.* [6] reported that a treatment combinations of 60 kg S ha^{-1} with 1 kg B ha^{-1} had a spectacular effect on growth and yield attributes, ultimately leading to maximum seed yield (2573.25 and 2673.84 kg ha1) in hybrid sunflower.

3.3 Stover Yield

The data on stover yield of linseed have been presented in Table 3. The mean stover yield of linseed increased from 2.57 g pot^{-1} in control to 3.82 g pot^{-1}at 2 mg kg^{-1} B application. The magnitude of increase in mean stover yield due to B application was much higher as compared to the magnitude of increase in mean seed yield due to limited translocation of B from vegetative to the reproductive part of the plant. Similarly, mean yield of stover significantly increased from 2.89 to 3.63 g pot^{-1} with increasing levels of sulphur from 0 to 60 mg kg^{-1} soil. The interaction effect between B and S significantly and synergistically influenced the stover yield of linseed which was the highest at 2 mg kg^{-1} of applied B in conjunction with 60 mg kg^{-1} S. The per cent increase in stover yield of linseed with application of boron was about 48.6 and with that of sulphur it was about 25.6 per cent.

Table 1. Effect of different levels of B and S application on dry matter yield of linseed

S levels (mg kg^{-1} soil)	Total dry matter yield (g pot^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	3.45	3.74	4.13	4.61	5.13	5.05	4.35
10	3.63	3.91	4.34	4.91	5.38	5.28	4.58
20	3.83	4.14	4.67	5.27	5.74	5.64	4.88
30	4.06	4.42	4.97	5.60	6.04	5.92	5.17
40	4.29	4.73	5.26	5.85	6.34	6.19	5.44
60	4.35	4.84	5.38	5.98	6.45	6.26	5.54
Mean	3.93	4.29	4.79	5.37	5.85	5.72	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.003			0.003		0.008	
C.D. ($p \leq 0.05$)	0.01			0.01		0.02	

Table 2. Effect of different levels of B and S application on seed yield of linseed

S levels (mg kg^{-1} soil)	Seed yield (g pot^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	1.21	1.29	1.39	1.51	1.69	1.66	1.46
10	1.25	1.33	1.45	1.63	1.80	1.78	1.54
20	1.32	1.41	1.53	1.78	1.99	1.95	1.66
30	1.40	1.50	1.61	1.91	2.14	2.10	1.78
40	1.48	1.58	1.75	2.05	2.24	2.20	1.88
60	1.50	1.61	1.78	2.10	2.30	2.22	1.92
Mean	1.36	1.45	1.58	1.83	2.03	1.98	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.005			0.005		0.012	
C.D. (p≤ 0.05)	0.01			0.01		0.03	

Table 3. Effect of different levels of B and S application on stover yield of linseed

S levels (mg kg^{-1} soil)	Stover yield (g pot^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	2.24	2.45	2.74	3.1	3.44	3.39	2.89
10	2.38	2.58	2.89	3.28	3.58	3.50	3.04
20	2.51	2.73	3.14	3.49	3.75	3.69	3.22
30	2.66	2.92	3.36	3.69	3.90	3.82	3.39
40	2.81	3.15	3.51	3.80	4.10	3.99	3.56
60	2.85	3.23	3.60	3.87	4.16	4.04	3.63
Mean	2.57	2.84	3.21	3.54	3.82	3.74	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.005			0.005		0.012	
C.D. (p≤ 0.05)	0.01			0.01		0.03	

3.4 Boron Concentration in Seeds and Stover of Linseed

The data on B concentration in seeds of linseed is presented in Table 4. The results indicate that concentration of B in seeds of linseed increased with increasing levels of boron and sulphur. The mean B concentration in seeds of linseed increased from 21.3 mg kg^{-1} in control to 24.4 mg kg^{-1} at 60 mg kg^{-1} of S application. The mean B concentration in seeds of linseed was found to increase from 12.8 mg kg^{-1} in control to 30.7 mg kg^{-1} due to two foliar sprays of B indicating that the foliar application was many fold efficacious in improving the accumulation of B in seed part of the plant due to an easy translocation of foliar applied B [16]). The concentration of B in stover of linseed is presented in Table 5. The concentration of B in stover of linseed also increased with increasing levels of boron and sulphur. The mean B concentration in stover of linseed increased from 32.3 mg kg^{-1} in control to 36.8 mg kg^{-1} at 60 mg kg^{-1} of S application. The mean B concentration in stover of linseed was found to increase from 23.8 mg kg^{-1} in control to 45.2 mg kg^{-1} due to foliar sprays of B.

3.5 Sulphur Concentration in Seeds and Stover of Linseed

The data on S concentration in seeds of linseed are presented in Table 6. The results indicate that concentration of Sulphur in seeds of linseed increased with increasing levels of boron and sulphur. The mean S concentration in seeds of linseed increased from 0.43 g kg^{-1} in control to 0.64 g kg^{-1} at 60 mg kg^{-1} of Sulphur application. The mean S concentration in seeds of linseed was found to increase due to Boron application from 0.47 g kg^{-1} in control to 0.62 g kg^{-1} at 2 mg kg^{-1} of Boron application. The concentration of

Sulphur in stover of linseed is presented in Table 7. The concentration of S in stover of linseed also increased with increasing levels of boron and sulphur. The mean S concentration in stover of linseed increased from 1.05 g kg^{-1} in control to 1.37 g kg^{-1} at 60 mg kg^{-1} of S application. Sulphur concentration in stover of linseed was found to increase due to B application from 0.91 g kg^{-1} in control to 1.45 g kg^{-1} in 2 mg kg^{-1} of boron application.

Table 4. Effect of different levels of B and S application on B concentration in seeds of linseed

S levels (mg kg^{-1} soil)	B conc. in seed (mg kg^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	10.8	15.4	20.2	24.1	27.7	29.5	21.3
10	11.4	16.2	20.8	24.7	28.3	30.1	21.9
20	12.6	17.2	21.4	25.3	28.8	30.5	22.6
30	13.4	18.0	22.1	25.9	29.4	31.0	23.3
40	14.0	18.6	22.8	26.1	30.1	31.4	23.8
60	14.7	19.0	23.6	26.6	30.6	31.8	24.4
Mean	12.8	17.4	21.8	25.4	29.2	30.7	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.05			0.05		0.011	
C.D. (p≤ 0.05)	0.1			0.1		0.3	

Table 5. Effect of different levels of B and S application on B concentration in stover of linseed

S levels (mg kg^{-1} soil)	B conc. in stover (mg kg^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	22.4	26.1	29.6	33.7	39.4	42.5	32.3
10	22.9	26.7	30.5	34.3	41.2	44.2	33.3
20	23.5	27.0	31.0	34.9	42.3	44.8	33.9
30	24.0	27.6	31.6	35.7	45.5	45.7	35.0
40	24.9	28.5	32.4	36.5	46.4	46.5	35.9
60	25.3	29.7	33.1	37.8	47.2	47.5	36.8
Mean	23.8	27.6	31.4	35.5	43.7	45.2	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.06			0.06		0.15	
C.D. (p≤ 0.05)	0.2			0.2		0.4	

Table 6. Effect of different levels of B and S application on S concentration in seeds of linseed

S levels (mg kg^{-1} soil)	S conc. in seed (g kg^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	0.33	0.39	0.44	0.47	0.49	0.45	0.43
10	0.36	0.44	0.48	0.51	0.55	0.50	0.47
20	0.39	0.48	0.57	0.56	0.61	0.54	0.53
30	0.43	0.51	0.61	0.59	0.66	0.59	0.57
40	0.46	0.54	0.64	0.65	0.69	0.65	0.60
60	0.48	0.59	0.67	0.7	0.73	0.68	0.64
Mean	0.41	0.49	0.57	0.58	0.62	0.57	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.003			0.003		0.006	
C.D. (p≤ 0.05)	0.01			0.01		0.02	

Table 7. Effect of different levels of B and S application on S concentration in stover of linseed

S levels (mg kg^{-1} soil)	S conc. in stover (g kg^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	0.82	0.86	0.95	1.11	1.27	1.28	1.05
10	0.86	0.94	1.03	1.18	1.30	1.30	1.10
20	0.88	1.03	1.12	1.29	1.40	1.37	1.18
30	0.93	1.11	1.19	1.38	1.53	1.41	1.26
40	0.97	1.23	1.31	1.40	1.58	1.46	1.32
60	0.98	1.29	1.37	1.45	1.65	1.48	1.37
Mean	0.91	1.08	1.16	1.30	1.45	1.38	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.003			0.003		0.006	
C.D. ($p \leq 0.05$)	0.01			0.01		0.02	

3.6 Uptake of Boron by Seeds and Stover of Linseed

The data on B uptake by seeds of linseed are presented in Table 8. The results indicate that similar to the dry matter, seed and stover yields, B uptake in both plant parts also increased with increasing levels of boron and sulphur. The mean B uptake by seeds of linseed increased from 32.2 µg pot^{-1} in control to 48.5 µg pot^{-1} at 60 mg kg^{-1} of S application. The mean B uptake by the seeds of linseed was found to increase due to B application from 17.6 µg pot^{-1}in control to 247.2 µg pot^{-1}with two foliar sprays of B. The uptake of B by the stover of linseed (Table 9) also increased with increasing levels of boron and sulphur. The mean B uptake by stover of linseed increased from 96.6 µg pot^{-1} in control to 137.0 µg pot^{-1} at 60 mg kg^{-1} of S application. The mean B uptake by stover of linseed was found to increase from 61.6 µg pot^{-1} in control to 169.4 µg pot^{-1} with foliar sprays of B proving the potential of foliar spray in effectively increasing the uptake of B by plants. Jaiswal et al. [17] studied the effect of sulphur and boron on the nutrient uptake by mustard (*Brassica juncea*l.) grown on a Vindhyan red soil and revealed that the highest uptake of boron was observed when 40 kg S ha^{-1} and 2 kg B ha^{-1} were applied, respectively along with recommended dose of NPK fertilizers. Singh et al. [18] also reported the maximum S and boron uptake by mustard with 60 kg S ha^{-1} and 2 kg B ha^{-1}, respectively.

3.7 Uptake of S by Seeds and Stover of Linseed

The data on S uptake by seeds of linseed are presented in Table 10. The results indicate that S uptake increased with increasing levels of boron and sulphur. The mean S uptake by seeds of linseed increased from 0.64 mg pot^{-1} in control to 1.25 mg pot^{-1} at 60 mg kg^{-1} of S application. The mean S uptake by the seeds of linseed was found to increase due to B application from 0.56 mg pot^{-1} in control to 1.28 mg pot^{-1} at 2 mg kg^{-1} of boron application. The uptake of S by the stover of linseed (Table 11) also increased with.

Table 8. Effect of B and S application on B uptake by seeds of linseed

S levels (mg kg^{-1} soil)	B uptake in seed (µg pot^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	13.0	19.8	28.1	36.4	46.8	49.0	32.2
10	14.2	21.6	30.2	40.2	51.0	53.6	35.1
20	16.6	24.2	32.7	45.0	57.3	59.4	39.2
30	18.8	27.0	35.6	49.5	62.9	65.0	43.1
40	20.7	29.4	39.9	53.5	67.5	69.2	46.7
60	22.0	30.6	42.0	55.9	70.3	70.5	48.5
Mean	17.6	25.4	34.7	46.7	59.3	61.1	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.14			0.14		0.35	
C.D. ($p \leq 0.05$)	0.4			0.4		1.0	

increasing levels of boron and sulphur. The mean S uptake by stover of linseed increased from 3.12 mg pot^{-1} in control to 5.05 mg pot^{-1} at 60 mg $kg^{-1}$of S application. The mean S uptake by stover of linseed was found to increase from 2.5 mg pot^{-1} in control to 6.85 mg pot^{-1} due to application of 2 mg $kg^{-1}$of B. These observations clearly indicated a synergistic relationship between B and S in linseed crop. Meshram *et al.* [19-20] also conducted an experiment on soybean crop to study the effect of sulphur and boron on uptake of nutrients and observed that the maximum uptake of sulphur was found when 40 kg S ha^{-1} and 1.5 kg B ha^{-1} were applied.

Table 9. Effect of B and S application on B uptake by stover of linseed

S levels (mg kg^{-1} soil)	B uptake by stover (µg pot^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	50.2	63.9	81.1	104.4	135.5	144.3	96.6
10	54.5	68.7	88.3	112.4	147.8	154.8	104.4
20	59.0	73.7	97.2	121.7	158.5	165.0	112.5
30	63.8	80.6	106.0	131.9	177.3	174.8	122.4
40	69.8	89.7	113.9	138.7	190.3	185.8	131.3
60	72.2	96.0	119.4	146.3	196.3	191.8	137.0
Mean	61.6	78.8	101.0	125.9	167.6	169.4	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.27			0.27		0.67	
C.D. (p≤ 0.05)	0.8			0.8		1.9	

Table 10. Effect of B and S application on S uptake by seeds of linseed

S levels (mg kg^{-1} soil)	S uptake by seeds (mg pot^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	0.39	0.51	0.62	0.72	0.83	0.75	0.64
10	0.45	0.59	0.69	0.84	0.99	0.89	0.74
20	0.51	0.67	0.87	1.0	1.22	1.06	0.89
30	0.60	0.77	0.98	1.12	1.42	1.24	1.02
40	0.67	0.85	1.12	1.33	1.54	1.43	1.16
60	0.72	0.96	1.18	1.48	1.67	1.51	1.25
Mean	0.56	0.72	0.91	1.08	1.28	1.15	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.006			0.006		0.014	
C.D. (p≤ 0.05)	0.02			0.02		0.04	

Table 11. Effect of B and S application on S uptake by stover of linseed

S levels (mg kg^{-1} soil)	S uptake by stover (mg pot^{-1})						
	B levels (mg kg^{-1} soil)						
	0	**0.5**	**1.0**	**1.5**	**2.0**	**Foliar spray**	**Mean**
0	1.84	2.11	2.62	3.44	4.37	4.33	3.12
10	2.04	2.42	2.97	3.88	4.64	4.57	3.42
20	2.21	2.82	3.50	4.49	5.25	5.04	3.89
30	2.47	3.22	4.00	5.10	5.97	5.40	4.36
40	2.71	3.86	4.60	5.33	6.46	5.85	4.80
60	2.80	4.16	4.93	5.61	6.85	5.99	5.05
Mean	2.35	3.10	3.77	4.64	5.59	5.20	
Effect	S levels			B levels		S×B levels	
S.Em.±	0.011			0.011		0.026	
C.D. (p≤ 0.05)	0.03			0.03		0.08	

4. CONCLUSIONS

Based on this pot culture study, it may be deduced that linseed crop responds to both B and S application and highest seed yield can be obtained under the combined soil application of 2 mg B and 60 mg S kg^{-1} soil. A synergistic relationship exist between B and S in linseed crop. Though two foliar applications of 0.2% borax were effective in increasing B concentration and uptake by both seed and stover of linseed due to ready translocation yet gave slightly lower but comparable seed yields in comparison to soil application of 2 mg B kg^{-1} soil. However, considering the lesser consumption of B fertilizer in two foliar sprays of 0.2% borax at 30 and 45 d after emergence it could be an attractive option to get higher grain yields of linseed on soils marginally deficient in B. Since the conclusion is based on a pot culture experiment, a field verification of the results would be necessary.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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