

Original Research Article

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Effect of Nutrient Combinations on Growth, Yield and Quality of Mustard (*Brassica juncea* L.)

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ABSTRACT

Keywords

Sulphur, Boron, Zinc, Mustard, CGR, RGR, Dry Weight

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A field experiment was conducted to determine the effect of sulphur, zinc and boron treatment combinations on plant growth, yield and its attributes on mustard at Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The treatment combinations of the study were as sulphur (0, 30 and 40 kg/ha) zinc (0 and 5 kg/ha) and boron (0% and 0.2% spray) respectively. There were 12 treatments each replicated thrice. Addition of 40 Kg S along with 5 kg Zn and 0.2% Boron spray resulted significant higher plant height (156.67), Dry weight (11.81 g), crop growth rate (2.59) and relative crop growth rate (0.05) at 100 DAS. Addition of 40 Kg S along with 5 kg Zn and 0.2% Boron spray resulted significant higher test weight (4.24 g), seed yield (1893.33 Kg/ha), stalk yield (3161.33 Kg/ha) and oil content percentage (35.93).

Introduction

Indian mustard (*Brassica juncea* L.) a member of Brassicaceae family and an important oil seed crop of the world. Brassica contains many agriculturally important species, including vegetable, condiment, and oilseed crops.

The genetic relationships between six diploid and allopolyploid cultivated Brassica species were described by Nagaheru. The three diploids are *B. rapa* ($2n = 20$), *B. nigra* ($2n = 16$), and *B. oleracea* ($2n = 18$) (Bayer, 2010).

The three allopolyploids are *B. juncea* ($2n = 36$), *B. napus* ($2n = 38$), and *B. carinata* ($2n = 34$), which have evolved as a result of hybridization between different monogenomic diploids. *B. juncea* (brown mustard, $2n = 4 \times = 36$) is an allotetraploid species evolved from a spontaneous hybridization of *B. rapa* and *B. nigra* (Bybordi & Mamedov, 2010).

Mustard has primary center of its origin in central Asia with secondary centers in central and western China, eastern India, Burma and through Iran to Near East cultivated for

centuries in many parts of Eurasia. However, the principal growing countries are Bangladesh, Central Africa, China, India, Japan, Nepal, and Pakistan, as well as southern Russia in north of the Caspian Sea (Kumar vineet *et al.*, 2016).

Mustard seeds are excellent source of minerals such as magnesium, calcium, potassium and phosphorus. It is a great source of dietary folate and Vitamin A (Tripathi *et al.*, 2010). Mustard leaves or greens are a great source of essential minerals such as calcium, potassium and phosphorus. It is a great source of dietary fiber and magnesium (Pandey *et al.*, 2006).

The role of S in plants is to help in the formation of plant proteins, and it is essential for the formation of chlorophyll and improves root growth. Sulphur is involved in the formation of vitamins and enzymes required for the plant to conduct its biochemical processes (Scherer *et al.*, 2008). Sulphur deficiency in the soil can not only reduce grain yield and quality of produce but also make a sharp impact in agro-based economy (Fismesa *et al.*, 2000). Sulphur is accumulated in plants in low concentrations compared to N, but is an essential element as a constituent of proteins, cysteine-containing peptides such as glutathione, or numerous secondary metabolites (Kumar *et al.*, 2012).

Boron plays a prominent role in diverse range of the plants functions including cell wall formation, stability, maintenance of structural and functional integrity of the biological membranes, movement of the sugar products in the plants from source to sink (Brown *et al.*, 2002). Micronutrient Boron (B) has a prominent role in translocation of sugars, carbohydrate metabolism, flowering and regulation of hormones, acts as an activator of starch phosphorylase enzyme which is responsible for synthesis of starch and seed

reserve substances. Foliar application of Boron improves fertilization and enhances the production and productivity of the oilseed legumes (Cara *et al.*, 2002).

Zinc being one of the micronutrient, plays a significant role in the various enzymatic and physiological activities of the plant system. It is also essential for assimilation and N-metabolism. It is important for stability of the cytoplasmic ribosome, cell division, dehydrogenase, proteinase, peptidase enzymes and helps in the synthesis of the protein and carotene (Das *et al.*, 2005 and Pandey *et al.*, 2006). Zn⁺² deficiencies usually results in severe yield losses and in acute cases lead to the death of the crop plant. Kutuk *et al.*, (2000) also suggested that the application of Zn has become necessary for improved crop yields. Mandal and Sinha (2004) recommended application of ZnSO₄ at the rate of 20 kg/ ha for oilseeds including mustard.

Materials and Methods

The experiment was carried out during *Rabi* season of 2019 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.2), low in organic carbon (0.58%), medium in available N (238 Kg/ha), high in available P (32.10 Kg/ha) and low in available K (189 Kg/ha). The treatment consisted of 3 levels of sulphur *viz.* S₁ (0 Kg S/ha), S₂ (30 Kg S/ha), S₃ (40 Kg S/ha), 2 levels of Zinc Z₁ (0 Kg/ha) Z₂ (5 Kg/ha) and 2 levels of Boron B₁ (0% spray) and B₂(0.2% spray) There are 12 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. It was sown on 6th December 2019 at spacing 45cm x 20cm recommended doses of nitrogen and potassium were applied.

Results and Discussion

The growth parameters like plant height, Dry weight of plant Crop growth rate and Relative growth rate were significantly affected by the application of sulphur, Boron and Zinc.

Growth parameters

Plant height

Mustard crop fertilized with 40 Kg S along with 5 kg Zn and 0.2% Boron spray resulted significant increase in plant height (156.67cms) at 100 DAS. Sulphur, being the fourth major essential element helps in formation of proteins, enzymes, vitamins that has a crucial role in plant metabolic activities. Kumawat and Pthan (2002) observed the increased plant height to the control in the mustard. Zinc activates certain enzymes which helps to synthesis certain enzymes

which had an active role in the metabolites and its by-products. Shailendra Kumar *et al.*, (2018) observed the same on application of zinc to the mustard crop in konkan region.

Dry weight

Mustard crop fertilized with 40 Kg S along with 5 kg Zn and 0.2% Boron spray resulted significant increase in dry weight (11.81 g) at 100 DAS. Sulphur application to the legumes increases leaves per plant, dry weight, protein content and nutrient up taking capacity, Katiyar *et al.*, (2014) observed gradual increase in dry weight on S application. The micronutrient B plays a major role in movement of energy or sugars in the growing parts of the plant provides cell stability which helps for increase in fresh and dry weights; Gopal *et al.*, (2018) reported similar results with B application in mustard.

Table.1 Effect of Nutrient Combinations on Growth of Mustard at (100 DAS)

Treatment Combinations	Plant Height (cms)	Dryweight (g/plant)	Crop Growth Rate (g/m ² /day)	Relative Growth Rate (g/g/day)
T ₁ : 0 Kg S + 0 kg Zn + Boron no spray	124.33	9.98	1.84	0.03
T ₂ : 0 Kg S + 0 kg Zn + 0.2% Boron spray	137.66	10.16	2.18	0.03
T ₃ : 0 Kg S + 5 kg Zn + Boron no spray	139.67	10.22	1.95	0.04
T ₄ : 0 Kg S + 5 kg Zn + 0.2% Boron spray	134.33	10.52	2.28	0.03
T ₅ : 30 Kg S + 0 kg Zn + Boron no spray	139.67	9.85	2.31	0.04
T ₆ : 30 Kg S + 0 kg Zn + 0.2% Boron spray	149.33	10.34	2.19	0.03
T ₇ : 30 Kg S + 5 kg Zn + Boron no spray	146.67	10.74	2.15	0.03
T ₈ : 30 Kg S + 5 kg Zn + 0.2% Boron spray	154.67	11.67	2.38	0.04
T ₉ : 40 Kg S + 0 kg Zn + Boron no spray	149.00	10.12	2.09	0.03
T ₁₀ : 40 Kg S + 0 kg Zn + 0.2% Boron spray	151.33	10.46	2.17	0.03
T ₁₁ : 40 Kg S + 5 kg Zn + Boron no spray	153.23	11.57	2.30	0.03
T ₁₂ : 40 Kg S + 5 kg Zn + 0.2% Boron spray	156.67	11.81	2.59	0.05
SEM±	2.19	0.26	0.08	-
CD (P = 0.05)	6.42	0.75	0.24	-

Table.2 Effect of Nutrient Combinations on Yield of Mustard

Treatment Combinations	Test weight (g)	Seedyield (Kg/ha)	StalkYield (Kg/ha)
T₁ : 0 Kg S + 0 kg Zn + Boron no spray	2.76	1584.33	2477.01
T₂ : 0 Kg S + 0 kg Zn +0.2% Boron spray	2.91	1656.33	2919.67
T₃: 0 Kg S + 5 kg Zn + Boron no spray	3.22	1692.83	2863.33
T₄ : 0 Kg S + 5 kg Zn + 0.2% Boron spray	3.67	1724.33	2757.33
T₅: 30 Kg S + 0 kg Zn + Boron no spray	3.62	1720.67	2763.33
T₆: 30 Kg S + 0 kg Zn + 0.2% Boron spray	3.73	1785.33	2840.02
T₇: 30 Kg S + 5 kg Zn + Boron no spray	3.78	1811.67	2941.67
T₈: 30 Kg S + 5 kg Zn + 0.2% Boron spray	4.06	1879.67	2906.66
T₉: 40 Kg S + 0 kg Zn + Boron no spray	3.23	1706.01	2983.33
T₁₀: 40 Kg S + 0 kg Zn + 0.2% Boron spray	3.86	1717.12	2860.04
T₁₁: 40 Kg S + 5 kg Zn + Boron no spray	3.93	1867.67	2971.67
T₁₂: 40 Kg S + 5 kg Zn + 0.2% Boron spray	4.24	1893.33	3161.33
SEm±	0.07	57.29	99.91
CD (P = 0.05)	0.23	168.02	293.04

Table.3 Effect of Nutrient Combinations on Oil Content of Mustard

Treatment Combinations	Oil content (%)
T₁ : 0 Kg S + 0 kg Zn + Boron no spray	32.07
T₂ : 0 Kg S + 0 kg Zn +0.2% Boronspray	33.04
T₃: 0 Kg S + 5 kg Zn + Boron no spray	32.59
T₄ : 0 Kg S + 5 kg Zn + 0.2% Boronspray	32.50
T₅: 30 Kg S + 0 kg Zn + Boron no spray	33.02
T₆: 30 Kg S + 0 kg Zn + 0.2% Boron spray	34.03
T₇: 30 Kg S + 5 kg Zn + Boron no spray	33.19
T₈: 30 Kg S + 5 kg Zn + 0.2% Boron spray	34.03
T₉: 40 Kg S + 0 kg Zn + Boron no spray	35.11
T₁₀: 40 Kg S + 0 kg Zn + 0.2% Boronspray	34.16
T₁₁: 40 Kg S + 5 kg Zn + Boron no spray	35.06
T₁₂: 40 Kg S + 5 kg Zn + 0.2%Boron spray	35.93
SEm±	0.48

Crop growth rate (g/m²/day) and Relative growth rate (g/g/day)

Mustard crop fertilized with 40 Kg S along with 5 kg Zn and 0.2% Boron spray resulted significant increase in Crop growth rate and Relative growth rate (2.59) and (0.05) respectively at 100 DAS. Due to availability of micro nutrients B and Zn+2, it enhanced translocation of nutrients, sugars during

seedling phase and development phases of crop growth, which accelerated the metabolic and physiological activity of the plant. It helped to assimilate more amounts of nutrients, facilitated more photosynthesis process and ultimately increased the growth parameters viz. LAI, CGR and RGR. Similar results were obtained by Rana *et al.*, (2005) and Malewar *et al.*, (2009).

Test weight

At harvest significantly higher test weight (4.24 g) was observed by fertilization of 40 Kg S along with 5 kg Zn and 0.2% Boron spray. Rao *et al.*, (2013), Kumar vineet *et al.*, (2016) reported that application of sulphur, zinc and boron significantly increased the yield attributes such as number of siliquae per plant, seeds per siliqua and test weight and ultimately increases in yield. Since, these are major nutrients for oilseeds; promoted rapid vegetative growth and branching, thereby, increasing flowering, sink size, fruit and seed setting.

Yield

Mustard crop fertilized with 40 Kg S along with 5 kg Zn and 0.2% Boron spray resulted significant higher seed yield and stalk yield (1893.33 Kg/ha) and (3161.33 Kg/ha) respectively.

Rana *et al.*, (2005), Gopal *et al.*, (2018), Rao *et al.*, (2013) and Jat and Mehra (2007) reported that the micro nutrients Zn⁺² and B also play their significant role in the enzymatic activities, proteins synthesis and show effect on nutrient up taking capacity (Singh and Meena 2005). Application of these treatment combinations, might have increased the microbial activity in the root zone which helped to uptake more nutrients thus maintain the proper nutritional system. As a result, all the growth parameters yield and its attributes increased which raised the Harvest Index (%) than that of control.

Oil content (%)

Mustard crop fertilized with 40 Kg S along with 5 kg Zn and 0.2% Boron spray resulted significant higher oil content percent (35.93). The increased oil content with sulphur may be due to synthesis of more glucosides, which

produces sulphur rich amino acids like cysteine and methionine, thioglucoside and synthesis of amino acids ultimately increased the oil content in seed Shankar and Meena (2015).

In conclusion, it is inferred from the present investigation that application of 40 Kg S along with 5 kg Zn and 0.2% Boron spray in addition to the full doses of nitrogen and potassium is recommended for receiving higher growth and yield of Mustard.

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