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Effect of Sulfur Sources and Levels on Growth, Yield Attributes and Yield of Mustard (*Brassica juncea*)

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Abstract

A field experiment was carried out during the winter season of 2001-02 to study the effect of four levels of (0, 20, 30, 40 kg S/ha) and three sources (gypsum, pyrite and elemental sulfur) of sulfur on growth, yield attributes and yield of mustard (*Brassica juncea* L.). Growth attributes, yield attributes seed yield and straw yield increased significantly with increasing levels of sulfur upto highest level of 40 kg S/ha. Maximum seed yield was obtained with 40 kg S/ha application which was 45.39% more over no sulfur fertilization. Among the sources of sulfur gypsum was markedly effective in increasing seed yield and was superior over pyrite and elemental sulfur.
Key words : Sulfur sources, Mustard, Growth, Yield attributes, Yield.

In India oil seeds form the second largest agricultural commodity after cereals accounting for nearly 5% GNP and occupying 27.45 million hactare area which shares 14% of the total cultivated area, with a production of 25.6 million tonnes. Among the oil seed crops mustard third in area and production next to ground nut and soybean, with an annual production of about 6.2 million tonnes during 2000-01. Of the several reasons plant nutrients have come to be recognized as the single major melody threatening the yield of this forgotten potential crop. As regards major plant nutrients NPK has established an unquestionable influence on yield and quality of crop. In recent years sulfur emerges as a vital nutrient and is now widely accepted as the fourth major plant nutrient along with N, P and K. Sulfur has certain specific roles in plant metabolism thereby increasing yield and quality of produce. Although sulfur is incidentally applied along with some popular fertilizers like SSP, ammonium phosphate sulfate, sulfate of potash, but this quantity is not sufficient to meet the growing need of crop. As such it becomes imperative to explore potetial sources of sulfur (gypsum, pyrite and elemental sulfur). The relative efficacy of different sources on crop needs to be investigated. Keeping these factors under consideration following study was laid out.

Methods

The field experiment was conducted on Agronomy Research Farm, Iglas, aligarh, UP, 27° north longitude and 77.2°E latitude and at an altitude of 170 m above mean sea level, during winter season of 2001-02. The climate of experimental site is semi-arid and sub-tropical with hot dry summer and severe cold winter. The annual average rainfall of the area is about 1,100 mm, however the crop received 16.8 mm rainfall during crop season. The experiment was laid out in randomized block design. The treatments consisted of four levels (0, 20, 30, 40 kg S/ha) and three sources (gypsum, pyrite and elemental sulfur). These comprise ten treatments which were replicated thrice. The soil of experimental site was sandy loam, neutral in reaction, low in organic carbon (0.20%), available nitrogen (115 kg N/ha), available p (14.0 kg p/ha), available potash (240 kg/ha) and available sulfur (18 kg/ha). Indian mustard Sanjukta Asch was sown at spacing of 45cm × 15 cm. The observations on growth, yield attributes and yield were recorded and relative economics was worked out for the treatment. Full dose of phosphorus, potash, sulfur based on treatment and half dose of nitrogen were given as basal application. The rest half dose of nitrogen was top dressed 30 days of sowing.

Table 1. Growth, yield attributes, yield and relative economics of mustards as influenced by different treatments.

Treatments	Plant height (cm)	No. of leaves/ Plant	No. of primary branches/ plant	No. of secondary branches/ plant	Dry matter accumulation (g)	Siliquae/ plant
Control	102.8	9.5	5.1	23.4	80.32	239.4
$S_1 L_1$ (20 kg S through gypsum)	115.8	15.0	5.5	27.7	99.6	371.5
S_1L_2 (30 kg S through gypsum)	117.2	18.0	5.6	28.3	104.83	381.0
S_1L_3 (40 kg S through gypsum)	118.9	19.6	5.6	29.4	106.56	383.3
S_2L_1 (20 kg S through pyrite)	112.5	14.8	5.4	26.7	91.73	285.6
S_2L_2 (30 kg S through pyrite)	113.5	16.3	5.4	27.9	94.37	310.3
S_2L_3 (40 kg S through pyrite)	119.2	16.5	5.5	28.5	95.13	312.2
S_3L_1 (20 kg S through elemental sulfur)	109.8	14.8	5.2	25.6	82.80	269.0
S_3L_2 (30 kg S through elemental sulfur)	110.8	14.9	5.3	26.5	84.30	287.4
S_3L_1 (40 kg S through elemental sulfur)	111.0	15.5	5.3	27.3	85.50	290.8
SE ±	2.20	1.45	0.20	1.3	0.36	2.9
CD (*P*=0.05)	6.50	4.31	NS	4.0	1.07	8.6

Table 1. Continued.

Treatments	Seeds/ siliquae	Test weight (g)	Seed yield (q/ha)	Stover yield (q/ha)	Harvest index (%)	B : C ratio
Control	12.9	1.45	15.84	40.67	27.96	1.52
S_1L_1 (20 kg S through gypsum)	14.9	1.73	20.72	47.42	30.35	2.19
S_1L_2 (30 kg S through gypsum)	15.5	1.77	22.0	48.63	31.08	2.34
S_1L_3 (40 kg S through gypsum)	15.8	1.78	23.03	50.73	31.22	2.45
S_2L_1 (20 kg S through pyrite)	14.3	1.58	17.88	43.70	28.92	1.76
S_2L_2 (30 kg S through pyrite)	14.5	1.64	19.80	45.30	30.36	2.0
S_2L_3 (40 kg S through pyrite)	15.2	1.69	20.08	45.38	30.60	2.0
S_3L_1 (20 kg S through elemental sulfur)	12.9	1.51	16.16	42.24	27.67	1.43
S_3L_2 (30 kg S through elemental sulfur)	13.5	1.55	17.12	43.29	28.30	1.50
S_3L_1 (40 kg S through elemental sulfur)	14	1.60	18.07	44.23	28.95	1.56
SE ±	0.25	0.08	0.38	0.45	0.33	–
CD (*P*=0.05)	0.74	0.23	1.13	1.35	0.99	–

Results and Discussion

Growth Attributes

All the growth attributes, plant height, number of leaves per plant, number of primary branches per plant, number of secondary branches per plant, dry matter accumulation of mustard increased significantly with increasing rates of sulfur through gypsum and iron pyrites, however levels of elemental sulfur failed to register any significant increase on these parameters except dry matter accumulation (Table 1). Amongst all the treatments the maximum plant height (118.9 cm), number of leaves per plant (19.6), number of primary branches per pant (5.6), number of secondary branches per plant (29.4), dry matter accumulation per plant (106.56 g) were recorded with sulfur 40 kg/ha through gypsum, however number of primary branches per plant was found to have non-significant effect. The increase in growth parameters with sulfur might be because sulfur application stimulates cell division, cell elongation and tissue differentiation which in turn increase growth parameters. These results were similar to the findings of Jain and saxena (1). Among sulfur sources gypsum proved to be best. It might be due to better supply of sulfur as gypsum oxidizes at faster rate. Similar findings were reported by Kumar et al (2) Sharma et al. (3).

Yield Attributes and Yield

The yield attributes viz. number of siliquae per plant, seeds per siliquae, test weight increased significantly with sulfur fertilization through gypsum and pyrite. Efficient partitioning and translocation of accumulated photosynthates due to sulfur application positively affected yield attributes. Similar findings were reported by Kachroa and kumar (4) and Raj et al. (5). The favorable effects of sulfur levels on yield attributing characters was found seed yield as yield is coordinated interplay of growth and yield attributes. Maximum seed yield of 23.03 q/ha was recorded with 40 kg of sulfur application per hactare through gypsum which was 45.39% more over no sulfur fertilization. Stover yield and harvest index also followed the same trend. The morphological frame work of plant effectively partitioned dry matter accumulation between seed and stover and this is the reason for markedly higher seed yield, stover yield and harvest index.

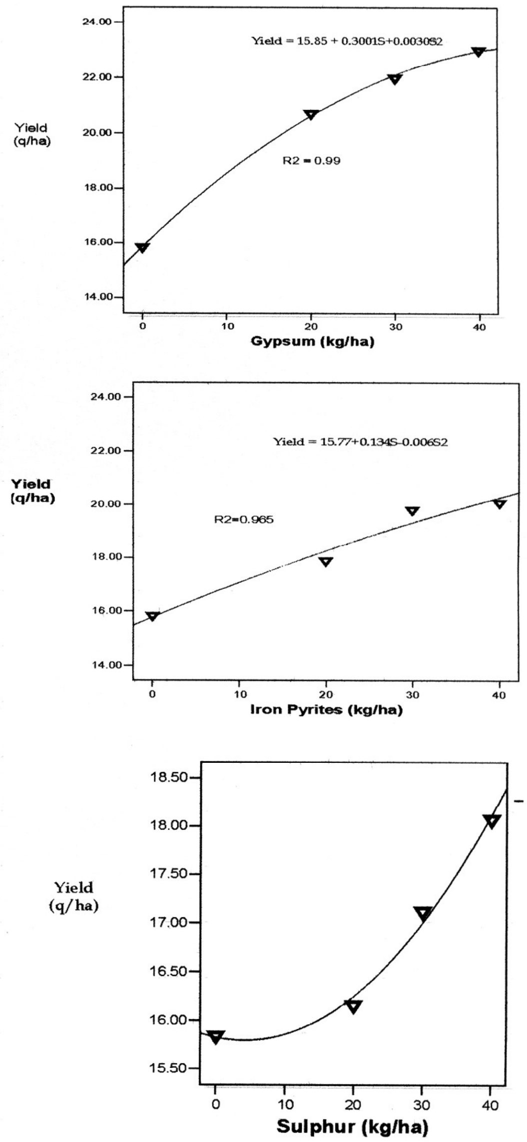

Figure 1. Response analysis of seed yield to sulfur.

Response Analysis

Application of sulfur through gypsum and iron pyrites induced a linear increase in the beginning but with further increase in levels of S subsequent increase in yield was at decreasing rate as a result of which seed yield of mustard recorded quadratic response to S application (Fig. 1). However, application of S through elemental sulfur does not showed any relation and was found to be insignificant. The N response was obviously better by application through gypsum owing to slow release and migration coefficients. The differential response of mustard to different sources of sulfur was also reported by Solanki et al. (6).

Relative Economics

The gross return varied under the influence of various treatments that ultimately affect the net return and benefit ratio. The maximum B : C ratio (2.45) was observed with the application of 40 kg S per hactare through gypsum. Elemental sulfur fails to give more net return and its application at 20 kg/ha registered B : C ratio even less than no sulfur application.

In general sulfur fertilization improved growth parameters which in turn increased yield attributes thereby increasing the source capacity to meet the sink demand. Thus it was concluded that application of sulfur at 40 kg/ha through gypsum was found to be optimum in registering high yield and high B : C ratio.

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