



# Effect of Boron on Yield of Different Varieties 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

The field experiment was conducted during Rabi 2022 at Crop Research Farm, Department of Agronomy, 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 (0.22 %), available N (171.48 kg/ha), available P (12.3 kg/ha) and available K (235.7 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments and one control plot each replicated three based on one-year experimentation. The results showed that treatment with the application of Laxmi + Boron at 20 kg/ha recorded a significantly higher number of Siliquae/plant (259.00), Number of seeds/siliquae (15.00), Test weight (6.12 g), Seed yield (2.05 t/ha) and Stover yield (6.30 t/ha).

**Keywords:** Boron; mustard; varieties; yield.

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## 1. INTRODUCTION

“Mustard (*Brassica juncea* L.) is one of several plant species in the genera *Brassica* and *Sinapis* in the family Brassicaceae. Mustard seed is used as a spice. The seeds can also be pressed to make mustard oil, and the edible leaves can be eaten as mustard greens. It is known as rai, raya or lah. They are generally divided into four groups: Brown mustard, Sarson, Toria and Taramira. In trade sarson, toria and taramira are known as rapeseed. India is one of the largest vegetable oil economies in the world next only to the USA, China and Brazil. Brassicaceae occupies about 23% of the area and 14.6% of production in India. In terms of rapeseed-mustard production, India ranks third in the world, trailing only Canada and China. Its seed contains 37-49% oil” [1]. “Mustard has a primary center of origin in central Asia with secondary centers in central and western China, Eastern India, Burma and through Iran to the Near East it has been 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 the north of the Caspian Sea” [2].

“In India, mustard is the second most important edible oil seed after groundnut. In India, mustard is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. Rajasthan ranks first in the area and production of rapeseed and mustard with a 2.50 million ha area and 3.71 million tonnes of production” [3]. “In our country, among the oil seed crops, rapeseed and mustard are the most important and highly promising groups of crops under different agro-climatic conditions. Among them, Indian mustard, alone accounts for about 80 percent of the 6.3 m ha area under rapeseed and mustard crops in the country” [4].

“Boron is one of the essential micronutrients required for the normal growth of most plants. Boron plays an important role in cell differentiation and development by, regulating membrane permeability, tissue differentiation, carbohydrates and protein metabolism. It also helps in the translocation of photosynthates and growth regulators from source to sink and the growth of pollen grains thereby increasing the seed yield of crops. Functions of plants like cell wall formation, cell wall strength, cell division, fruit and seed development and sugar transport

are related to boron. The Availability of boron to plants is affected by a variety of soil factors including soil pH, texture, moisture, temperature, oxide content, carbonate content, organic matter content and clay mineralogy” [5]. “Under Boron deficiency, pollen viability and seed set of rape are greatly reduced and protein formation is also restricted. Flowering and fruit development were restricted by a shortage of boron. It also makes up of the calcium deficiency to some extent. Reproductive growth, especially flowering, fruit and seed set is more sensitive to B deficiency than vegetative growth. Mustard as a Brassica crop is very responsive to B application. The B application produced the best quality seeds in respect of the protein content of mustard. Boron deficiency in mustard may cause sterility i.e., fewer pods and fewer seeds per pod, resulting in low seed yield” [6].

## 2. MATERIALS AND METHODS

The experiment conducted to know the Effect of boron on the yield of different varieties of mustard was carried out at the Crop Research Farm of Sam Higginbottom University, Prayagraj, Uttar Pradesh in 2022. The experiment was laid out in an RBD (Randomized Block Design) consisting of Ten treatments including Control with 3 replications, with the treatment combinations T1 - Aravali + Boron 10 kg/ha, T2 - Aravali + Boron 15 kg/ha, T3 - Aravali + Boron 20 kg/ha, T4 - Laxmi + Boron 10 kg/ha, T5 - Laxmi + Boron 15 kg/ha, T6 - Laxmi + Boron 20 kg/ha, T7 - Vardan + Boron 10 kg/ha, T8 - Vardan + Boron 15 kg/ha, T9 - Vardan + Boron 20 kg/ha, T10 - Control. Boron is essential for many growth functions in plants including nitrogen metabolism, enzyme activity and protein and oil synthesis. Boron is essential for many growth functions in plants including nitrogen metabolism, enzyme activity and protein and oil synthesis.

## 3. RESULTS AND DISCUSSION

### 3.1 Number of Siliquae/Plants

“The number of siliquae per plant was significantly influenced due by different treatment combinations. The number of siliqua per plant was recorded significantly higher (259.00) in treatment with Laxmi + Boron 20 kg/ha, which was statistically at par (258.12) with Laxmi + Boron 15 kg/ha and minimum was recorded in Control – RDF (80:40:40 kg/ha) (231.00). Boron

enhances the primary and secondary branches which are silique-bearing organs as flowers are borne at the terminals of the branches. Therefore, with an increased number of branches, there was an increase in the number of siliquae per plant” [7].

### 3.2 The number of Seeds/Siliquae

The number of seeds per siliquae was significantly influenced due by different treatment combinations. The number of seeds per siliquae was recorded significantly higher (15.00) in treatment with Laxmi + Boron 20 kg/ha, which was statistically at par (14.28) with Laxmi + Boron 15 kg/ha and the minimum was recorded in Control – RDF (80:40:40 kg/ha) (10.12). “Boron promotes the pollen-producing capacity of anthers and hence might have produced a higher number of seeds per siliqua. It also had a positive effect on the photosynthetic performance of plants by influencing the phosphorylation process, reducing the quantity of assimilates consumed by respiration to obtain energy and accelerating the removal of products of photosynthesis” [8].

#### 3.2.1 Test weight (g)

The data on Test weight was significantly influenced by different treatment combinations. However, a higher test weight (6.12 g) was recorded significantly higher in treatment with Laxmi + Boron 20 kg/ha, which was statistically at par (6.00 g) with Laxmi + Boron 15 kg/ha, and

the minimum was recorded in Control – RDF (80:40:40 kg/ha) (4.01 g).

#### 3.2.2 Seed yield (t/ha)

The seed yield was significantly influenced by different treatment combinations. Seed yield was recorded significantly higher (2.05 t/ha) in treatment with Laxmi + Boron 20 kg/ha, which was statistically at par with Laxmi + Boron 15 kg/ha (2.03 t/ha), and the minimum was recorded in treatment Control – RDF (80:40:40 kg/ha) (1.77 t/ha). “The increase in seed yield might be due to the significant positive effect of B application on yield attributes such as the number of siliqua plant -1, length of siliqua and the number of seeds siliqua -1. Stover yield, 1000 seed weight and harvest index manifested a non-significant effect of B application. The maximum stover yield was recorded in T5 and the minimum in T1 (RDF)” [9,10].

#### 3.2.3 Stover yield (t/ha)

The significantly higher (6.30 t/ha) Stover yield was observed in treatment with Laxmi + Boron 20 kg/ha, the minimum was recorded in treatment Control – RDF (80:40:40 kg/ha) (6.02 t/ha) and there was no significant difference between the treatments. Application of boron enhanced the uptake of major nutrients resulting in greater photosynthetic activities and leading to greater vegetative growth in plants. Ultimately this accelerated growth due to proper metabolic

**Table 1. Effect of boron and varieties on growth of mustard**

Treatments	Plant height	Number of branches per plant	Dry weight	No. of siliqua/ plant	No. of seeds/ siliqua	Test weight (g)
T1	168.50	15.33	31.00	237.00	11.32	4.10
T2	171.60	16.00	32.00	241.30	12.41	4.51
T3	172.00	16.67	32.29	245.79	13.00	4.79
T4	172.40	17.00	33.07	247.56	13.27	5.08
T5	176.30	18.00	34.40	258.12	14.28	6.00
T6	177.00	18.33	35.12	259.00	15.00	6.12
T7	169.70	16.00	31.56	239.61	12.00	4.27
T8	172.90	17.00	33.56	249.46	13.56	5.34
T9	173.10	18.00	34.00	255.09	14.19	5.76
T10 (Control)	167.20	15.33	30.50	231.00	10.12	4.01
F – Test	S	S	S	S	S	S
S.Em(±)	1.63	0.29	0.44	3.53	0.23	0.07
CD (p=0.05)	4.86	0.86	1.31	10.51	0.70	0.22

**Table 2. Effect of boron and varieties on yield attributes of mustard**

Treatments	Seed yield (t/ha)	Stover yield (t/ha)
T1	1.67	3.14
T2	1.69	3.40
T3	1.71	3.43
T4	1.29	2.78
T5	1.56	3.03
T6	1.67	3.10
T7	1.20	2.64
T8	1.37	2.85
T9	1.48	2.96
T10 (Control)	1.14	2.63
F – Test	S	S
S.Em(±)	0.02	0.04
CD (P=0.05)	0.08	0.12

activities produced a higher stover yield in mustard. [7]. The favorable effect of phosphorus fertilization on seed, Stover, oil yields and chlorophyll content in leaves might be due to its key role in energy transformation under various metabolic processes [11].

### 3.2.4 Harvest index (%)

A significantly higher (24.54 %) harvest index was observed in treatment with Laxmi + Boron 20 kg/ha, the minimum was recorded in treatment Control – RDF (80:40:40 kg/ha) (22.70 %) and there was no significant difference between the treatments.

## 4. CONCLUSION

The study concluded that the application of Laxmi + Boron at 20 kg/ha (T6) performed better in growth and yield parameters and was economically viable. Since the findings are based on one season, further trials are needed to confirm the results.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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