International Journal of
Innovative Research

International Journal of Innovative Research, **5(2)**:18–25, 2020
ISSN 2520-5919 (online)
www.irsbd.org

RESEARCH PAPER

Impacts of Varieties and Boron on Physico-Chemical Quality of Summer Tomato

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ARTICLE HISTORY

Received: May 22, 2020
Revised : July 23, 2020
Accepted: August 11, 2020
Published: August 31, 2020

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ABSTRACT

Boron (B), a micronutrient, has shown to improve quality of vegetables including tomato. However, it is not known whether it can equally enhance the quality of tomato produced from different cultivars. Here, we examined the effects of different levels of boron (B) on physico-chemical quality of different summer tomato (*Lycopersicon esculentum* Mill.). The experiment comprised of two factors, a) summer tomato varieties *viz.*, BARI hybrid tomato 4, 8 and 10; and b) B levels- five levels B *viz.*, 0, 1, 2, 3 and 5 kg ha^{-1}. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Plants were grown in pots under poly-shed house condition. Both varieties and boron levels had significant (p<0.05) effects on quality attributes of summer tomato. In varieties, the highest fruit firmness (3.01 lbs), total soluble solids (TSS) (5.41%), vitamin C (7.93 mg/100g), calcium (0.343%), magnesium (0.231%) and potassium (4.853%) were recorded in BARI hybrid tomato 8 while the highest titrable acidity (TA) (0.98%), phosphorous (0.576%) and sodium (2.524%) were recorded in BARI hybrid tomato 4. However, the highest pH (3.88) and sulphur (0.098%) were found in BARI hybrid tomato 10. Conversely, the lowest TSS (4.97%), pH (3.71), calcium (0.166%), magnesium (0.219%), sulphur (0.061%) and potassium (2.862%) were found in BARI hybrid tomato 4; the lowest phosphorous (0.485%) and sodium (2.390%) were in BARI hybrid tomato 8; and the lowest firmness (2.47 lbs), TA (0.65%) and vitamin C (5.35 mg/100g) were in BARI hybrid tomato 10. In boron levels, maximum TSS (5.76%), vitamin C (7.97 mg/100 g), TA (0.97%), Ca (0.387%), K (5.039%), Na (3.209%) and S (0.101%) were recorded at 2 kg B ha^{-1}; maximum fruit firmness (2.94 lbs), Mg (0.242%) and P (0.593%) were at 3 kg B ha^{-1}; and the highest pH (3.87) was at 5 kg B ha^{-1} treatment. Conversely, the lowest firmness (2.51 lbs), TSS (4.52 %), TA (0.78%), vitamin C (6.39 mg/100 g), Ca (0.147%), Mg (0.198%), K (2.424%), P (0.459%), S (0.051%) and Na (1.934%) were found at control (0 kg B ha^{-1}) treatment; and minimum pH (3.72) was at 2 kg B ha^{-1} treatment. Results suggest that application of B at 2 kg B ha^{-1} followed by 3 kg B ha^{-1} treatment is required to obtain summer tomato fruit with maximum quality.

Key words: Variety, Boron level, Physico-chemical quality, Summer tomato

Introduction

Tomato (*Lycopersicon esculentum* Mill.), belongs to the family Solanaceae, is one of the most popular, important and widely grown quality vegetable in the world and ranked first in preserved and processed vegetables. It was originated in tropical America particularly in Peru, Ecuador, Bolivia of the Andes (Kallo 1986; Salunkhe *et al.* 1987). Tomato is cultivated all over the world including Bangladesh due to its adaptability to wide range of soil and climate (Ahmed & Saha 1976; Agyeman *et al.* 2014). It ranks third, next to potato and sweet potato, in terms of world vegetable production (FAO 2002) and tops the list of canned vegetables (Choudhury 1979). Tomato is considered as one of the body protective foods because of its special nutritive value especially rich source of vitamin A and C, nutrients like Na, K, Fe, Ca, Mg and antioxidants (Rashid 1983; Bose & Som 1990; Afzal *et al.* 2013). Ripe tomato are consumed throughout the world in the

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form of fresh like salads as well as processed products including ketchup, sauce, marmalade, chutney and juice, and can contribute to solve malnutrition problem.

However, nutritionally important tomato usually is grown from November to March (cool season; Rahman *et al.* 1998). Tomato practically is not grown from April to October in Bangladesh due to the weather of tropical region which is characterized by high temperature and heavy rainy conditions. The maximum temperature in summer reaches 34–38 °C and causes very poor fruit set (Aung 1976). Due to the excellent nutritional and processing potentials of tomato, the demand of tomato remains higher round the year, but production and quality is far below the demand, especially in the summer season. Most recently, Bangladesh Agricultural Research Institute (BARI) released summer tomato varieties, for example, BARI hybrid tomato 4, 8, 10 which are suitable for growing in summer season, but their improved production technology has not yet been established. Therefore, it is urgent to explore the improved production technology that will ensure higher yield and quality. The yield potential and quality of summer tomato can be improved by maintaining proper fertilizer application under protective structure like poly-shed house. Like other nutrients, micronutrient especially boron (B) has a pronounced effect on the production and quality of tomato (Nonnecke 1989; Bose & Tripathi 1996).

Increased cropping intensity along with cultivation of modern crop varieties having high yield potential has resulted in deterioration of soil fertility with an emergence of micronutrient deficiency in Bangladesh. Among the micronutrients, zinc and boron deficiencies have widely been reported (Hossain *et al.* 2008). Although the importance of boron as a nutrient is probably under-estimated; however, more boron is needed for the reproductive than for the vegetative phase of plant development (Sommer & Lipman 1926). Pollen tube growth, fruit-set and development are affected by boron (Blamey *et al.* 1979; De Wet *et al.* 1989). The functions of boron in plants have been related to cation and anion absorption, water relations, pollen viability, and the metabolism of phosphorus, nitrogen, fats, and carbohydrates (Shol'nik 1965). Boron also affects cell division, cell-wall synthesis, membrane functioning, sugar transport, differentiation, regulation of plant hormone levels, root elongation, and growth of plants (Marschner 1995). Its deficiency affects translocation of sugar, starches, nitrogen and phosphorus, synthesis of amino acids and proteins (Stanley *et al.* 1995). Although, boron is a minor element, however, plants differ widely in their demands. Again, boron management is challenging as its optimum application range is limited, and optimum boron application rates can differ from one soil to another (Gupta 1993; Marschner 1995). It is reported that the ranges between deficiency and toxicity of boron are quite narrow and that an application of boron can be extremely toxic to plants at concentrations only slightly above the optimum level (Gupta *et al*. 1985; Metwally *et al.* 2012). This emphasizes the need for a judicial use of boron fertilizer for quality summer tomato production. However, there is limited information in Bangladesh on the effect of boron on quality attributes of summer tomato production. Therefore, the present research work was undertaken to evaluate the quality of summer tomato as influenced by varieties and different levels of boron under protected condition.

Materials and Methods

An experiment was carried out at Germplam Centre and Postharvest Laboratory of the Department of Horticulture, and Central Laboratory of Patuakhali Science and Technology University, Dumki, Patuakhali during the period from May 2018 to September 2018. Two-factor experiment with fifteen treatment combinations consisted of three summer tomato varieties *viz.*, BARI hybrid tomato 4, 8 and 10; and five different levels of boron (B) *viz.*, 0, 1, 2, 3 and 5 kg B ha^{-1} were used. Different levels of boron as boric acid (H_3BO_3) were sprayed to the fresh soil separately and were mixed thoroughly for making pot mixture of summer tomato crop. However, control pot mixture was prepared without adding of boron (0 kg B ha^{-1}). The factorial experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Summer tomato seeds were collected from Vegetable Research Division of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur which were high yielding, heat tolerant and indeterminate type varieties. Seeds were sown in protected seedbed. Thirty-days-old seedlings were transplanted in earthen pot (0.79 $feet^3$) under poly-shed house condition. The maturity of the crop was determined on the basis of red colouring of fruits. Harvesting was completed from 55 to 70 DAT (days after transplanting). Boron treated and non-treated control summer tomato fruits were harvested and brought to laboratories for physico-chemical quality analyses.

Tomato fruit firmness was measured by Force gauge (Yamagata Univ. Japan: FG – 5000A) and was expressed in Neuton. Total soluble solid (TSS) content of tomato pulp was estimated by using Digital Refractometer (BOECO, Germany) and was expressed in per cent. Titratable acidity (TA) was determined according to the method by Ranganna (1977) and was expressed in per cent. Vitamin C (Ascorbic acid) content was determined according to the method of Ranganna (1979) and was expressed in milligram (mg) per 100 gram of fruit pulp. Fruit pulp pH was determined by calibrated electric pH meter (model H 12211 pH/OPR meter of Hanna Company) using buffer solution. Calcium (Ca) was determined by complexometric method of titration using Na_2-EDTA as a complexing agent (Page *et al.* 1982). Estimation of magnesium (Mg) was done titrimetrically (Page *et al*. 1982; APHA 2005). Sulphur (S) was determined by turbidimetric method (Tandon 1995) with the help of spectrophotometer (T60UV) and the absorbance reading was taken at 425 nm wave lengths. Sodium (Na) and Potassium (K) in the samples were determined separately with the help **of** flame emission spectrophotometer (Spectrolab analytical, UK) using appropriate filters. After digestion, 0.5 ml digested sample was taken and it was diluted 200 times to take the flame emission spectrophotometer reading for fruit samples. Phosphorus (P) was determined using ascorbic acid as a reductant for color development and

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reading was recorded with the help of spectrophotometer (T60UV). All mineral (Ca, Mg, S, Na, K, & P) data were expressed in per cent. The recorded data obtained from different parameters were analyzed using Minitab 17 statistical software (Minitab Inc, State College, PS, USA) to find out the significance of variation resulting from the experimental treatments. Analyses of variances (ANOVA) for different parameters was performed by general linear model (GLS) and the means were separated with Tukey at 5% level of probability (p<0.05).

Results and Discussion

Fruit firmness

Fruit firmness showed significant variations (p<0.05) in respect of summer tomato varieties and different levels of boron after harvesting (Fig. 1a and 1b). The highest (3.01 lbs) and lowest (2.47 lbs) fruit firmness were found from V_2 (BARI hybrid tomato 8) and V_3 (BARI hybrid tomato 10), respectively which was statistically similar with V_1 (BARI hybrid tomato 4) (2.61 lbs) (Fig. 1a). The differences of fruit firmness might be due to the genetical effects or varietal character of the summer tomato. In boron levels, maximum firmness (2.94 lbs) was recorded from B_3 (3 kg B ha^{-1}) treated plants which was statistically similar with B_2 (2 kg B ha^{-1}) (2.77 lbs) while the minimum firmness (2.51 lbs) was recorded from B_0 control (0 kg B ha^{-1}) plants (Fig. 1b). The maximum firmness at 3 kg B ha^{-1} indicates fruit firmness increases with the increases of boron level up to a certain limit and then it was declined. The result is in agreement with the findings of Smit and Combrink (2004). Tomato fruits cause less damage during carrying and when sliced for consumption less extraction of juice occur due to hard firmness.

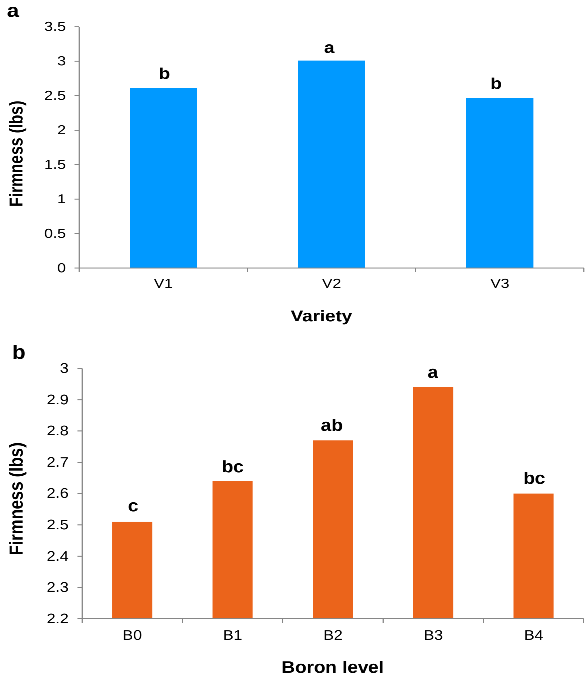

Fig. 1. Effects of varieties (a) and boron levels (b) on fruit firmness of summer tomato

V_1= BARI hybrid tomato 4, V_2= BARI hybrid tomato 8, V_3 = BARI hybrid tomato 10; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, B_3= 3 kg B ha^{-1} and B_4= 5 kg B ha^{-1}.

The figures having common letter (s) do not differ significantly at 5% level of probability analysed by Tukey.

Total soluble solids (TSS)

Significant variations (p<0.05) were observed in case of total soluble solids (TSS) of summer tomato varieties and different levels of boron (Fig. 2a and 2b). The highest TSS (5.41%) was found from V_2 (BARI hybrid tomato 8) which was statistically similar with V_3 (BARI hybrid tomato 10) (5.23%) while the lowest TSS (4.97%) was obtained from V_1 (BARI hybrid tomato 4) (Fig. 2a). Varietal character might influence the variations of TSS in summer tomato. In boron levels, maximum TSS (5.76 %) was found from B_2 (2 kg B ha^{-1}) treated plants whereas, the minimum TSS (4.52 %) was found from B_0 control (0 kg B ha^{-1}) plants which was statistically similar with B_4 (5 kg B ha^{-1}) (5.02%) treated plants (Fig. 2b). This finding indicates that TSS increases with the increases of boron level up to a certain limit and then it was declined. This result is agreed with the findings of Smit and Combrink (2004) and Patel *et al.* (2019). The higher TSS in tomato fruits may be due to the fact that increased boron synthesized more carbohydrate content to higher TSS value and therefore, fruits were richer in minerals contents (Oyinlola 2004).

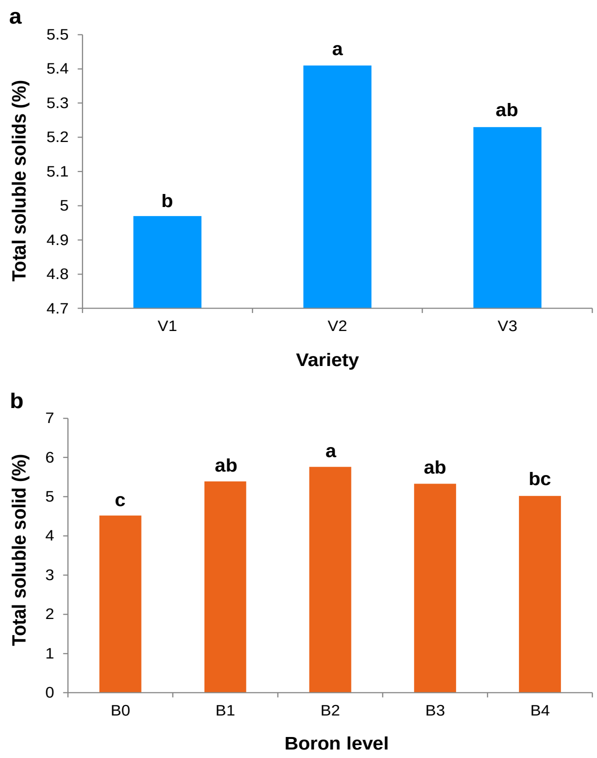

Fig. 2. Effects of varieties (a) and boron levels (b) on total soluble solids of summer tomato

V_1= BARI hybrid tomato 4, V_2= BARI hybrid tomato 8, V_3 = BARI hybrid tomato 10; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, B_3= 3 kg B ha^{-1} and B_4= 5 kg B ha^{-1}.

The figures having common letter (s) do not differ significantly at 5% level of probability analysed by Tukey.

Titrable Acidity (TA)

There were significant effects (p<0.05) of titrable acidity (TA) on summer tomato varieties and different levels of boron (Fig. 3a and 3b). The highest TA (0.98%) was recorded from V_1 (BARI hybrid tomato 4) which was

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statistically similar with V_2 (BARI hybrid tomato 8) (0.95%) while the lowest TA (0.65%) was recorded from V_3 (BARI hybrid tomato 10) (Fig. 3a). The differences of TA might be due to the varietal character of the summer tomato. In boron levels, maximum TA (0.97 %) was recorded from B_2 (2 kg B ha^{-1}) treated plants which was statistically similar with B_3 (3 kg B ha^{-1}) (0.93%) and the minimum TA (0.78%) was recorded from B_0 control (0 kg B ha^{-1}) plants (Fig. 3b). This finding proposes that TA increases with the increased level of boron upto a certain limit and then it was declined. The result of the present study is in support of the findings of Smit and Combrink (2004) and Harris *et al.* (2015).

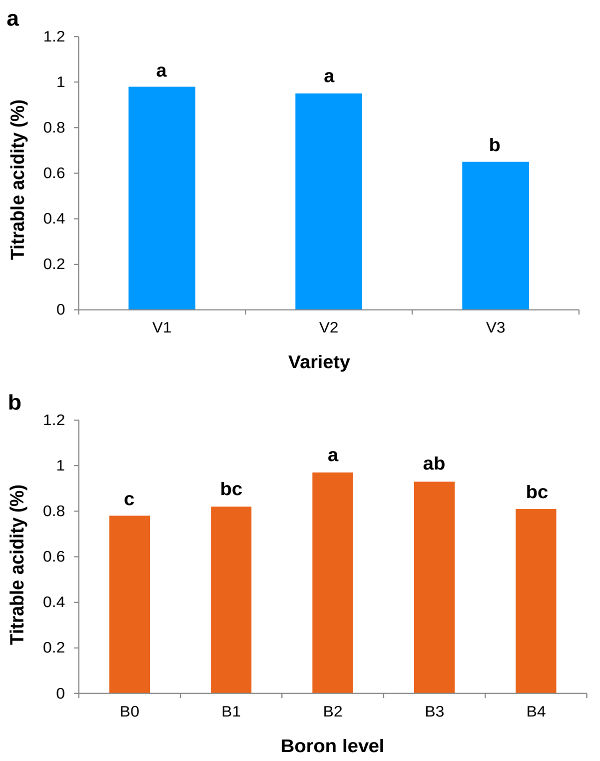

Fig. 3. Effects of varieties (a) and boron levels (b) on titrable acidity of summer tomato

V_1= BARI hybrid tomato 4, V_2= BARI hybrid tomato 8, V_3 = BARI hybrid tomato 10; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, B_3= 3 kg B ha^{-1} and B_4= 5 kg B ha^{-1}.

The figures having common letter (s) do not differ significantly at 5% level of probability analysed by Tukey.

Vitamin C contents

Varieties and boron levels had significant influences (p<0.05) on vitamin C content in summer tomato (Fig. 4a and 4b). The highest vitamin C content (7.93 mg/100 g) was found in V_2 (BARI hybrid tomato 8) which was statistically similar (7.82 mg/100 g) with V_1 (BARI hybrid tomato 10) and the lowest vitamin C (5.35 mg/100 g) was found in the V_3 (BARI hybrid tomato 10) (Fig. 4a). Varietal character might influence the differences of vitamin C content in summer tomato. In boron levels, maximum vitamin C content (7.97 mg/100 g) was noticed in B_2 (2 kg B ha^{-1}) treated plants which was statistically similar with B_3 (3 kg Bha^{-1}) (7.34 mg/100 g) whereas, the minimum vitamin C content (6.39 mg/100 g) was noticed in B_0 control (0 kg B ha^{-1}) plants (Fig. 4b). This finding proposes that vitamin C increases with the increased level of boron upto a certain limit and then it was declined. This result is supported by the findings of Harris *et al.* (2015).

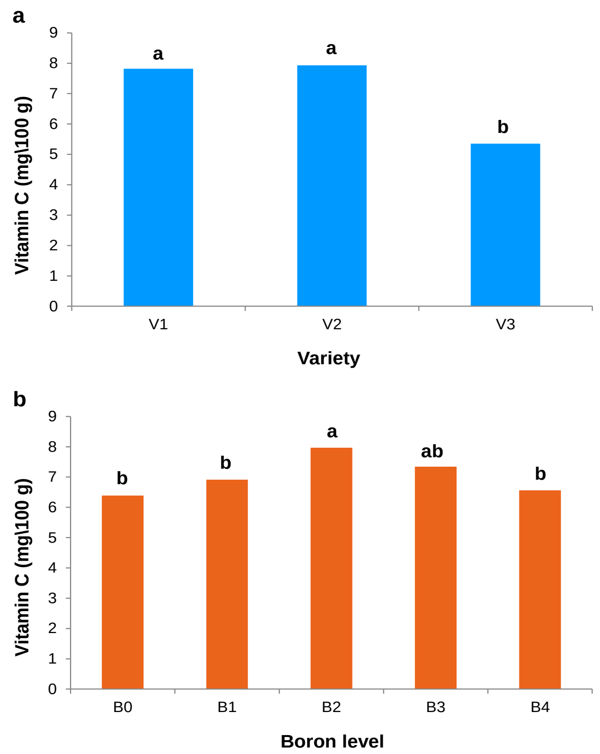

Fig. 4. Effects of varieties (a) and boron levels (b) on vitamin C content of summer tomato

V_1= BARI hybrid tomato 4, V_2= BARI hybrid tomato 8, V_3 = BARI hybrid tomato 10; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, B_3= 3 kg B ha^{-1} and B_4= 5 kg B ha^{-1}.

The figures having common letter (s) do not differ significantly at 5% level of probability analysed by Tukey.

pH

It was observed that the statistically significant variations (p<0.05) were found in pH content of varieties and different levels of boron in summer tomato (Fig. 5a and 5b). The highest (3.88) and lowest (3.71) pH were found from V_3 (BARI hybrid tomato 10) and V_1 (BARI hybrid tomato 4), respectively (Fig. 5a). The differences of pH might be due to the varietal character of the summer tomato. In boron levels, maximum pH (3.87) was recorded from B_4 (5 kg B ha^{-1}) treated plants which was statistically similar with B_0 control (3.81) plants and the minimum pH (3.72) was recorded from B_2 (2 kg B ha^{-1}) treated plants (Fig. 5b). This result is supported by the findings of Smit and Combrink (2004). This result is also agreed with the findings of Wang and Lin (2002) who observed correlation among pH of fruit with acidity and acid content and citric acid. Fruits containing less amount of pH (grown in 2 kg B ha^{-1} treatment) indicate presence of more citric acid, which is beneficial for human consumption (Wang & Lin 2002). Additionally, fruit with low pH is more suitable for ripening while it also improves shelf life (Hernández-Pérez *et al.* 2005).

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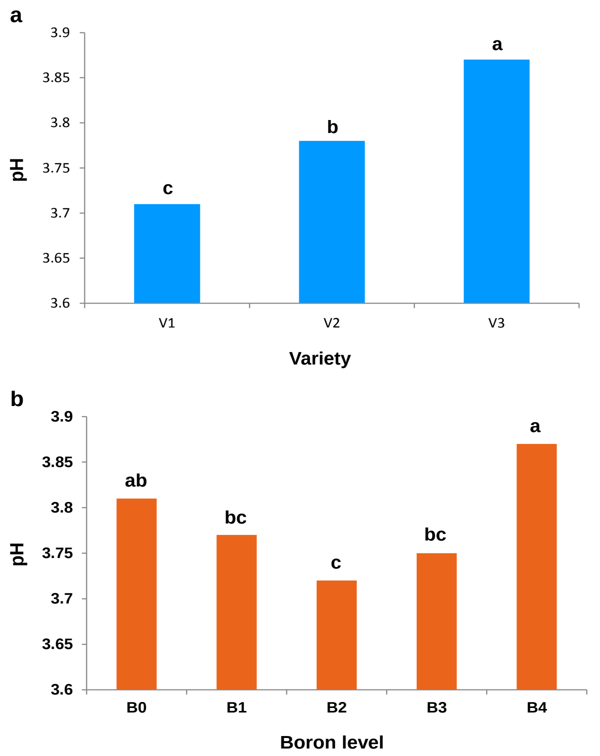

Fig. 5. Effects of varieties (a) and boron levels (b) on pH content of summer tomato

V_1= BARI hybrid tomato 4, V_2= BARI hybrid tomato 8, V_3 = BARI hybrid tomato 10; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, B_3= 3 kg B ha^{-1} and B_4= 5 kg B ha^{-1}.

The figures having common letter (s) do not differ significantly at 5% level of probability analysed by Tukey.

Mineral properties

Calcium

Varieties of summer tomato and different levels of boron showed statistically significant effects (p<0.05) on calcium (Ca) content (Table 1). The highest (0.343%) and lowest (0.166%) Ca were found from V_2 (BARI hybrid tomato 8) and V_1 (BARI hybrid tomato 4), respectively. The differences of Ca content might be due to the genetical effects or varietal character of the tomato. In boron levels, maximum Ca (0.387%) was recorded from B_2 (2 kg B ha^{-1}) treated plants whereas, the minimum Ca (0.147%) was recorded from B_0 control (0 kg B ha^{-1}) plants. This result indicates that Ca increases with increasing level of B application upto a certain limit and after that it was declined. The findings of the current study are also parallel to the results of Smit and Combrink (2004) and Dursun (2010) who observed that uptake of Ca increases with the increasing level of B (2 kg B ha^{-1}) application in tomato fruit. In this connection Blevins *et al.* (1993) reported that B has a major influence on the plasma membrane of plant cells and ion transport and that B amendments increased Ca level in soybean leaves.

Magnesium

Magnesium (Mg) content was significantly influenced (p<0.05) by varieties of summer tomato and different levels of boron (Table 1). The highest (0.231%) and lowest (0.219%) Mg were found from V_2 (BARI hybrid tomato 8) and V_1 (BARI hybrid tomato 4), respectively which was statistically similar with V_3 (BARI hybrid tomato 10) (0.221%). The variations of Mg content might be due to the varietal character of the summer tomato. In boron levels, maximum (0.242%) and minimum (0.198%) Mg were recorded from B_3 (3 kg B ha^{-1}) and B_0 control (0 kg B ha^{-1}) plants, respectively. This result indicates that Mg increases with increasing level of B application upto a certain limit and after that it was declined. In this connection, B has a major influence on the plasma membrane of plant cells and ion transport and that B amendments increased Mg levels in soybean (Blevins *et al.* 1993) and tomato leaves (Smit & Combrink 2004).

Potassium

There were significant effects (p<0.05) on potassium (K) content of varieties of summer tomato and different levels of boron (Table 1). The highest (4.853%) and lowest (2.862%) K were found from V_2 (BARI hybrid tomato 8) and V_1 (BARI hybrid tomato 4), respectively. Varietal character might influence the differences of K content in summer tomato. In boron levels, maximum (5.039%) and minimum (2.424%) K were recorded from B_2 (2 kg B ha^{-1}) and B_0 control (0 kg B ha^{-1}) plants, respectively. This result indicates that K increases with increasing level of B application upto a certain limit and after that it was declined. This result is supported by the findings of Turan *et al.* (2009) who observed that B application resulted in increased Brussels sprout yield and tissue K. In this connection, Blevins *et al.* (1993) reported that B has a major influence on the plasma membrane of plant cells and ion transport and that B amendments increased K level in soybean leaves. Maintenance of high foliage K levels during tomato fruit development is recommended but is often difficult to achieve (Adams 1986; Bradley & Flemming 1960). Fruit become large sinks for K as they develop, thereby diminishing K levels in leaves that are needed for continued plant growth and physiological processes (Ho & Hewitt 1986). Thereby, adequate B levels help to maintain leaf K levels in tomato during fruit development (Sperry 1995).

Phosphorus

It was noticed that varieties of summer tomato and different boron levels also showed significant variations (p<0.05) in terms of phosphorous (P) content (Table 1). The highest (0.576%) and lowest (0.485%) P were found from V_1 (BARI hybrid tomato 4) and V_2 (BARI hybrid tomato 8), respectively which was statistically similar with V_3 (BARI hybrid tomato 8) (0.495%). The differences of P content might be due to the varietal character of the summer tomato. In boron levels, maximum (0.593%) and minimum (0.459%) P were recorded from B_3 (3 kg B ha^{-1}) and B_0 control (0 kg B ha^{-1}), respectively which was statistically similar with B_1 (1 kg B ha^{-1}) (0.461%). This result indicates that P increases with increasing level of B application upto a certain limit and after that it was declined. This result is also supported by the findings of Turan *et al.* (2009) who observed that B application resulted in increased Brussels sprout yield and tissue P. Increased boron application significantly improved the uptake of P by grain and straw of barley crop (Singh and Singh, 1984).

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Sodium

Significant variations ($p<0.05$) were observed in relation to sodium (Na) content of summer tomato varieties and different levels of boron (Table 1). The highest (2.524%) and lowest (2.390%) Na were found from V_1 (BARI hybrid tomato 4) and V_2 (BARI hybrid tomato 8), respectively. Varietal character might influence the differences of Na content in summer tomato. In boron levels, maximum Na (3.209%) was recorded from B_2 (2 kg B ha^{-1}) treated plants while the minimum Na (1.934%) was recorded from B_0 control (0 kg B ha^{-1}) plants. This result indicates that Na increases with increasing level of B application upto a certain limit and after that it was declined. Singh and Singh (1984) reported that uptake of Na by grain and straw of barley crop significantly increased with increasing in boron application. The findings of the current study are also parallel to the results of Smit and Combrink (2004) in tomato.

Sulphur

Sulphur (S) content varied significantly ($p<0.05$) due to the effect of varieties of summer tomato and different levels of boron (Table 1). The highest (0.098%) and lowest (0.061%) S were found from V_3 (BARI hybrid tomato 10) and V_1 (BARI hybrid tomato 4), respectively. The differences of S content might be due to the varietal character of the summer tomato. In boron levels, maximum S (0.101%) was recorded from B_2 (2 kg B ha^{-1}) treated plants and the minimum S (0.051%) was recorded from B_0 control (0 kg B ha^{-1}) plants. The maximum S content at 2 kg B ha^{-1} indicates its optimum level that might improve the uptake of S nutrients and raise the concentration of S in tissues of tomato fruit. This result is in the similar line of Begum *et al.* (2015) who observed that higher rate of B application increased the S uptake in onion bulb.

Table 1. Effects of varieties and boron levels on mineral contents of summer tomato

Treatments	Mineral contents (%)					
	Ca	Mg	K	P	Na	S
Varieties						
V_1	0.166 c	0.219 b	2.862 c	0.576 a	2.524 a	0.061 c
V_2	0.343 a	0.231 a	4.853 a	0.485 b	2.390 c	0.067 b
V_3	0.248 b	0.221 b	3.819 b	0.495 b	2.458 b	0.098 a
Level of significance	**	**	*	**	*	*
Boron levels						
B_0	0.147 e	0.198 c	2.424 e	0.459 d	1.934 e	0.051 d
B_1	0.249 c	0.222 b	4.441 b	0.461 d	2.488 c	0.074 b
B_2	0.387 a	0.229 ab	5.039 a	0.512 c	3.209 a	0.101 a
B_3	0.276 b	0.242 a	3.028 d	0.593 a	2.127 d	0.076 b
B_4	0.201 d	0.228 ab	4.291 c	0.569 b	2.529 b	0.075 bc
Level of significance	*	**	**	**	*	**
CV (%)	6.96	8.00	18.13	9.11	12.34	17.51

V_1= BARI hybrid tomato 4, V_2= BARI hybrid tomato 8, V_3= BARI hybrid tomato 10; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, B_3= 3 kg B ha^{-1} and B_4= 5 kg B ha^{-1}

* and ** indicate significant at 5% and 1% level of probability, respectively; CV= Co-efficient of variation

The figures having common letter (s) do not differ significantly at 5% level of probability analysed by Tukey.

Conclusion

Boron diversely affected summer tomato physico-chemical quality. Among the varieties, BARI hybrid tomato 8 performed the best in terms of fruit firmness, total soluble solids (TSS), vitamin C, Ca, Mg and K; BARI hybrid tomato 4 performed the best in terms of titrable acidity (TA), P and Na; and BARI hybrid tomato 10 performed the best in terms of pH and S. In contrast, TSS, pH, Ca, Mg, S and K seems to be the least in BARI hybrid tomato 4; P and Na seems to be the least in BARI hybrid tomato 8; and fruit firmness, TA and vitamin C seems to be the least in BARI hybrid tomato 10. Among the boron levels, maximum TSS, vitamin C, TA, Ca, K, Na and S were recorded at 2 kg B ha^{-1}; maximum fruit firmness, Mg and P were at 3 kg B ha^{-1}; and the highest pH was at 5 kg B ha^{-1} treatment. Conversely, control (0 kg B ha^{-1}) treatment exhibited the lowest effects on all attributes except the minimum pH which was found at 2 kg B ha^{-1} treatment. Across average varieties, 2 kg B ha^{-1} followed by 3 kg B ha^{-1} treatment level is found to be the most effective in enhancing physico-chemical quality of summer tomato. Altogether, our results suggest that B can improve summer tomato quality although the level of enhancement can depend on varieties.

Acknowledgements

We thank the Research and Training Centre, Patuakhali Science and Technology University (PSTU), Bangladesh for financial support to complete this research work successfully. We also thank the Vegetable Research Division of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur to provide seed materials.

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