

Original Research Article

Effect of boron on yield of different varieties of mustard (*Brassica juncea*L.)

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Abstract:

The field experiment was entitled “Effect of boron on yield of different varieties of mustard (*Brassica juncea* L.)” conducted during Rabi 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). The soil of the experimental plot was sandy loam 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 each replicated thrice based on one-year experimentation. The treatments viz., 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 and Control. The results showed that treatment with the application of Laxmi + Boron 20 kg/ha recorded a significantly higher number of Siliquae/plant (259.00), Number of Seeds/siliquae (15.00), Test weight (6.12 g), Seedyield (2.05 t/ha) and Stover yield (6.30 t/ha).

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Keywords: Boron; Varieties; Yield.

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Introduction:

Mustard (*Brassica juncea*L.) is one of the 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. Intra-desarson, toria and taramira are known as rapeseed. India is one of the largest vegetable oil economies in the world next only to USA, China and Brazil. Brassicaceae occupies about 23% area and 14.6% of production in India. Rapeseed-mustard in world production India ranks third after Canada and China. Its seed contains 37-49% oil (Singh *et al.* 2014). Mustard has a primary centre of its origin in central Asia with secondary centres in central and western China, Eastern India, Burma and through Iran to the Near East cultivated for centuries in many parts of Eurasia. However, the principal

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growing countries are Bangladesh, Central Africa, China, India, Japan, Nepal and Pakistan as well as Southern Russia in the north of the Caspian Sea (Kumar Vineet *et al.*, 2016).

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 (Anonymous, 2017). 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 per cent of the 6.3 m ha area under rapeseed and mustard crops of the country (Singh and Kumar, 2015).

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, 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 in 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. 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 (Goldberger *et al.*, 2000). Under Boron deficiency, pollen viability and seed set of rape is greatly reduced and protein formation is also restricted. Flowering and fruit development were restricted by a shortage of boron. It also makes up 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. 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, attributing to low seed yield (Islam and Anwar 1994).

Material 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 consisting of 10 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

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+Boron10 kg/ha, T5 - Laxmi +Boron15 kg/ha, T6 - Laxmi +Boron20 kg/ha, T7 - Vardan +Boron10 kg/ha, T8 - Vardan +Boron15 kg/ha, T9 - Vardan +Boron20 kg/ha, T10 - Control.

Results and Discussion:

The number of Siliquae/plant:

The number of siliquae per plant was significantly influenced due to different treatment combinations. The number of siliquae 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 siliqua-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. **Mounika et al. (2021).**

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The number of Seeds/siliqua:

The number of seeds per siliqua was significantly influenced due to different treatment combinations. The number of seeds per siliqua 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. **Ranvir et al. (2017).**

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Test weight (g):

The data on Test weight was significantly influenced due to 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).

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Seed yield (t/ha):

The seed yield was significantly influenced due to 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 significant positive effect of B application on yield attributes such as number of siliqua plant⁻¹, length of siliqua and number of seeds siliqua⁻¹. Stover yield, 1000

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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). These findings are in the similar line as reported by Dey and Nath (2015) and Jaiswal et al. (2015).

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Stover yield (t/ha):

This 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 in between the treatments. Application of boron enhanced more uptake of major nutrients resulting in greater photosynthetic activities and led to greater vegetative growth of plants. Ultimately this accelerated growth due to proper metabolic activities produced higher stover yield in mustard. Mounika et al. (2021). The favourable effect of phosphorus fertilization on seed, Stover, oily yields and chlorophyll content in leaves might be due to its key role in energy transformation under various metabolic processes Faujdare et al. (2008)

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Harvest index (%):

A significantly higher (24.40 %) 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.

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Conclusion:

From the above results, it was concluded that the application of Laxmi + Boron 20 kg/ha (T6) had 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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Table 1: Effect of Boron and varieties and their combination on yield of Mustard.

Treatments	Number of siliqua per plant	Seeds per siliqua	Test weight	Pods/plant(No)	Seed yield(t/ha)	Stover yield(t/ha)	Harvest index (%)
T1	237.00	11.32	4.10	32.4	1.83	6.08	23.14
T2	241.30	12.41	4.51	32.6	1.87	6.12	23.41
T3	245.79	13.00	4.79	33.5	1.92	6.17	23.70
T4	247.56	13.27	5.08	34.6	1.93	6.19	23.83
T5	258.12	14.28	6.00	36.0	2.03	6.29	24.40
T6	259.00	15.00	6.12	36.2	2.05	6.30	24.54
T7	239.61	12.00	4.27	36.7	1.85	6.11	23.30
T8	249.46	13.56	5.34	37.0	1.95	6.21	23.95
T9	255.09	14.19	5.76	37.6	2.01	6.26	24.30
T10 (Control)	231.00	10.12	4.01	30.5	1.77	6.02	22.70
SEm	3.53	0.23	0.07	0.57	0.02	0.12	0.44
CD(p=0.05)	10.51	0.70	0.22	1.69	0.07	-	-

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References:

- Anonymous. Agriculture statistics at a glance. (2017). Directorate of Economics & Statistics, DAC & FW.
- Dey, D. and Nath, D. (2015) Response of mustard to boron application in the soils of Tripura. *International Journal in Physical and Applied Sciences* 2, 1-4.
- R.S. FAUJDAR, A.K. MATHUR AND A.K. VERMA (2008) Yield and quality of mustard as influenced by different levels of phosphorus and sulphur; *An Asian Journal of Soil Science*, Vol. 3 No. 1: 207-208.
- Goldberg S, Scott ML, Surez DL, (2000). Predicting boron adsorption by soil chemical parameters in the constant capacitance model. *Soil Sci. Soc. Am. J.* **64**:1356-1363.
- Islam, M.S. and M.N. Anwar, 1994. Production technologies of oilseed crops. Recommendations and future plan. Proceedings of the Workshop on Transfer of Technology of Cdp Crops under Research Extension Linkage Programme, (TTCDPCREL94), BARI, Gazipur, pp: 20-27.
- Jaiswal, A.D., Singh, S.K., Singh, Y.K., Singh, S. and Yadav, S.N. (2015) Effect of sulphur and boron on yield and quality of mustard (*Brassica juncea* L.) grown on Vindhyan red soil. *Journal of the Indian Society of Soil Science* 63, 362-364.
- Kumar Vineet, Knadpal, Diwedi Ashish, Sagar Vipin Kumar, Kumar Vikasah and Sharma Dinesh Kumar, (2016). Effect of nitrogen and zinc fertilizers rates on growth, yield and quality of Indian mustard (*Brassica juncea* L.). *International Journal of Agricultural Sciences*. 8(6) 1031-1035.
- Mounika Jalapathi, Dawson Joy and Sagar Vidya. (2021). Influence of boron and sulphur levels on growth and yield of yellow mustard (*Sinapis alba*). *The Pharma Innovation Journal* **10**(11):174-177.
- Ranvir Singh, Yogesh Singh and Sarika Singh. (2017). Yield, quality and nutrient uptake of Indian mustard (*Brassica juncea* L.) under sulphur and boron nutrition. *Annual of Plant and Soil Research* **19**(2): 227 -231.
- Singh, Raju, Singh, Anil Kumar, Kumar, Pravesh. (2014). Performance of Indian mustard (*Brassica juncea* L.) in response to integrated nutrient management. *Journal of Agri. Research*. **1**(1):9-12.
- Singh D. and Kumar K. Present scenario of oilseed Brassica cultivation in India.

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ICARsponsored winter school on new para diagrams in disease management:
ConventionalandMolecularApproachesforrapeseed-
mustardproductionorganizedbyICAR-Directorate of rapeseed mustard
research, Bharatpur during December09-29,2015. Pp 66-71.

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