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Effect of sulphur on utilization of nutrients in linseed (*Linum usitatissimum* L.) genotypes

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ABSTRACT

A field experiment was conducted during winter seasons of 2017-18 and 2018-19 at the Private Research Farm, Benda-Semaria Road, Rewa (M.P.) to study the effect of sulphur on uptake of nutrient by linseed genotypes. The experiment was laid out in factorial randomized black design with five cultivars and four levels of sulphur with three replications. The genotype, JLS-67 recorded highest N, P, K and S contents in seed and straw followed by JLS-27, RLC-91 and JLT 84-12-5. The genotype, JLS-67 producing total biomass of 46.83 q ha^{-1} utilized the maximum nutrients (79.0 kg N, 17.1 kg P, 38.2 kg K and 25.4kg S ha^{-1}) from the soil. Amongst the sulphur levels, 60 kg S ha^{-1} recorded significantly higher N, P, K and S contents in seed and straw. Thus, the 60 kg S ha^{-1} producing total biomass upto 44.73 q ha^{-1} has drawn the maximum nutrients (70.04 kg N, 15.34 kg P, 35.85 kg K and 22.11 kg S ha^{-1}) from the soil. The best treatment combination (JLS-67 with 60 kg S ha^{-1} further augmented the uptake of these nutrients.

Key words: Nutrient contents, uptake, sulpur, genotypes, linseed

INTRODUCTION

The multi-nutrient deficiencies are increasing day by day on account of heavy withdrawal of nutrients by high-yielding varieties, intensive cropping systems and imbalanced and insufficient use of manurs and fertilizes. The general tendency is that thee total crop removal of nutrients from the soil is never replenished. Amongst the nutrients, sulphur deficiency is widespread in Indian soils due to wide gap between removal of sulphur and its additions in the soil. The continuous use of S-free fertilizes resulted in the depletion of S from the soil reserves (Upadhyay, 2012). Sulphur deficiency tends to adversely affect the growth and yield of oilseed crops to the extent of 10-30 per cent due to its poor nourishment. The high-yielding linseed genotypes are coming forward which require variable quantity of sulphur due to their variable genetic makeup. A high level of nutrients withdrawal may likely to exist with respect to advanced traits. Moreover, genotype x location interaction may also influence the quantity of nutrients withdrawal and ultimate grain production (Kushwaha *et al.* 2019). In view of the above facts, the present investigation was taken up under the existing agro-climatic conditions using linseed as test crop.

MATERIALS AND METHODS

The field experiment was carried out during 2017-18 and 2018-19 at the Private Research Farm, Benda-Semaria Road, Rewa (M.P.). The soil of the experimental field was silty-clay-loam having pH 7.6, electrical conductivity 0.34 dS m^{-1}, organic carbon 8.8 g kg^{-1}, available N, P_2O_5 and K_2O 238, 13.8 and 381 kg ha^{-1}, respectively. The rainfall received during the rainy season was 760 and 752 mm in 2017 and 2018, respectively. The treatments comprised five genotypes (JLS-67, JLS-27, RLC-91, JLT-84-12-5, JLT-84-5) and four levels of sulphur (0, 20, 40 and 60 kg ha^{-1}). Thus, the twenty treatment combinations were laid out in the field in a factorial randomized block design keeping three replications. The linseed genotypes were sown on 25 and 15 November in 2017 and 2018, respectively @ 6 kg ha^{-1} in rows 30 cm. The sulphur was applied as basal through elemental sulphur. The common dose of 40 kg N, 30 kg P_2O_5 and 20 kg K_2O ha^{-1} was applied in all the treatments. The crop was raised as per recommended package of practices. The genotypes were harvested on 9 April, 2018 and 2 March, 2019. The per cent N, P, K and S contents in seed and straw were determined as per standard procedures (Jackson, 1973). The nutrients uptake was calculated by multiplying the seed or straw yield with the percentage of nutrient content in seed or straw.

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RESULTS AND DISCUSSION

Nutrient contents

Amongst the linseed genotypes (Table 1), the N, P, K and S contents in seed and straw were higher in JLS-67 as against the other genotypes. The second best genotype was JLS-27. This was followed by RLC-91 and then JLT-84-12-5. The significantly lowest values of these nutrients were observed in JLT-84-5 genotype of linseed. The genotypic differences in nutrient concentrations might be owing to the differences in the absorption pattern of these nutrients which is deeply associated with the plant's root-shoot growth. The difference in the root-shoot growth and development among these genotypes is but natural because of genetic variability inherited in them. Thus, the overall improvement in these nutrient concentrations in seed and straw under the influence of genetic build up of genotypes could be due to stimulation of root growth enhanced nutrients absorption, increased metabolic activities and chlorophyll content of leaves. These present findings are in consonance with those of Singh *et al.* (2015).

Table 1: Nutrient contents (%) and yield of linseed as influenced by genotypes and sulphur (Mean of 2 years)

Treatments	Nitrogen		Phosphorus		Potassium		Sulphur		Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Total biomass (q ha^{-1})
	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw			
Genotypes											
JLS-67	3.43	0.70	0.73	0.15	0.69	0.88	0.76	0.41	16.95	29.88	46.83
JLS-27	3.30	0.67	0.72	0.14	0.68	0.87	0.73	0.38	19.39	29.20	48.59
RLC-91	3.15	0.64	0.70	0.14	0.67	0.86	0.70	0.35	15.47	28.75	44.22
JLT-84-12-5	3.00	0.62	0.67	0.13	0.65	0.84	0.67	0.33	14.41	28.34	42.75
JLT-84-5	2.95	0.60	0.66	0.12	0.65	0.84	0.65	0.31	13.33	28.05	41.38
CD (P=0.05)	0.03	0.014	0.002	0.001	0.001	0.001	0.002	0.002	0.018	0.14	0.32
Sulphur (kg/ha)											
0	3.11	0.64	0.69	0.13	0.66	0.85	0.69	0.34	14.96	28.64	43.60
20	3.15	0.64	0.69	0.14	0.67	0.86	0.70	0.35	15.17	28.77	43.94
40	3.19	0.65	0.70	0.14	0.67	0.86	0.71	0.36	15.43	28.92	44.35
60	3.23	0.66	0.70	0.14	0.67	0.86	0.72	0.37	15.68	29.05	44.73
CD (P=0.05)	0.02	0.013	0.001	0.001	0.001	0.001	0.002	0.002	0.16	0.13	0.29

Increasing sulphur levels from $S_o$to S_{60} increased all these nutrient contents almost significantly both in seed as well in straw as compared to control. Thus, the significant differences persisted amongst the S-levels. This might be due to the fact that plants absorbed proportionately higher amount of all these nutrients as the pool of available nutrients increased in the soil by adding higher doses of sulphur. In fact, the increase in contents of these nutrients in seed and straw due to sulphur application may be on account of increase in thesoil in available forms. The present results corroborate with the findings of Pandey *et al.* (2012), Singh *et al.* (2015) and Singh *et al.* (2017) and Basumatary *et al.* (2019).

Uptake of nutrients

The data (Table 2) reveal that the uptake of nutrients by the whole plants (seed + straw) was found highest in genotype JLS-67 which recorded the total N, P, K and S uptake of 79.0,17.1, 38.2 and 25.4 kg ha^{-1}, respectively. This was followed by JLS-27, RLC-91, JLT-84-12-5 genotypes and then the lowest in JLT-84-5 genotype of linseed. The higher uptake of nutrients in JLS-67 and then JLS-27 might be owing to higher grain and straw yield as well as higher nutrient contents in these genotypes as compared to others. Application of highest level of sulphur (S_{60}) enhanced the N, P, K and S uptake by seed and straw . At the highest level of sulphur, the total biomass (seed + straw) produced was 44.73 q ha^{-1} which removed highest amount of 70.0 kg N, 14.3 kg P, 35.8 kg K and 22.1 kg S ha^{-1}. The higher uptake of these nutrients under different genotypes and S-levels may be due to increased seed and straw yields and increased N, P, K and S contents in seed and straw of linseed (Singh *et al.*, 2015 and Singh *et al.*, 2017).

Table 2: Nutrient uptake (kg ha^{-1}) of linseed as influenced by genotypes and sulphur (Mean of 2 years)

Treatments	Nitrogen			Phosphorus			Potassium			Sulphur		
	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
Genotypes												
JLS-67	58.1	20.9	79.0	12.5	4.6	17.1	11.8	26.4	38.2	13.0	12.4	25.4
JLS-27	54.1	19.5	73.0	11.7	4.2	16.0	11.1	25.4	36.6	12.0	11.2	23.3
RLC-91	48.8	18.6	67.4	10.8	4.0	14.8	10.3	24.7	35.1	10.9	10.2	21.1
JLT-84-12-5	43.2	17.8	61.0	9.7	3.7	13.5	9.4	24.0	33.5	9.7	9.3	19.0
JLT-84-5	39.4	17.0	56.4	8.9	3.6	12.5	8.6	23.6	35.3	8.7	8.7	17.4
CD (P=0.05)	1.7	1.1	1.8	0.09	0.71	0.8	1.1	0.89	0.4	3.2	2.1	3.0
Sulphur (kg ha^{-1})												
0	46.8	18.4	65.2	10.4	3.9	14.3	9.9	24.5	34.5	9.4	9.0	18.4
20	47.9	18.6	66.6	10.6	4.0	14.6	10.9	24.7	34.9	10.7	10.2	20.9
40	49.3	18.9	68.3	10.8	4.1	14.9	10.4	24.9	35.4	11.0	10.5	21.5
60	50.8	19.2	70.0	11.1	4.1	15.3	10.6	25.2	35.8	12.	10.7	23.0
CD(P=0.05)	1.5	0.86	1.6	0.06	0.59	0.7	1.0	0.61	0.30	2.8	1.6	2.8

Yield

The data (Table 1) revealed that the JLS-27 genotype of linseed produced maximum seed yield (19.39 q ha^{-1}) over other genotypes. Similar pattern was noted for straw and biomass yields. The differences in seed yield were statistically significant. The yields of linseed cultivars increased significantly with sulphur application over control. The differential responses to various cultivars to added sulphur have also been reported by Chandan *et al.* (2019) for yields. The increase in yield of linseed crop may be attributed to improved yield attributes (Basumatary *et al.*2019).

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