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Effect of iron and sulphur levels on yield, oil content and their uptake by Indian mustard *(Brassica juncea)*

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ABSTRACT

A field experiment was conducted during winter seasons *(rabi)* of 1999–2000 and 2000–01 to study the effect of graded levels of iron and sulphur on Indian mustard *[Brassica juncea* (L.) Czernj. & Cosson]. Indian mustard responded significantly to the application of Fe and S. The seed and stover yields increased linearly up to 20 kg Fe/ha and 40 kg S/ha. The seed yield (17.72 q/ha) at 20 kg Fe/ha was 12.4% higher than that obtained in the control. Similarly, application of 40 kg S/ha gave the highest seed yield (18.37 g/ha), which was 28.1% more in comparison with that of the control. The uptake of Fe and S significantly increased up to 40 kg S/ha and 40 kg Fe/ha, and at 60 kg S/ha and 20 kg Fe/ha respectively. Oil content increased significantly with Fe and S addition. The added Fe and S were utilized maximum under application of the lowest levels of Fe and S.

Key words : Iron, Sulphur, Oil content, Indian mustard

Intensive cropping along with decreased use of S-free N and P fertilizers, lower use of organic manures and very low rates of application or practically no use of iron in soils have led to depletion of the reserves of S and Fe in the soils, limiting the productivity. The low yields of oilseed crops and poor quality of oils are due to various constraints including nutrient management. Iron is an essential micronutrient whose deficiency causes chlorosis; and sulphur is a constituent of sulphur-bearing amino acids. Global reports of sulphur deficiency and consequent crop responses are quite ostensible (Tandon, 1989). Keeping these in view, the effect of iron and sulphur on Indian mustard *(Brassica juncea)* was evaluated on alluvial soils.

MATERIALS AND METHODS

A field experiment involving four levels each of S (0, 20, 40 and 60 kg/ha) and Fe (0, 10, 20 and 40 kg/ha) was conducted in randomized block design with three replications during winter seasons *(rabi)* 1999-2001 on Indian mustard at R.B.S. College farm, Bichpuri at Agra. The soil was sandy loam, having pH 8.0; organic carbon 4.5 g/kg; and the available N 170 kg/ha, available P 9.0 kg/ha, available S 8.5 mg/kg and available Fe 4.2 mg/kg. The crop received N, P_2O_5 and K_2O @ 80, 40 and 40 kg/ha, respectively. Ferrous sulphate, elemental S, half of the nitrogen and whole of phosphatic and potassic fertilizers were supplied at the time of sowing, and the rest half of N a month after sowing. The crop was sown in lines (30 cm) in the first week of October and was harvested in the end of February. Variety used was 'Rohini'. Plant samples were digested in di-acid mixture and S was estimated by turbidimetric method and Fe by atomic-absorption spectrophotometer. Oil content in seeds was determined by Soxhlet extraction method.

RESULTS AND DISCUSSION

Application of 20 kg Fe/ha and 40 kg S/ha produced significantly higher seed and stover yields in comparison

Table 1. Effect of S and Fe levels on seed and stover yields, oil content and yield of Indian mustard seeds (means data of 2 years)

Treatment	Seed yield (q/ha)	Stover yield (q/ha)	Oil content (%)	Oil yield (q/ha)
S (kg/ha)				
0	14.34	45.38	38.62	5.55
20	17.06	55.14	39.43	6.75
40	18.37	62.41	39.89	7.32
60	17.87	60.15	40.82	7.30
CD (P=0.05)	0.67	2.29	1.33	0.33
Fe (kg/ha)				
0	15.76	50.63	39.00	6.20
10	16.66	55.10	39.54	6.60
20	17.72	59.12	39.95	7.08
40	17.41	57.90	40.27	7.01
CD (P=0.05)	0.67	2.29	NS	0.33

Table 2. Effect of sulphur and iron levels on uptake, recovery and -use efficiency of S and Fe by mustard (mean data of 2 years)

Treatment	Sulphur (kg/ha)	Iron (g/ha)	Apparent S recovery (%)	Apparent Fe recovery (%)	Fertilizer-use efficiency (kg seed/kg nutrient)
S (kg/ha)					
0	9.7	366.9			
20	14.0	444.2	21.5	0.38	13.6
40	17.5	486.1	17.5	0.21	8.8
60	19.1	480.0	8.0	0.02	6.7
CD (P=0.05)	1.1	26.6			
Fe (kg/ha)					
0	14.4	373.9			
10	15.1	435.8	7.0	0.64	9.0
20	15.5	474.3	4.0	0.38	8.2
40	15.2	524.1	1.5	0.25	4.9
CD (P=0.05)	NS	26.6			

to control (Table 1). The highest mean seed and stover yields of Indian mustard were recorded with the application of 20 kg Fe/ha, which were respectively 12.4 and 10.5% higher than of the control. Application of 40 kg S/ha recorded the highest seed and stover yields, which were respectively 28.1 and 37.4% higher than in the control. This increase might be attributed to the deficiency of these minerals in soil. Muralidharudu and Singh (1990) and Misra (2003) reported similar results in oilseed crops for Fe and S respectively. The higher magnitude of S response may be due to the quite low initial available S status of the soil.

Oil content increased significantly with the application of sulphur, which was lowest in the control (38.62%) and highest (40.82%) at 60 kg S/ha (Table 1). It may be attributed to the increase in glucosides. Misra (2003) reported similar results. Application of Fe increased the oil content but this increase was non-significant. Muralidharudu and Singh (1990) also reported similar results for sesame. The oil production increased significantly with increase in S level. The maximum oil yield was observed in the treatment where 40 kg S/ha was applied. Similarly, application of Fe increased the oil yield from 6.20 q/ha in the control to 7.08 q/ha with 20 kg Fe/ha. Since oil yield is the resultant of seed yield and oil percentage, it also increased due to Fe and S because of increase in seed yield.

Application of Fe progressively increased its uptake by mustard, i.e. at 10, 20 and 40 kg Fe/ha it was 11.2, 24.1 and 40.1% respectively. The Fe application had significant effect also on S uptake by the mustard seeds. However, the highest level of Fe reduced the S uptake compared with its lower levels as a result of lower content of S in seeds. The S uptake by mustard seeds increased with its addition, and the highest value of S uptake was recorded at 60 kg S/ha level. It was the combined effect of higher yield along with higher sulphur content. Our results confirm the findings of Misra (2003). Iron application did not affect the S uptake by mustard crop significantly over the control. However, higher level of Fe slightly reduced the S uptake in comparison with the marked depressing effect of S and Fe uptake, indicating the preponderance of S over Fe in reducing the translocation of the latter in the plant. The interactions of Fe and S application on uptake of these nutrients were not found significant.

Data on apparent recovery and fertilizer-use efficiency of S and Fe (Table 2) show that the mean values of recovery of S on added S and Fe varied from 8.0 to 21.5% and from 1.5 to 7.0% respectively. The apparent recovery of Fe on its addition varied from 0.25 to 0.64% and on S addition from 0.02 to 0.38%. The use efficiencies of fertilizer Fe and S were higher at their lower rates of application. The response varied from 6.7 to 13.6 kg seed/kg S applied, and from 4.9 to 9.0 kg seed/kg Fe applied. Misra (2003) also reported greater recovery of S at its lower rates.

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