

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

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)

Keywords : Sulphur, Micronutrients, Growth, Yield, Mustard

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" **Yanthan and Singh (2021)**.

The deficiency of soil S in agriculture soils has been reported frequently in mustard crops **Mansoori (2011)** 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., (2002)** 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" **Sharma et al., (2020)**.

"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" (**Fageria et al., 2009**).

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° 39' 42''N latitude, 81° 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 T₁ – Sulphur 10ppm + Mg 30 kg/ha, T₂ – Sulphur 10ppm + B 5 kg/ha, T₃ – Sulphur 10ppm + Ca 5 kg/ha, T₄ - Sulphur 15ppm + Mg 30 kg/ha, T₅ - Sulphur 15ppm + B 5 kg/ha, T₆ - Sulphur 15ppm + Ca 5 kg/ha, T₇ - Sulphur 20ppm + Mg 30 kg/ha, T₈ - Sulphur 20ppm + B 5 kg/ha, T₉- Sulphur 20ppm + Ca 5 kg/ha, T₁₀ - 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 (**Gomez and Gomez, 1976**) and economic data analysis by a mathematical method using MS Excel.

Results and Discussion

Growth parameters

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

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 (T₉) and Sulphur 10ppm + Ca 5 kg/ha (T₃) are found statistically at par with Sulphur 20 ppm + B 5 kg/ha. (T₈)

“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” (**Sinha et al., 2012**). “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” **Debnath et al. (2014)**.

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 (T₈) whereas the minimum dry weight (g) per plant (23.63) was recorded with Control (RDF) 80:40:40 kg/ha (NPK) (T₇). There was a significant difference between different treatment combinations. However, Sulphur 20ppm + Mg 30 kg/ha and Sulphur 20ppm + Ca 5 kg/ha (T₉). Are found statistically at par to Sulphur 20ppm + B 5 kg/ha (T₉). (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 **Menthham *et al.* (2021)**. “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” **Prashant *et al.* (2021)**.

Yield Parameters

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

Seed yield (t/ha)

The highest Seed yield (t/ha) (2.69) was observed in treatment Sulphur 20ppm + B 5 kg/ha (T₈), 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 (T₉) is found statistically at par to Sulphur 20ppm + B 5 kg/ha (T₈)

“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 CO₂ 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” (**Nzan and Joy, 2021**). 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.* (2020)**.

Stover yield (t/ha)

The highest stover yield (t ha⁻¹) (4.33) was observed in treatment Sulphur 20ppm + B 5 kg/ha (T₈), 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 (T₈) (4.21) is found statistically at par to with Sulphur 20ppm + B 5 kg/ha (T₈).

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 (2019)**. “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” **Neha *et al.* (2014)**.

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.

Table 1. Influence of Sulphur and Micronutrients on growth and yield of Mustard

S. No.	Treatment combinations	Plant height	Plant dry	Seed Yield	Stover Yield
		(cm) (80 DAS)	weight (g) (80 DAS)	(t/ha)	(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

Acknowledgement

The authors are thankful to Sam Higginbottom University of Agriculture, Technology and Sciences, Uttar Pradesh, India for the necessary support and encouragement. The authors are grateful to the editor, whose suggestions significantly improved the manuscript.

References

1. Amanullah Jan, Khan Noorullah, Khan Naeem, Khan Ijaz Ahmad, Khattak Baharullah (2002). Chemical composition of canola as affected by nitrogen and sulphur. *Asian Journal of Plant Science*. 1(5):579-521.
2. Debnath Abhijit, Subhas Chandra, Koley and Joseph, M. Sukhim., (2014) "Evaluation of the efficacy of different sulphur amendments and sulphur oxidizing bacteria in relation to its transformation in soil and yield of mustard (*Brassica juncea*)". *Research on Crops*, 15 (3): 578-584.
3. Fageria, N. K., Barbosa-Filho, M. P., Moreira, A. and Guimaraes, C. M. (2009). Foliar fertilization of crop plants. *Journal of Plant Nutrition*. 32: 1044-1064.
4. Gomez, K. A. and Gomez, A. A. (1976). Statistical procedures for agriculture Research, 2nd Edition, John Wiley and Son, New York, 680p.
5. Mansouri Irandokht (2011). Response of canola to nitrogen and sulphur fertilizers. *International Journal of Agriculture and Crop Sciences*. 4(1):28-33.
6. Mentham Sasidhar Reddy, Biswarup Mehera. Effect of organic manures and micronutrients (Zn & B) on growth, yield and economics of Indian mustard (*Brassica juncea* L.). *Pharma Innovation* 2022;11(4):1251-1254.
7. Neha, Dashora, L. N. Kaushik, M. K. and Upadhyay, B. "Yield, nutrient content, uptake and quality of Indian mustard genotypes as influenced by sulphur under Southern Rajasthan conditions". *Annals of Agriculture and Biological Research*, 19(1): 81- 84, 2014.
8. Nzan Lotha and Joy Dawson (2021). Effect of micronutrients on growth and yield of sunflower (*Helianthus annuus* L.) Variety DRSH-1 . *The Pharma Innovation Journal* 2021; 10(11): 1023-1026
9. Prashant Deo Singh, Abhilasha Pathak, Anand Singh and Pramod Kumar (2021). Effect of different levels and sources of sulphur on growth, yield attributes and nutrient removal by mustard (*Brassica juncea* L.). *The Pharma Innovation Journal* 2021; 10(4): 521-524.
10. Shanoor Nadaf and Chandranath, H.T. 2019. Effect of Zinc and Boron on Nutrient

Uptake, Yield and Quality of Mustard under Rainfed Condition. *Int.J.Curr.Microbiol.App.Sci.* 8(06): 2490-2495.

11. Sharma Simta, Chaudhray Shikha and Singh Rupinder (2020). Effect of boron and sulphur on growth, yield and nutrient uptake of mustard (*Brassica juncea* L.) *International Journal of Chemical Studies.* 8(4): 1998-2001.
12. Singh L., Sharma R., Singh N. (2020). Effect of Foliar Application of Sulphur and Integrated Nutrient Management on Yield, Quality and Economics of Bed Transplanted Canola (*Brassica napus* L.). *Indian Journal of Agricultural Research.* 55(2): 192-196.
13. Sinha, P., Khurana, N., & Nautiyal, N. (2012). Induction of oxidative stress and antioxidant enzymes by excess cobalt in mustard. *Journal of plant nutrition*, 35(6), 952-960.
14. Yanthan Mhonthung R and Singh Rajesh (2021). Effect and boron and zinc level on growth, yield and yield parameters of Mustard (*Brassica campestris* L.). *The Pharma Innovation Journal.* 10(11): 474-476.