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Research Article

FOLIAR APPLICATION OF BORON ENHANCES GROWTH, YIELD, AND PHYTOCHEMICAL COMPOSITION OF TORI-7 MUSTARD (*BRASSICA CAMPESTRIS*)

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Abstract

This research was conducted at Sylhet Agricultural University to evaluate the effects of different foliar boron application methods on growth, yield and phytochemical composition of Tori-7 (*Brassica campestris*). Three treatments each having four replications were evaluated: T₁, no boron application (control), T₂, a single foliar spray of 0.5% boron during the vegetative stage, and T₃ two foliar applications of 1.5% boron during the vegetative and pod-forming stages. Boron application significantly increased several growth and yield parameters, including plant height, number of leaves per plant, number of branches per plant, root length, inflorescence length, number of siliquae per plant, number of seeds per siliqua, seed yield, stover yield, 1000-seed weight, biological yield, and harvest index. The T₃ treatment produced the highest number of siliquae per plant (121.15), seeds per siliqua (11.75), stover yield (1641.69 kg ha⁻¹), and 1000-seed weight (3.25gm), seed yield (1035.37 kg ha⁻¹). However, the plant population was not substantially impacted by the various boron treatments. In terms of the phytochemical makeup, the study discovered that among the treatments, boron had no significant effect on the total phenolic and total flavonoid contents. Total flavonoid content ranged from 17.05 mg Qe/g to 15.99 mg Qe/g, and total phenolic content ranged from 14.97 mg GAE/g to 14.71 mg GAE/g. Further studies involving different mustard varieties and growing conditions are recommended to better understand the effect of boron as a micronutrient.

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Introduction

Mustard scientifically known (*Brassica* spp. L.) is an important oilseed crop cultivated extensively across the northern region of Bangladesh during winter season (November to March). The vegetative growth of mustard is dependent on a cool and dry climate, followed by warmer weather during its reproductive stage (BARI). Bangladesh produced approximately 9.24 lakh metric tons of mustard during 2020-2021 fiscal year, with a spanning of 6.24 lakh hectares of cultivated area (Rahman *et al.*, 2024). The production of mustard is frequently constrained by several biotic and abiotic stresses, including fungal diseases, pests and other nutrient deficiencies (Verma *et al.*, 2023). Mourou *et al.* (2023) reported that mustard production was often constrained by fungal diseases such as *Alternaria blight* and white rust, resulting in significant yield losses.

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Nutrient deficiencies specifically boron deficiency, is considered as a major factor limiting mustard production in Bangladesh. Bari *et al.* (2023) reported around 50% of the agricultural soils in Bangladesh are deficient in boron, which can lead to reduced growth and yield in mustard. To improve productivity several short-duration, high yielding mustard varieties, including BARI Sharisha-14, 15 and BinaSharisha-4, has been developed. However, farmers mainly focus on application of basic NPK fertilizer while paying little attention to microelements such as boron.

Boron is an essential micronutrient that plays a significant role in cell wall synthesis, membrane integrity, carbohydrate metabolism, pollen germination and seed development. The application method employed and the rate of boron with other fertilizer can significantly increase the yield of mustard crops. The Sylhet region is part of the Agro-Ecological Zone-20, which is known as the Eastern Surma-Kushiara floodplain. Soil analysis conducted by FRD and SRDI in the Sylhet region usually prefer to cultivate the local variety of mustard Tori-7, which is a low yielding and pest susceptible variety.

Mustard oil contains mono and polyunsaturated fatty acid that can help in reducing LDL cholesterol in humans (Dhara *et al.*, 2013). Additionally, mustard and mustard oil possess antimicrobial properties that make them potent food preservative (Luciano *et al.*, 2011). Mustard has bioactive compounds such as glucosinolates, polyphenols, dietary fiber, β -carotene, and ascorbic acid were reported for their high nutritional value and richness (Campbell *et al.*, 2012). The Phenolic contents in mustard seeds have antioxidant properties such as catechin, epicatechin, gallic acid, myricetin, quercetin, and rutin (Lee *et al.*, 2015). This content can vary according to crop variety, environment, extraction technology, and food processing (Borrs *et al.*, 2014). This research aims to evaluate the effects of various boron application methods and rates on growth, yield, and nutritional quality and phytochemical composition of Tori-7 mustard (*Brassica campestris*).

Materials and Methods

This study was conducted at the Agronomy Experimental Field of Sylhet Agricultural University, Sylhet. Total phenolic content and total flavonoid content of the harvested samples were analyzed at the Faculty of Biotechnology and Genetic Engineering to understand the biochemical properties of the crops. The materials used and the methods employed to conduct the research are described below.

Experimental design

A standard experimental design was laid out in a Randomized Complete Block Design (RCBD) with four replications (n) for each treatment, where the plot size was kept at $2\text{m} \times 2\text{m}$ (4m^2). Pre-sowing soil analysis revealed that the soil had low fertility status having 1.45% organic matter, 0.80% total nitrogen (N), 0.07m mol/100g potassium (K), 25 $\mu\text{g/g}$ available phosphorus (P), and 10 $\mu\text{g/g}$ available Sulfur (S), with a low pH value of 4.80. Three boron treatments were given using (boric acid) as the boron source. T_1 served as the control with no boron applied. T_2 received a foliar application of boric acid (BA) at a concentration of 0.5% during the vegetative stage, and T_3 received foliar boric acid at a rate of 1.5% during both the vegetative and pod forming stages applied at 20 and 40 days after sowing (DAS) following the method described by (Khalifa *et al.*, 2011). The Tori-7 seeds were planted in rows, maintaining a spacing of 30-35 cm between them and crops were harvested 73 DAS.

Phytochemical screening:

Preparation of samples

Seeds from each treatment were collected after harvesting, washed and cleaned, and then dried in an oven at 45°C. The dried samples were grounded using an electric grinder and used for photochemical extraction.

Reagents and instruments

The chemicals used in this study included Solidum carbonate, Aluminum chloride, Gallic acid, 2,2-Diphenyl-1-Picryldrazyl (DPPH). Methanol, Quercetin, Potassium acetate, Folin-Ciocalteu reagents and distill water. The instruments used included Grider, Sonicator, Magnetic stirrer with heater, and Schoot UV Line 9400 UV -Visible spectrophotometer.

Extraction of seed samples

Around 100mg of mustard seed powder was extracted in 80% methanol and diluted to achieve the concentration of 1mg/ml. The samples were then gently mixed by continuous shaking for at least 15 minutes left for 72 hr. at room temperature and filtered through Whatman No. 1 filter paper.

Determination of total phenolic contents

Total phenolic contents of mustard seed extracts from different treatments were determined by Folin-Ciocalteu (FC) method using the standard gallic acid with slight modification according to (Gök et al., 2021). The absorbance was measured at varying gallic acid concentration to construct the standard curve.

Preparation of 1N Follin Ciocalteu reagent (FCR) and 7.5% sodium carbonate (Na_2CO_3)

A commercially available 2N Follin Ciocalteu (FCR) was mixed with dH_2O to prepare the reagent, was prepared by dissolving 7.5 g Na_2CO_3 in dH_2O final volume of 100ml. 7.5% (w/v) sodium carbonate (Na_2CO_3) was prepared by dissolving 7.5g of Na_2CO_3 in dH_2O adjusting the final volume of 100 ml. A blank solution was prepared from 0.5 ml FCR and 1 ml Na_2CO_3 (7.5%).

Preparation of standard gallic acid

A gallic acid stock solution of a concentration of (0.1 mg/ml) was prepared in dH_2O , different concertation of 0.0125, 0.025, 0.075, and 0.1 mg/ml was prepared from the stock solution. The absorbance of different concentrations was recorded at a wavelength (λ_{max}) of 760 nm against a reagent blank to generate a standard calibration curve.

Determination of Total Flavonoid Contents (TFC)

The total flavonoid content (TFC) was determined using aluminum chloride colorimetric method described by (Gök et al., 2021). 10% (w/v) aluminum chloride solution was prepared by dissolving 10g of aluminum chloride in dH_2O in 100 ml final volume. A 1M potassium acetate solution was prepared by dissolving 9.8 gm of potassium acetate adjusting the final volume up to 100 ml in dH_2O .

Preparation of Quercetin Standard Solution

A stock solution was prepared by dissolving 10mg of methanol. Serial dilutions were then carried out using methanol to obtain a final concentration of 12.5, 25, 50, 75 and 100 $\mu\text{g/ml}$. The experiment was conducted following the method described by (Gök et al., 2021). Briefly, 1.5 ml of methanol was mixed with 0.1 ml of sample extract or varying quercetin standard solution. Subsequently, 0.2 ml of aluminum chloride (10%), 0.2 ml of 1M potassium acetate were added followed by 5.6 ml of dH_2O . The reaction mixture was incubated at room temperature, and absorbance was measured at 420 nm against reagent blank. The total flavonoid content was calculated from quercetin standard calibration curve and expressed as milligram of quercetin equivalents (QE) per gram of dry weight.

Statistical analysis

The dataset was examined utilizing R software (Version 4.1.1, 2021) to assess statistical significance among different treatments. Phytochemical analysis was performed in triplicate, and findings were expressed as the mean $\pm$ standard error. Experimental data underwent evaluation through the general linear model in Minitab. Furthermore, Turkey's test ($p < 0.05$) was applied to compare the means across various treatments and groups at the 5% significance level to identify significant differences.

Results & Discussion

Mustard production in Sylhet region of Bangladesh has declined in recent years. This reduction in yield is attributed to several factors, including limited adoption of improved agricultural technologies, inadequate awareness of essential micronutrients, inappropriate fertilizer usage, and the continued reliance on traditional farming practices. Many farmers in the region still cultivate the traditional Tori-7 mustard variety without integrating essential nutrients like boron, which may contribute to low productivity.

Effect of boron on plant height, number of leaves and branches plant

No significant differences were noted in plant height, number of leaves and branch per plant, or root length among treatments at 20 DAS. However, by 30 DAS, significant differences were evident. The highest height of plants (47.21 cm) was found in the treatment with two foliar boron applications at 1.5% (T_3), while the shortest plants (39.88 cm) were in control (T_1) (Figure 1).

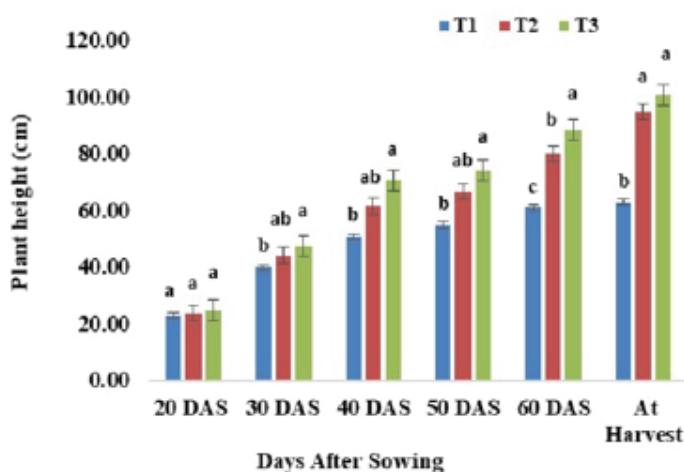


Figure 1. Effect of different boron levels in plant height (cm) of Mustard at different days after sowing (DAS).

Values are mean $\pm$ standard error ($n=4$). Bars sharing the same letter within a sampling stage are not significantly different from each other ($P \leq 0.05$), as determined by Tukey's test. T_1 (control), T_2 (single foliar spray of 0.5% boron during the vegetative stage), and T_3 (two foliar applications of 1.5% boron).

The growth increased plant height in the boron treated plants may be associated with established role of boron in photosynthetic activity and chlorophyll synthesis which provide better vegetative growth. Bevara *et al.* (2022), reported that the maximum plant height in mustard was recorded with the application of 90 kg nitrogen per hectare and 1.5 kg boron per hectare. Hossain *et al.* (2011) also reported that applying boron at a rate of 1 kg per hectare markedly increased mustard plant height.

The number of leaves per plant followed a similar pattern, with T₃ showing the highest leaf count (12.75) by 30 DAS, though differences diminished by 60 DAS (**Figure 2**). Similar trends have been observed in other studies. Rathore *et al.* (2022), Sinha *et al.* (2022), and Safdar *et al.* (2023) reported similar observations that boron applications significantly influenced leaf number in mustard during the early growth stages, but the effect diminished during the later stages of plant development.

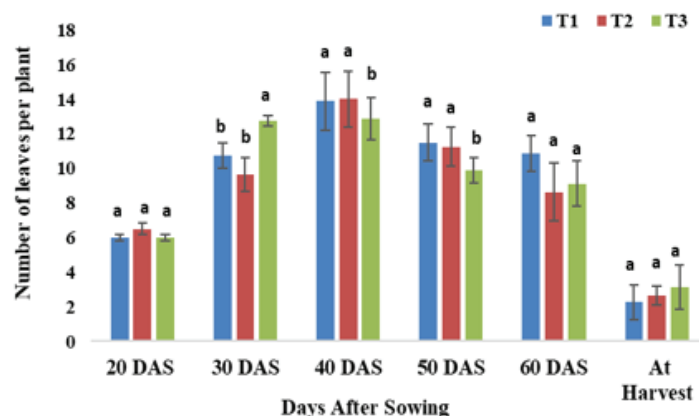


Figure 2. Effect of different boron levels on Leaf count per plant on different days after sowing (DAS).

Values are mean $\pm$ standard error (n=4). Bars sharing the same letter within a sampling stage are not significantly different from each other ($P \leq 0.05$), as determined by Tukey's test. T₁ (control), T₂ (single foliar spray of 0.5% boron during the vegetative stage), and T₃ (two foliar applications of 1.5% boron).

The highest number of branches per plant were recorded in the treatment with two foliar applications of 1.5% boron (T₃), reaching 12.93 branches, whereas the control treatment (T₁) had the lowest count, with 9.67 branches (**Figure 3**). The increased branching in the T₃ treatment may be linked to the role of boron in cell wall formation, stability, and energy translocation within the plant. All these physiological processes directly contribute to the formation of additional branches. Riaj *et al.* (2018) found similar results, reporting significant variations in the number of branches for varied levels of boron. Naser and Islam (2001) also reported that appropriate doses of boron positively influenced both plant height and the number of branches per mustard plant.

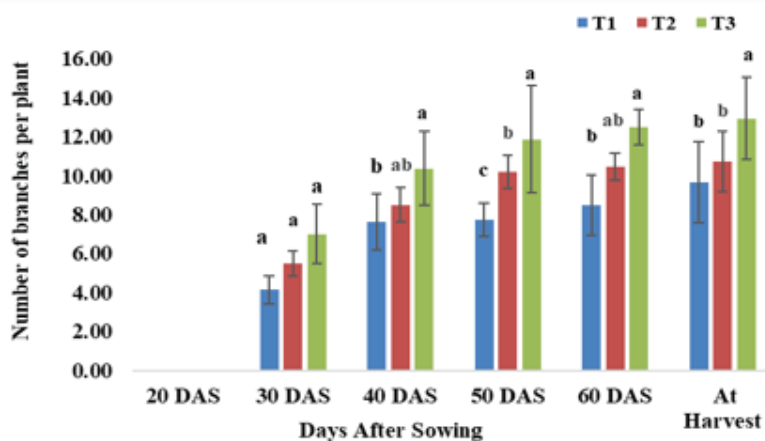


Figure 3. Effect of different boron levels on Number of Branches at different days after sowing (DAS).

Values are mean $\pm$ standard error (n=4). Bars sharing the same letter within a sampling stage are not significantly different from each other ($P \leq 0.05$), as determined by Tukey's test. T₁ (control), T₂ (single foliar spray of 0.5% boron during the vegetative stage), and T₃ (two foliar applications of 1.5% boron).

Effect of boron on inflorescence length and dry weight

Boron influences the synthesis and activity of plant hormones, such as auxins and gibberellins, which are involved in flower development. These hormones regulate cell elongation and expansion, contributing to longer inflorescence. In this study, two foliar applications of boron at 1.5% (T₃) and (T₂) resulted in the longest inflorescence. The shortest inflorescence length was observed in control treatment (**Figure 4**). The enhanced inflorescence length may be associated with the role of boron in reproductive growth.

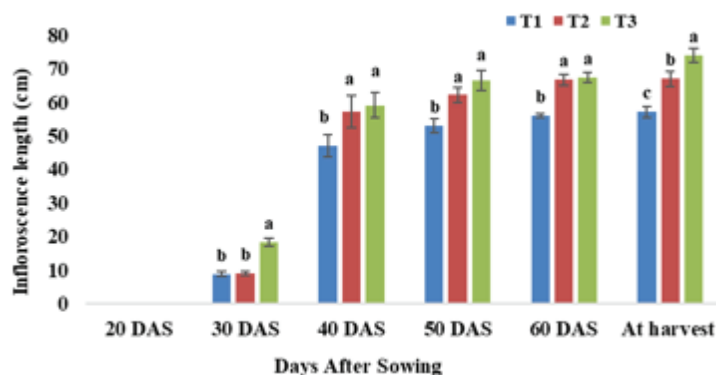


Figure 4. Effect of varying boron levels on Inflorescence length (cm) after sowing (DAS).

Values are mean $\pm$ standard error (n=4). Bars sharing the same letter within a sampling stage are not significantly different from each other ($P \leq 0.05$), as determined by Tukey's test. T₁ (control), T₂ (single foliar spray of 0.5% boron during the vegetative stage), and T₃ (two foliar applications of 1.5% boron).

Ara *et al.* (2015) found similar results, reporting that the longest inflorescence length was observed with 2 kg boron per hectare, while the shortest was recorded in the control treatment. Until 40 DAS, the impact of boron on dry weight was not as pronounced, as the plants were focused on establishing their root systems and vegetative structures. However, after this initial phase, the treatment with two foliar applications of boron (T₃) resulted in the highest dry weight, indicating that boron played a key role in biomass accumulation during the reproductive growth phase (**Figure 5**). Yadav *et al.* (2016) and Choudhury *et al.* (2022) found similar results, reporting that boron promotes cell proliferation and overall plant development, leading to higher dry-weight accumulation in mustard.

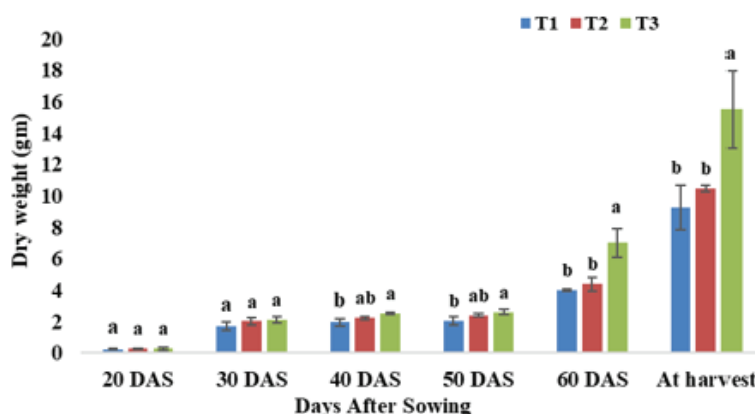


Figure 5. Effect of different boron levels on dry weight (gm) on different days after sowing.

Values are mean $\pm$ standard error (n=4). Bars sharing the same letter within a sampling stage are not significantly different from each other ($P \leq 0.05$), as determined by Tukey's test. T₁ (control), T₂ (single foliar spray of 0.5% boron during the vegetative stage), and T₃ (two foliar applications of 1.5% boron).

Impact of boron on yield factors: siliquae development, seed generation, seed weight

Boron application significantly improved the yield components of mustard. The highest number of siliquae per plant, seed per siliqua, and 1000-seed weight were all positively impacted by the boron application. The number of siliquae per plant peaked at 121.15 in T₃, with T₁ exhibiting the least (99.50). Siliqua length followed the same trend, with T₃ having the longest siliqua (6.09 cm) and T₁ the shortest (5.05 cm). The number of seeds per siliqua and 1000-seed weight were considerably affected by boron application, with T₃ yielding 21.75 gm weight and the highest seed weight (3.25 g). Fresh weight also showed significant differences, with T₃ producing the highest fresh weight (20.38 t/ha) compared to 11.16 t/ha in T₁. Awal *et al.* (2020) reported increased siliqua formation and seed yield with boron application. Kour *et al.* (2017) and Yadav *et al.* (2016) also found that boron significantly enhanced seed set and overall yield in mustard (**Table 1**).

Table 1. Yield and yield attributing components

Treatment	Plan population m ⁻²	Branches plant ⁻¹	Siliqua plant ⁻¹ (No.)	Siliqua Length (cm)	Seeds silliqua ⁻¹ (No.)	1000 seed wt. (g)	Fresh weight (t ha ⁻¹)	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
T ₁ (Control)	70.122a	9.67b	99.50b	5.05c	15.88b	3.04c	11.16c	717.76c	1315c	2040.42c	34.27b
T ₂	70.35a	10.75b	111.70a	5.67b	18.04b	3.10b	16.43b	826.02b	1444b	2270.46b	36.29ab
T ₃	70.69a	12.93a		6.09a	21.75a	3.25a	20.38a	1035.97a	1641.69a	2677.66a	38.63a
CV (%)	0.45	9.37	6.28	4.28	8.22	0.89	9.25	3.801	2.43	1.93	4.25
LSD (0.05)	0.54	1.8	12.03	0.41	2.63	0.048	2.55	56.63	61.69	77.84	2.67
P value	NS	*	*	*	***	***	***	***	***	***	*

Boron on yield attributes

Boron application significantly increased seed yield and other yield attributes of mustard. The highest seed yield was observed in T₃ (1035.97 kg/ha) while the control had the lowest yield (717.46 kg/ha). A similar pattern was observed for stover yield and biological yield where T₃ resulted in the highest yields (1641 kg/ha and 2677.66 kg/ha, respectively). Finally, the harvest index was highest in T₃ (38.63%) and lowest in T₁ (34.26%) (**Table 1**). These results align with the findings of Jaiswal *et al.* (2015), who also reported significant increases in stover yield with boron application. Choudhary *et al.* (2013) found similar results, reporting that mustard cultivars showed significant increases in biological yield with increasing levels of boron application. Riaj *et al.* (2018) reported similar findings, showing that boron application increased the harvest index of mustard.

Total phenolic and flavonoid content

The total phenolic concentration of the extracts was measured using the regression formula obtained from the standard curve and represented as milligrams of gallic acid equivalents (**Figure 6**, **Table 02**). No statistically significant differences were noted among the treatments for total phenolic composition ($P < 0.05$). However, T₂ (foliar spray of 0.5% Boron) had a higher TPC of (14.97 mg GAE/g. Followed by T₃ (Two times foliar spray at 1.5%) and T₁ (samples having no boron) at 14.84 and 14.71 mg GAE/g, respectively.

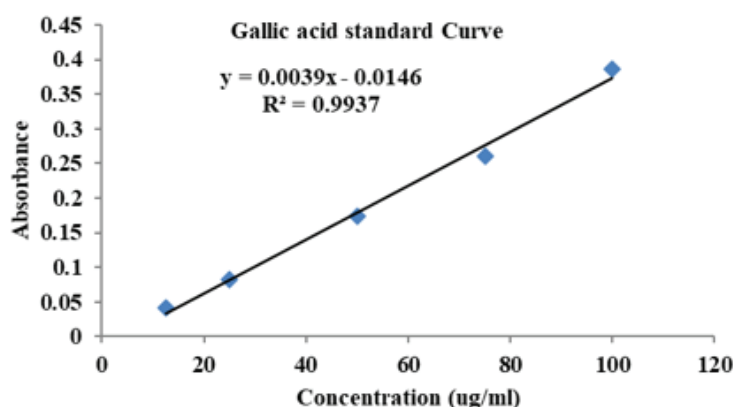


Figure 6. Standard curve of Gallic acid (TPC).

Table 2. Total phenol content of the extracts

Sample	Total Phenol Content (TPC) mg/g
T ₁ (Control)	14.71±0.07 ^a
T ₂	14.97±0.81 ^a
T ₃	14.84±0.30 ^a

Total flavonoid content (TFC) was calculated using the regression equation (**Figure 7**) and represented as milligrams of quercetin equivalents per gram of dry sample (mg Qe/g) (**Table 03**). No notable variations were observed between the treatments regarding overall flavonoid concentration.

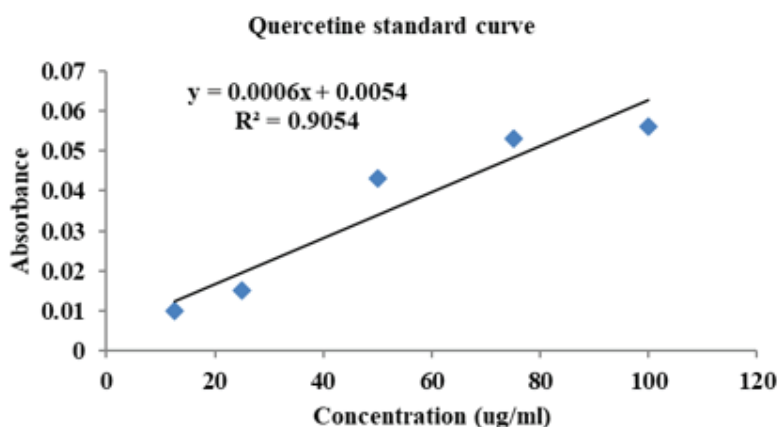


Figure 7. Standard curve of quercetin (TFC).

Table 3. Total Flavonoid content of the extracts

Sample	Total Flavonoid Content (TFC) mg/g
T ₁ (Control)	15.99 ± 2.63 ^a
T ₂	17.054 ± 0.91 ^a
T ₃	16.52 ± 1.90 ^a

However, T₂ (foliar spray of 0.5% Boron) had a higher TPC of (17.05 mg Qe/g). Followed by T₃ (two times foliar spray of 1.5% and T₁ (sample having no boron) at 16.52 and 15.99 mg Qe/g, respectively. No remarkable variation was detected across treatments concerning the overall phenolic and flavonoid levels (**Figure 8**). This might be due to the wide-ranging differences in the overall phenolic content in rapeseed varieties, which is primarily influenced by genotype, while agronomic and environmental factors contribute to only minor variations. Unlike rapeseed meals, limited studies have examined total phenolic content in the lipid fraction, measured using various individual phenolic acids as standards. As a result, boron treatment in this experiment did not have a significant impact on the phytochemical composition of mustard. Similar findings were reported by Shahidi *et al.*, (1992); Cai *et al.*, (2001), and Siger *et al.*, (2004). According to Borrs *et al.* (2014), the phenolic content values ranged from 260 to 516 mg GAE per 100g, while total flavonoid content varied between 388 and 475 mg QE per 100g. In the present study, only slight variation in total phenolic and flavonoid content were observed among the three treatments.

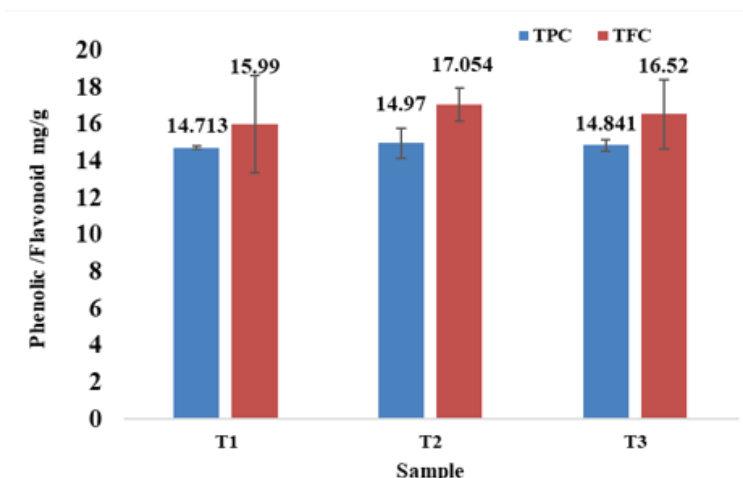


Figure 8. TPC and TFC of mustard for different boron treatments

Conclusion

Foliar application of boron significantly improved the growth and yield of the mustard variety Tori-7. Among the treatments two foliar applications of 1.5% (T₃) during the vegetative and pod developmental stages produced the highest yield components, seed yield and harvest index, indicating that this treatment was the most effective under the present experimental condition. As this study was conducted at a single location, multi-location trials including different varieties of mustard are needed to validate the optimum boron application rate for AEZ-20 region.

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Author Guidelines

Article Types

- Three types of manuscripts may be submitted: Regular research articles, Short communications and Reviews
- The manuscript should be based on original research work in any branch of Agricultural and Biological Sciences.

Length of Manuscript

- Regular research papers: not more than 4000 words
- Review articles: up to 6000 words
- Short communications: 1500 words

Formatting and Style of Manuscript

- **Language:** The manuscript must be in clear English and grammatically correct
- **Paper size:** A4 (8.27×11.69 inches or 210x297 mm)
- **Page margin:** 1 inch or 25 mm on all sides
- **Font Face:** Times New Roman
- **Font size:**
 - ✓ **Heading:** Abstract, Introduction, Materials and Methods etc. should be at the top of the **left margin** line at the beginning of each section in **12pt** font size with **bold** phase
 - ✓ **Sub Heading:** Sub heading can be used after the main heading with **12pt** font size with **bold italic** but not underlined
 - ✓ **Paragraph:** Content under each section should be 1.5 space with a font size of **12pt**
- **File type:** MS Word document (.doc or .docx)
- **Page Number:** Page number should start from title page and position in bottom middle part

Chronology of the Manuscript

The article should have the chronological orders of-

- | | |
|--|------------------------------|
| 1. Cover page (Title, authors affiliation, short running title, corresponding address) | 5. Results and Discussion |
| 2. Title Page (Title, abstract and keywords) | 6. Acknowledgements (if any) |
| 3. Introduction | 7. References |
| 4. Materials and Methods | 8. Tables |
| | 9. Figures |

Cover Page:

This page should contain following information-

1. Title of manuscript: Title should be clear and concise reflecting the objective and content of the paper. It must be written in capital letters, in bold phase and font size of 12pt in "left alignment" with 1.5 spaced
2. Author(s): Full Name of Author/s and affiliation/s with an asterisk* after the name of corresponding author.
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Title Page:

1. Title of manuscript: Title should be written in capital letters, in bold phase and font size of 12pt in "left alignment" with single spaced
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3. Keywords: Keywords are to be confined within 5 words/phrases following the abstract in same page

Introduction:

- Introduction should start following Keywords
- It should reflect the rationale of the research and illustration of the problems with references and reasons
- There may be several subsections/paragraphs for the text
- Objectives of the study should be clearly stated

Materials and Methods:

- This section should have brief description of the materials used and the methods/methodologies followed. Already published or established procedure should be cited and only new procedure should be described in detail.
- There may be several subsections/paragraphs in the text. Experimental site, duration, procedure & design, statistical analysis may be included

Results and Discussion:

- This section should present the key results of the study clearly with sub-headings and in several paragraphs
- Results to be written with facts and figures and should be discussed with proper causes and reasons. These should be interpreted comparing with relevant similar or dissimilar information already available with proper references;
- References in the text: References in the text should follow the author last name and year system e.g.
 - ✓ for one author: last name, year; Example: Brown, 2018
 - ✓ for two authors: 1st and 2nd author names, year; Example: John and Alex, 2018
 - ✓ for more than two authors: 1st author name *et al.*, year; Example: Roy *et al.*, 2018
 - ✓ for reporting: author name (year); Example: Roy (2018) reported that.../John and Alex (2018) Roy *et al.* (2018)

Acknowledgements:

The author(s) can acknowledge (if any) to individual or organizations for their significant contribution to the research work through funds, grants or involvement in knowledge exchange.

References:

References should be given in alphabetical order at the end of the article must in the following styles.

- a. Journal papers/article: Bhatt RM, Rao NKS and Anand N. 1992. Response of bell pepper to irradiance photosynthesis, reproductive attributes and yield. Indian Journal of Horticulture. 56(1):62-66.
- b. Book: Dodds JR and Roberts LW. 1982. Experiment in plant tissue culture. Cambridge University Press, London. 650p.
- c. Collected article: Engler D. 1997. Control of cell cycle. In: Greppin H, Penel C and Simon P (Eds.). Travelling shot on plant development. pp. 95-96. Univ. of Geneva, Switzerland.

- d. Proceeding paper: Booth EJ, Walker KC and Schung E. 1991. Effect of site, foliar sulphur and nitrogen application on glucosinolate content and yield of oil seed (*Brassica napus* L.). In: Proc. Eighth International Rapeseed Congress, Saskatoon, Canada. pp. 567-572.
- e. Thesis/Dissertation: Paul TK. 2009. Technology of sweet pepper production in Bangladesh. PhD Thesis. Dept. Hort. BSMRAU, Salna, Gazipur. 225p.
- f. Internet/on line:
 - I. Author's Last Name, First Initial, Middle Initial. (Date of Publication or Update). Title of work. Retrieved Month Day, Year, from URL from Homepage; Example: Seville C. (2001, January 25). Finish materials in design/build. Retrieved June 20, 2012, from <http://www.housingzone.com/topics/hz/cmaterials/hz01aa604.asp>
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Tables:

- Tables should be self descriptive and placed after references in separate sheet
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- Each Table should have title in bold phase with 12pt font size
- If any foot note below Table or Figure they should be in font size 10pt
- There should be no vertical lines in Table construction
- Statistical parameters may be separated with horizontal lines

Figures:

- The figures should be typed in numerical order and should be placed in separate sheet
- Title and labeling of the figure should be indicated in such a way that the figure is understandable without reading the text of the manuscript
- Information given in the legend should not be repeated in the text

Short Communication

Short Communication limited to 4 pages. The items of manuscript preparation are: (1) Abstract (limited to 100 words); 2) Short Methodology, Results and Discussion should be combined in a single section.

Other Instructions

- Abbreviation: Abbreviation may be used but first time it must be given in detail;
- Symbol and Unit: Standard International Units (SI units) should be used, e.g. mg, g, kg, mm, cm, m, km, ppm, cpm, μCi (microCurie), l (litre), ml, s (second), min (minute), h (hour), mol, m^{-1} , kg ha^{-1} . Please use mg l^{-1} , not mg/l

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