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Influence of Sulphur and Micronutrients on growth and yield of Mustard (*Brassica juncea* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during rabi 2023-2024 at Department of Agronomy, Sam Higginbottom University of Agriculture, Technology And Sciences SHUATS, Prayagraj on effect of sulphur and micronutrient on growth and yield of Mustard (*Brassica juncea* L.) with ten treatments combination such as Sulphur 10ppm + Mg 30 kg/ha, Sulphur 10ppm + B 5 kg/ha, Sulphur 10ppm + Ca 5 kg/ha, Sulphur 15ppm + Mg 30 kg/ha, Sulphur 15ppm + B 5 kg/ha, Sulphur 15ppm + Ca 5 kg/ha, Sulphur 20ppm + Mg 30 kg/ha, Sulphur 20ppm + B 5 kg/ha, Sulphur 20ppm + Ca 5 kg/ha and Control (RDF) 80:40:40 kg/ha (NPK)in randomized block design with three replications. Application of Sulphur 20ppm + B 5 kg/ha (Treatment 8) recorded maximum plant height (214.20), dry weight (g) per plant (31.61), Seed yield (t/ ha) (2.69) and stover yield (t/ha) (4.33).

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1. INTRODUCTION

"Mustard is the major rabi oilseed crop of India and the world. It occupies a prominent place being next to groundnut both in the area and production in India. It belongs to the family Cruciferae. It is known by different common names Rai, Raya and Laha in India. India is the 4th largest oil seed producing economy in the world after the USA, China and Brazil, which contributes about 10% of the world's oilseeds production, 6-7% of the global production of vegetable oil, and nearly 7% of protein meal. Although India has 20.8% of the world's area under oilseed crops, it accounts for about 10% of global production. This is because of the low productivity of oilseed crops and year-to-year fluctuations in production in India. This is because of the low productivity of oilseed crops and year-to-year fluctuations in production in India. Currently, India accounts for about 13% of the world's oilseeds area, 7% of the world's oilseeds output and 10% of the world's edible oil consumption. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% of the total oilseeds production and ranks second after groundnut sharing 27.8% in India's oilseed economy" [1].

The deficiency of soil S in agriculture soils has been reported frequently in mustard crops [2] found "a significant interaction between N and S on the height of the plant, number of pods per plant, number of seeds per pod, 1000 seed weight, seed yield and oil percentage". Amanullahjan *et al*., [3] reported that "grain yield was significantly higher at the highest levels of both the nutrients applied while oil contents decreased with an increase in the level of Sulphur to 90 kg/ha (43/19%) and nitrogen to the level of 120 kg/ha (42%)". "Boron is one of the essential micronutrients required for the normal growth of most of the plants. Boron plays an important role in cell differentiation and development, regulating membrane permeability, tissue differentiation, carbohydrates, and protein metabolism" [4].

"Magnesium is also an important nutrient required by plants as it is a major constituent of the cell wall. It is a constituent of the chlorophyll molecule and an enzyme activator for several a number of energy transfer reactions. It plays a vital role in the process of photosynthesis and is therefore important for the life of the plant. It acts as a cofactor and activator for many enzymes and substrate transfer reactions. Even slight magnesium deficiency may affect biomass formation and plant susceptibility to environmental stresses by diminishing several biochemical and physiological processes. The foliar spraying of magnesium provides a means of addressing the increasing occurrence of magnesium deficiency in crops. Foliar nutrient application can be a good strategy to increase crop yield, help in soil supplementation, and generate response in a short period" [5].

2. MATERIALS AND METHODS

The experiment was conducted during the Rabi season 2023, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25^{o} 39' 42''N latitude, 81^{o} 67' 56" E longitude and 98 m altitude above the mean sea level (MSL). This area is situated on the right side of the Yamuna River by the side of Prayagraj - Rewa road about 12 km from the city.The experiment was laid out in Randomized Block Design Which consisting of ten treatments with T_1 – Sulphur 10ppm + Mg 30 kg/ha, T_2 –Sulphur 10ppm + B 5 kg/ha, T_3 – Sulphur 10ppm + Ca 5 kg/ha, T_4 - Sulphur 15ppm + Mg 30 kg/ha, T_5 - Sulphur 15ppm + B 5 kg/ha, T_6 - Sulphur 15ppm + Ca 5 kg/ha, T_7 - Sulphur 20ppm + Mg 30 kg/ha, T_8 - Sulphur 20ppm + B 5 kg/ha, T_9- Sulphur 20ppm + Ca 5 kg/ha, T_{10} - Control (RDF 80-40-40).Data recorded on different aspects of the crop, *viz.,* growth, and yield attributes were subjected to statistical analysis by analysis of variance method [6] and economic data analysis by a mathematical method using MS Excel.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

There are different types of growth parameters included as Plant height (cm) and Plant dry weight (g).

3.2 Plant Height (cm)

At 80 DAS, the maximum plant height (214.20 cm) was recorded with the application of Sulphur 20ppm + B 5 kg/ha whereas the minimum plant height (203.00 cm) was recorded with Control (RDF) condition 80:40:40 kg/ha (NPK). There

was no significant difference between different treatment combinations. However, Sulphur 20ppm + Ca 5 kg/ha (T_9) and Sulphur 10ppm + Ca 5 kg/ha (T_3) are found statistically at par with Sulphur 20 ppm + B 5 kg/ha. (T_8)

"The significant and higher plant height was with application of potassium (1 kg/ha) might be due to with increased levels of Boron function in most of the physiological and metabolic processes resulting in increased growth and development, resulting in higher plants height" [7]. "Further The significant and higher plant height was with application of Sulphur (45kg/ha) might be due to involvement of sulphur in stimulation of cell division, photosynthetic process as well as formation of chlorophyll" [8].

3.3 Plant Dry Weight (g)

At 80 DAS, the maximum dry weight (g) per plant (31.61) was recorded with the application of Sulphur 20ppm + B 5 kg/ha (T_8) whereas the minimum dry weight (g) per plant (23.63) was recorded with Control (RDF) 80:40:40 kg/ha (NPK) (T_7). There was a significant difference between different treatment combinations. However, Sulphur 20ppm + Mg 30 kg/ha and Sulphur 20ppm + Ca 5 kg/ha (T_9). Are found statistically at par to Sulphur 20ppm + B 5 kg/ha (T_9). (Table 1).

The significant and higher plant dry weight (g) was observed with the application of Boron (3 kg/ha) might be due increase levels of Boron function of protein yield is the resultant of dry matter yield and protein content because it balance photosynthesis and respiration due to potassium application because of an increase in dry matter yield. Similar results were reported by Mentham *et al.* [9]. "Further The significant and higher plant dry weight was with the application of sulphur (40kg/ha) might be due to the continuous and slow release of nutrients" [10].

3.4 Yield Parameters

There are several types of yield parameters included as Seed yield (t/ha) and Stover yield (t/ha) (Table 1).

3.5 Seed Yield (t/ha)

The highest Seed yield (t/ha) (2.69) was observed in treatment Sulphur 20ppm + B 5 kg/ha (T_8), whereas the lowest Seed yield (t/ha) (2.56) was found in treatment Control (RDF) 80:40:40 kg/ha (NPK). However, Sulphur 20ppm + Ca 5 kg/ha (T_9) is found statistically at par to Sulphur 20ppm + B 5 kg/ha (T_8).

"The significant and maximum seed yield was observed with the application of Boron (3 kg/ha) might be due increase levels of Boron application to may be attributed strong exchange mechanism in soil, greater cell division and elongation, efficient nodulation and CO_2 assimilation. The higher photosynthetic surface for longer duration in crops receiving Boron might have resulted in enhanced photosynthetic activity and thus more metabolites are directed for the development of crop increase in seeds yield" [11]. Further The significant and higher haulm yield was observed with the application of sulphur (40 kg/ha) might be due to sulphur enhances the plant metabolism and photosynthetic activity. Similar results have been. Results were similar to Singh *et al*. [12].

Table 1. Influence of sulphur and micronutrients on growth and yield of mustard

S. No.	Treatment combinations	Plant height (cm) (80 DAS)	Plant dry weight (g) (80 DAS)	Seed Yield (t/ha)	Stover Yield (t/ha)
1	Sulphur 10ppm + Mg 30 kg/ha	203.00	23.65	1.77	2.81
2	Sulphur 10ppm + B 5 kg/ha	204.60	24.25	1.85	2.92
3	Sulphur 10ppm + Ca 5 kg/ha	205.40	24.41	1.92	3.07
4	Sulphur 15ppm + Mg 30 kg/ha	199.40	26.01	2.00	3.30
5	Sulphur 15ppm + B 5 kg/ha	210.87	26.66	2.06	3.66
6	Sulphur 15ppm + Ca 5 kg/ha	211.80	24.70	2.10	3.77
7	Sulphur 30ppm + Mg 30 kg/ha	214.00	25.33	2.25	3.91
8	Sulphur 30ppm + B 5 kg/ha	214.20	31.61	2.69	4.33
9	Sulphur 30ppm + Ca 5 kg/ha	204.87	30.01	2.56	4.21
10	Control (RDF)	195.73	22.3	1.45	2.58
	F-test	S	NS	S	S
	SEm(±)	3.20	1.87	0.05	0.07
	CD (p=0.05)	9.50	-	0.21	0.22

3.6 Stover Yield (t/ha)

The highest stover yield (t ha^{-1}) (4.33) was observed in treatment Sulphur 20ppm + B 5 kg/ha (T_8), whereas the lowest stover yield (t ha^{-1}) (2.58) was found in treatment Control (RDF) 80:40:40 kg/ha (NPK). However, Sulphur 20ppm + Ca 5 kg/ha (T_8) (4.21) is found statistically at par to with Sulphur 20ppm + B 5 kg/ha (T_8).

The significant and maximum straw yield was observed with the application of Boron (1.5 kg/ha) might be due increase levels of Boron application to may be either direct or indirect, under different environments, in major plant processes such as photosynthesis, respiration, protein synthesis, enzyme activation, water uptake, osmoregulation straw yield of plant. Similar results were reported by Shanoor and Chandranath [13] "Further The significant and higher harvest index was obtained with the application of sulphur (60 kg/ha) might be due to the part of amino acid, which helps in chlorophyll formation, photosynthetic process, activation of enzymes and grain formation" [14].

4. CONCLUSIONS

It was concluded that the effect of Sulphur and Micronutrients perform effective improvement to the growth as well as in yield of *rabi* mustard. The application of Sulphur 20ppm + B 5 kg/ha (Treatment 8) recorded maximum growth and yield of mustard.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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