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Effect of sources and levels of sulphur on yield, quality and nutrient uptake by linseed (*Linum usitatissimum*)

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ABSTRACT

A field experiment was conducted during 2001–02 and 2002–03 at Bichpuri, Agra, to assess the effect of sources and levels of sulphur on productivity, sulphur content and uptake of nutrients (NPS) by linseed (*Linum usitatissimum* L.). Each successive increase in the level of sulphur up to 60 kg/ha significantly increased seed yield, oil yield and content of S as well as total uptake of N, P and S by the crop. Among sources of sulphur, gypsum proved significantly superior to other sources for seed and oil yields and uptake of nutrients. Linseed fertilized with 60 kg S/ha through gypsum was found most profitable. Sulphur-use efficiency was the highest when lowest level of S was applied.

Key words : Linseed, Quality, Sulphur, Yield

Linseed is one of the most important oilseed crops of India. Global reports of sulphur deficiency and consequent crop response, particularly in oilseed crops, are quite ostensible. Sulphur plays an important role in the formation of amino acids, synthesis of proteins, chlorophyll and oil. Since adequate information is lacking on the choice of sulphur fertilizers for linseed, this study was undertaken to study the suitability of various sources and levels of sulphur for linseed grown in agro-climatic conditions of Agra region.

MATERIALS AND METHODS

A field experiment was conducted during 2001–02 and 2002–03 on alluvial soil (pH 8.1, EC 0.18 dS/m, organic carbon 4.5 g/kg, available N 200 kg/ha, available P 16.3 kg/ha, and available S 14.9 kg/ha) at the Research farm, R.B.S. College, Bichpuri, Agra, Uttar Pradesh. The treatments comprising 3 sources (gypsum, elemental sulphur and pyrite) and 4 levels of S (0, 20, 40 and 60 kg S/ha) were tested in randomized block design with 3 replications. A basal dose of 80 kg N, 26.2 kg P, 33.3 kg K/ha and different sources of sulphur to supply the prescribed doses of S were applied at the time of sowing. Nitrogen, phosphorus and potassium were applied through urea, diammonium, phosphate and muriate of potash respectively. Half dose of N and full of P and K were applied basal. The remaining N was top-dressed after the first irrigation, i.e. 30 days after sowing. Linseed (cv 'Neelam') was sown on 30 October in both years, keeping row-to-row distance 25 cm, with a seed rate of 30 kg/ha. The crop duration was 125 and 127 days in the first and second year, respectively. Nitrogen, phosphorus and sulphur were estimated in seeds using standard methods. Oil percentage was determined by Soxhlet's extraction method.

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RESULTS AND DISCUSSION

The seed and stover yields of linseed increased significantly when sulphur was applied through gypsum compared to the other sources of sulphur (Table 1). This increase in yield might be attributed to easy availability of SO_4^{2-} sulphur present in gypsum compared to sulphide form in pyrite, which essentially requires its oxidation to be converted in to SO_4^{2-} - S prior to its absorption by the plants. The seed and stover yields of linseed increased significantly with increasing levels of sulphur up to 60 kg/ha in both the years. The mean increase in seed yield owing to 20, 40 and 60 kg S/ha over the control was 10, 16 and 25.5%, respectively, in the first year. The corresponding increase in seed yield during 2002–03 was 10.1, 18.5 and 26.3%, respectively. Application of 60 kg S/ha recorded significantly higher stover yield over 40 kg S/ha, which in turn gave significantly higher stover yield than the control. Application of 20, 40 and 60 kg S/ha increased the stover yield over the control by 5.6 and 6.1, 18.9 and 14.4, and 30.0 and 23.5% respectively in 2001–02 and 2002–03. The soil low in S status was unable to supply the nutrient sufficiently for optimum growth and yield of the crop.

Table 1. Effect of sources and levels of sulphur on yield and quality of linseed (pooled data)

Treatment	Yield (t/ha)				Oil yield (kg/ha)		Net returns (Rs/ha)	Benefit: cost ratio	S content (%) in seed	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total S uptake (kg/ha)
	Seed		Stover									
	2001–02	2002–03	2001–02	2002–03	2001–02	2002–03						
S source												
Gypsum	1.80	1.76	3.45	3.31	792	775	13,254	1.93	0.46	92.4	9.6	18.7
Pyrites	1.67	1.58	3.12	2.95	715	693	10,793	1.75	0.45	82.7	9.0	16.8
Elemental S	1.60	1.51	2.89	2.80	684	661	9,745	1.63	0.44	78.4	8.6	16.1
CD (P=0.05)	0.08	0.07	0.24	0.21	40	32			NS	5.1	0.3	0.5
S level (kg/ha)												
0	1.49	1.42	2.80	2.75	605	589	8,575	1.61	0.40	69.0	6.9	13.4
20	1.64	1.56	2.96	2.91	677	660	10,646	1.75	0.43	77.6	8.2	15.9
40	1.73	1.68	3.33	3.14	761	736	12,072	1.84	0.46	90.4	10.0	18.5
60	1.89	1.79	3.64	3.39	827	803	13,948	1.96	0.49	101.1	11.4	21.1
CD (P=0.05)	0.09	0.08	0.28	0.24	44	53			0.10	5.9	0.4	0.6

These results corroborated the findings of Pandey *et al.* (2003).

The oil yield increased significantly with increasing levels of sulphur up to 60 kg/ha (Table 1). The application of 60 kg S/ha increased the oil yield by 36.7 and 36.2% over the control in first and second year, respectively. The higher oil yield with increasing levels of S was because of the increase in seed yield and oil content. The lowest oil yield was recorded when elemental S was the source of sulphur, while pyrites was intermediate between the two. The lowest oil yield in elemental S-treated plots was due to the comparatively less seed yield. Net returns increased with the increase in S rate up to 60 kg/ha and this dose resulted in the highest net returns. The benefit : cost ratio in sulphur fertilizer was 1.75, 1.84 and 1.96 due to application of 20, 40 and 60 kg S/ha, respectively.

The S content in seed increased significantly with increasing levels of S up to 60 kg/ha (Table 1). Application of S increased its content in seeds from 0.40% in the control to 0.49% with 60 kg S/ha. The results (Table 1) showed that the total uptake of N, P and S significantly increased linearly with increasing S levels (0 to 60 kg/ha) from 69.0 to 101.1, 6.9 to 11.4 and 13.4 to 21.1 kg/ha respectively. The higher content of nutrients in seed and stover together with higher seed and stover yield resulted in higher uptake of nutrients. These findings confirm the results of Chaubey and Dwivedi (1995). The uptake of N, P and S was significantly higher with gypsum than with pyrites and elemental S, which may be attributed to higher seed and stover production with gypsum. The fertilizer S-use efficiency was higher with lower rate of its application. The response varied from 6.2 to 7.3 kg seed/kg S applied. Greater S-use efficiency with its lower rate was also reported by Mishra (2003). Among the sources of sulphur, maximum value of S-use efficiency was recorded with gypsum, followed by pyrite and elemental sulphur.

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