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Response of rapeseed to sulphur application (*Brassica napus* L.)

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Abstract

A field experiment was laid out in randomized block design during *rabi* 2024 on Experimental Farm of Research Sub-Station Akrot, Tehsil Amb, District Una to see the impact of sulphur treatments on gobhi sarson. The experiment were comprised of T₁ (10 kg ha⁻¹ Bentonite Sulphur), T₂ (20 kg ha⁻¹ Bentonite Sulphur), T₃ (30 kg ha⁻¹ Bentonite Sulphur), T₄ (40 kg ha⁻¹ Bentonite Sulphur), T₅ (50 kg ha⁻¹ Bentonite Sulphur), T₆ (375 kg ha⁻¹ SSP), T₇ (160 kg ha⁻¹ Gypsum) and T₈ (Control) replicated thrice. The results indicated that the T₅ (50 kg ha⁻¹ Bentonite Sulphur) recorded significantly higher values for key growth attributes, yield attributes and highest gross returns, benefit-cost ratio as compare to SSP and Gypsum.

Keywords: Bentonite sulphur, growth, Gobhi sarson, Gypsum, SSP

1. Introduction

Oilseeds have an important place in Indian agriculture. It is the second major group among agricultural crops after cereals in the country. Among the *rabi* oilseed crops gobhi sarson (*Brassica napus* L.) is an important crop for assured irrigation situations. Gobhi sarson is high yielding oilseed crop suitable for high fertility conditions. These crops are also important for reducing the imports of edible oil which require a huge amount of foreign exchange 1Bhowmik and thrives in relatively cool temperatures with a moderate supply of soil moisture during the growing season. Rapeseed mustard has been cultivated all over the country for generations, owing to its adaptability in traditional farming systems.

Rapeseed is responsive to plant nutrients especially for nitrogen and sulphur. One of the key nutrients that oilseed crops require is sulphur, which is considered as the fourth major nutrient. Sulphur plays a significant role in several physiological and biochemical functions in plants. It promotes oil synthesis, in addition to being a crucial component of seed protein, amino acids, enzymes, glucosinolate, and chlorophyll. Sulphur also boosts mustard seed production. Due to modern agricultural practices, including multiple cropping, the use of sulphur-free fertilizers, and limited organic manure application, soil sulphur levels are depleting rapidly in India 2 Maruya. Adding sulphur increases mustard oil content by enhancing the activity of an enzyme called acetyl-CoA carboxylase, which is essential for oil synthesis. Sulphur also mitigates the harmful effects of heavy metal toxicity, especially from cadmium.

Sulphur interacts with other nutrients in both positive and negative ways and recommendation for sulphur fertilization in different mustard growing regions have been made based on various research programs. To maximize sulphur use efficiency, it is crucial to apply the correct amount based on soil tests and in balance with other limiting nutrients. The fertilizers have played a prominent role in increasing the oil seed production. The oil content in mustard seeds varies from 37-39%, balanced fertilization is the key to achieve higher production and increasing nutrient use efficiency. Timing of sulphur application is also important it is best applied at the beginning but can also be top-dressed 20-40 days after planting for optimal yield. Research suggests that Rapeseed- mustard responds well to foliar spraying of thiourea during flowering and basal placement before sowing. Sulphur is required for biosynthesis of S containing essential amino acids and is also associated with N metabolism in plant Marsic [3]. Deficiency of sulphur may result in poor flowering and fruiting, cupping of leaves, reddening of stem and petiole, and stunted growth Singh [4]. The yield and performance of brassica oilseeds depend

upon various factors. Sulphur requirement and metabolism in plants are closely related to N nutrition and N metabolism is also strongly affected by the sulphur status of the plant.

2. Data and Methodology

A field experiment was carried out at Experimental Farm of Research Sub-Station Akrot, Tehsil Amb in Randomized block design with treatments comprised of T₁ (10 kg ha⁻¹ Bentonite Sulphur), T₂ (20 kg ha⁻¹ Bentonite Sulphur), T₃ (30 kg ha⁻¹ Bentonite Sulphur), T₄ (40 kg ha⁻¹ Bentonite Sulphur), T₅ (50 kg ha⁻¹ Bentonite Sulphur), T₆ (375 kg ha⁻¹ SSP), T₇ (160 kg ha⁻¹ Gypsum) and T₈ (Control) replicated thrice and replicated thrice. The soil of the experimental site was sandy loam in texture and had medium range of available nitrogen, phosphorus, potassium and low level of sulphur. Seeds of variety ‘GSC 7’ of rapeseed crop was used for sowing and crop was sown on 29th of October 2024 with 45×10 cm spacing. The seed rate used for the crop was 6 kg ha⁻¹. The crop was supplied with 120: 60: 40 kg ha⁻¹ N, P, K respectively. Nitrogen, Phosphorus, Potassium was supplied through IFFCO 12:32:16.

3. Results and Discussion

3.1 Effect on plant height

Plant height plays an important role in crop production, as it significantly affects the yield potential of crop, crop management and the overall success of agricultural output. The mean values of plant height as affected by sulphur treatments, was recorded periodically at 30 days interval after sowing and at

harvest. Highest plant height was observed in 50 kg ha⁻¹ (T₅) at all growth stages because there was sustained release of sulphur throughout the growth period of the crop. The variation in plant height was mainly due to the differences in sulphur availability and optimization with crop demand. It also plays an important role in the synthesis of amino acids like cysteine, methionine and also enhances the cell division and elongation. The application of sulphur through bentonite significantly increased plant height over SSP, Gypsum, and control. The higher plant in Bentonite Sulphur applied plots may be attributed due to slow-release mechanism of elemental sulphur encapsulated in bentonite clay, which ensures a continuous supply of sulphur throughout the crop growth period. This sustained availability not only improved chlorophyll synthesis but also enhanced nitrogen assimilation, resulting in vigorous vegetative growth and elongation of internodes.

In contrast, SSP and Gypsum, being sparingly soluble sulphate sources, released sulphur rapidly but failed to maintain its availability at later vegetative stages. Consequently, their impact on plant height was limited, as transient sulphur availability could not support continuous metabolic activity where control plot which received no sulphur, exhibited the lowest plant height due to restricted chlorophyll formation and inefficient nitrogen utilization under sulphur deficiency. These results clearly demonstrate the superiority of Bentonite Sulphur in sustaining vegetative vigor and promoting greater plant height in gobhi sarson. Similar outcomes were reported by Verma [5], Goyal [6], Sahu [7].

Table 1: Effect of sulphur treatments on plant height (cm)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	At Harvest
T ₁ - Bentonite Sulphur 10 kg ha ⁻¹	13.9	36.2	92.8	132.5	174.3
T ₂ - Bentonite Sulphur 20 kg ha ⁻¹	14.4	37.9	95.2	135.2	177.8
T ₃ - Bentonite Sulphur 30 kg ha ⁻¹	16.8	40.3	98.6	138.4	180.3
T ₄ - Bentonite Sulphur 40 kg ha ⁻¹	17.3	41.4	99.5	139.4	181.3
T ₅ - Bentonite Sulphur 50 kg ha ⁻¹	18.7	42.6	100.4	140.4	182.5
T ₆ - SSP 375 kg ha ⁻¹	15.9	39.9	97.6	137.3	179.8
T ₇ - Gypsum 160 kg ha ⁻¹	14.9	38.8	96.6	136.1	178.8
T ₈ - Control	13.0	34.8	90.6	127.9	169.3
SEm±	1.2	1.5	2.0	2.3	2.5
CD (P=0.05)	NS	4.7	6.1	7.1	7.4

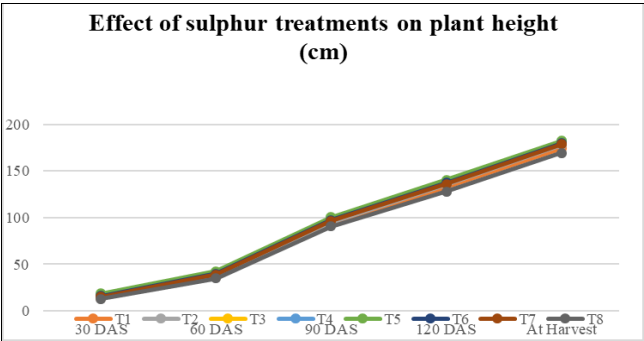


Fig 1: Effect of sulphur treatments on plant height (cm)

3.2 Effect on quality parameters

The highest oil content (%) was recorded in 50 kg ha⁻¹ (T₅). This might be due to the adequate release of sulphur during the critical seed filling stage. Sulphur is essential for the synthesis of oil through its role in enzyme activation and fatty acid metabolism. The adequate supply availability enhances the activity of acetyl- CoA carboxylase and other key enzymes which are responsible for lipid biosynthesis, leading to improved oil accumulation. The highest protein content (%) was recorded in 50 kg ha⁻¹ (T₅).

This was due to higher sulphur application, especially through Bentonite Sulphur, which enhance the protein content by improving nitrogen assimilation and amino acid synthesis. The slow-release nature of bentonite sulphur ensured continuous S supply, supporting balanced N-S nutrition and better protein biosynthesis, whereas SSP and Gypsum released S rapidly, meeting early demand but less effectively sustaining protein formation during seed filling. Similar outcomes were reported by Kumar [8], Priyanka [9], Sahu [7].

Table 2: Effect of sulphur treatments on oil content and protein content (%)

Treatments	Oil content (%)	Protein content (%)
T ₁ – Bentonite Sulphur 10 kg ha ⁻¹	38.75	18.02
T ₂ - Bentonite Sulphur 20 kg ha ⁻¹	39.00	18.58
T ₃ - Bentonite Sulphur 30 kg ha ⁻¹	40.89	19.23
T ₄ - Bentonite Sulphur 40 kg ha ⁻¹	41.85	19.42
T ₅ - Bentonite Sulphur 50 kg ha ⁻¹	42.43	19.54
T ₆ - SSP 375 kg ha ⁻¹	40.00	19.04
T ₇ - Gypsum 160 kg ha ⁻¹	39.41	18.94
T ₈ - Control	37.40	17.79
SEm±	0.88	0.35
CD (P=0.05)	2.70	1.00

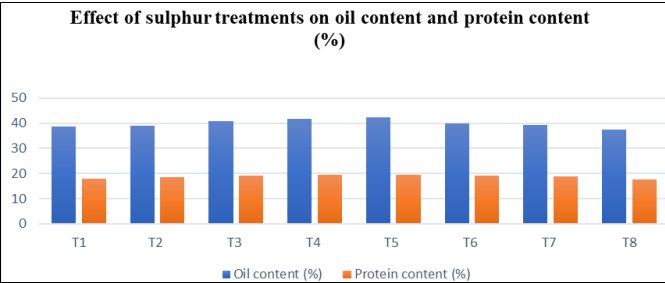


Fig 2: Effect of sulphur treatments on oil content and protein content (%)

3.3 Effect of Sulphur on Grain and Stover Yield

There was a significant impact of levels of sulphur on the seed yield. It was recorded that application of Bentonite Sulphur @ 50 kg ha⁻¹ (T₅) produced significantly higher seed yield of 1365 kg ha⁻¹ being statistically at par with the application of Bentonite Sulphur @ 40 kg ha⁻¹ (T₄), application of Bentonite Sulphur @ 30 kg ha⁻¹ (T₃), application of SSP @ 375 kg ha⁻¹ (T₆), application of Gypsum @ 160 kg ha⁻¹ (T₇), application of Bentonite Sulphur @ 20 kg ha⁻¹ (T₂). Significantly lower seed yield was obtained at Control (T₈) which was at par with Bentonite Sulphur @ 10 kg ha⁻¹ (T₁). The increase in seed yield with the increment of high sulphur levels due to which number of primary and secondary branches increased which in result increased the number of siliquae⁻¹ plant and number of seeds siliqua⁻¹ thus ultimately increased the seed yield. And significantly higher stover yield of 3264 kg ha⁻¹ was obtained with the application of Bentonite Sulphur @ 50 kg ha⁻¹ (T₅) however this treatment remained statistically at par with Bentonite Sulphur @ 40 kg ha⁻¹ (T₄), Bentonite Sulphur @ 30 kg ha⁻¹ (T₃), SSP @ 375 kg ha⁻¹ (T₆), Gypsum @ 160 kg ha⁻¹ (T₇) and Bentonite Sulphur @ 20 kg ha⁻¹ (T₂). Significantly lower stover yield was obtained in Control (T₈) which was at par with Bentonite Sulphur @ 10 kg ha⁻¹ (T₁).

Table 3: Effect of Sulphur on Grain and Stover Yield

Treatments	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
T ₁ - Bentonite Sulphur 10 kg ha ⁻¹	1190	2980
T ₂ - Bentonite Sulphur 20 kg ha ⁻¹	1259	3136
T ₃ - Bentonite Sulphur 30 kg ha ⁻¹	1310	3207
T ₄ - Bentonite Sulphur 40 kg ha ⁻¹	1335	3236
T ₅ - Bentonite Sulphur 50 kg ha ⁻¹	1365	3264
T ₆ - SSP 375 kg ha ⁻¹	1295	3191
T ₇ - Gypsum 160 kg ha ⁻¹	1279	3161
T ₈ - Control	1089	2784
SEm±	44	91
CD (P=0.05)	136	276

4. Summary

Among all the treatments T₅ (50 kg ha⁻¹ Bentonite Sulphur) recorded higher value for growth parameters, Yield (Seed and Stover yield) and quality parameters in gobhi sarson.

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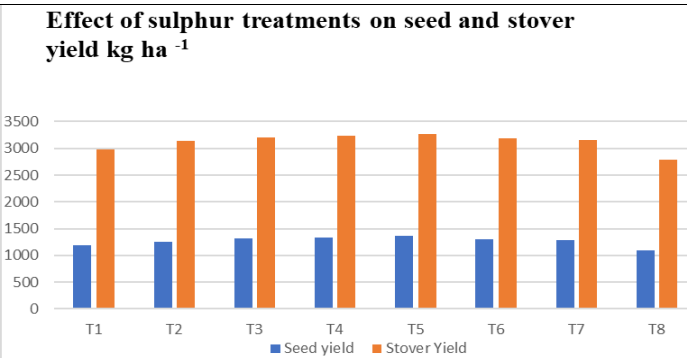


Fig 3: Effect of sulphur treatments on seed and stover yield