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Research Article

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Effect of Different Sources and Levels of Boron on Quality of Tomato (*Solanum lycopersicum*)

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ABSTRACT

A field experiment was conducted to study the importance of boron in regulating quality of tomato. The experiment was laid out in a randomized complete block design with ten treatments and three replications. Boron was applied through three different sources such as borax, boron metalosate and boric acid. Borax was applied as soil application whereas boric acid and boron metalosate were supplied as foliar spray. The experimental results indicated that application of boron significantly influenced the quality of tomato. Significantly higher quality parameters such as total soluble solids (5.44^0 Brix), lycopene content (54.16 mg/kg) and ascorbic acid content (47.26 mg/100g) was recorded in treatment which consists of NPK+ FYM + 1.1 kg ha^{-1} B through borax as soil application + 0.05% B through boron metalosate as foliar application.

Key words: *Tomato, Boron, Boric acid, Boron metalosate, Quality parameters and Foliar application*

INTRODUCTION

Boron(B) plays a vital role in the physiological processes of plants such as maturation, cell elongation and cell division, carbohydrate, protein and nucleic acid metabolisms, cytokinin synthesis, auxin and phenol metabolisms[6]. In the absence of B, proper development of meristematic tissues of plant does not takes place. Food value of tomato is generally dependent on its chemical composition such as dry matter, titratable acidity, total sugars, total soluble solids and ascorbic acids. Boron improves the quality of tomato fruit, particularly size and shape, colour, smoothness, firmness, keeping quality and chemical composition. Fruit shape, yield and shelf life of tomato were also improved by boron nutrition[2].

Boron is also required in the translocation of sugars in plants. Besides, B is regarded to be a buffer in plant tissues working as some kind of regulator to other substances. It is a constituent of membranes that regulate passage of sugars in plant bodies. Normally ascorbic acid and sugar contents are increased by supplementing B[5]. Crops differ in their sensitivity to boron deficiency.

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Foliar fertilization is the most efficient way to increase yield and quality. It is an effective method for correcting nutritional soil deficiencies and overcoming the soil's inability to transfer nutrients to the plant under low moisture conditions. The effective supply of micronutrient through foliar spray has received little attention despite their importance for maintaining production .The importance of boron on regulating the quality of tomato is very limited. Keeping in view the present study was undertaken.

MATERIAL AND METHODS

The experiment entitled with "Study the effect of different sources and levels of boron on soil properties, growth and yield of tomato (*Solanum lycopersicum*)*"* was conducted during 2015-2016 at Nayanhalli village, Chintamani taluk Chickaballapur district under this study we were taken quality of tomato as one of the objective. The experiment was laid out in a randomized complete block design including ten treatments and three replications. The experimental site was adjusted into small plots of required size and levelled. The site was divided into thirty equal plots with an area of 14.4 m^2 each. Treatment details are given in Table:1. Two sprays were taken one is at vegetative stage and other was at flowering stage.

Fruit samples were collected at 3^{rd}, 5^{th} and 8^{th} picking, processed and analysed for quality parameters such as Total soluble solids, lycopene content and ascorbic acid content by adopting standard analytical methods.

Table: Treatment Details

S. No.	Treatment Details
T_1	NPK + FYM
T_2	T_1 + 1.1kg ha^{-1} Boron through Borax as Soil application
T_3	T_1 + 1.6 kg ha^{-1} Boron through Borax as Soil application
T_4	T_1 + 2.2 kg ha^{-1} Boron through Borax as Soil application
T_5	T_1 + 0.55 kg ha^{-1} Boron through Borax as Soil application +0.05% Boron through Boric acid as foliar spray
T_6	T_1 + 0.82 kg ha^{-1} Boron through Borax as Soil application +0.05% Boron through Boric acid as foliar spray
T_7	T_1 + 1.1kg ha^{-1} Boron through Borax as Soil application +0.05% Boron through Boric acid as foliar spray
T_8	T_1 + 0.55 kg ha^{-1} Boron through Borax as Soil application +0.05%Boron through Boron metalosate as foliar spray
T_9	T_1+ 0.82 kg ha^{-1} Boron through Borax as Soil application +0.05%Boron through Boron metalosate as foliar spray
T_{10}	T1 + 1.1kg ha^{-1} Boron through Borax as Soil application +0.05% Boron through Boron metalosate as foliar spray

Total soluble solids were estimated in freshly cut fruit samples at the time of harvest by using Erma hand refractrometer. Fruits were cut into halves and the middle portion of the fruit was squeezed on refractrometer. The TSS was expressed in ºBrix.

Lycopene in the tomato samples was extracted by hexane: ethanol: acetone (2:1:1) mixture. Tomato fruits were homogenized using a mixer. 100 micro liter of homogenized sample were taken in a test tube and 8 mL of hexane: ethanol: acetone, which was added and mixed thoroughly. Blank sample was prepared using 100 micro liter water instead of tomato sample. Then samples and blank tubes were incubated out of bright light for 10 minutes. After 10 minutes, 1 ml of water was added to an each test tube and mixed. Tubes were allowed to stand for 10 minutes to separate into distinct polar and nonpolar layers. The absorbance was measured at 503 nm, using hexane as a blank. The cuvette was rinsed with the upper layer of the blank samples. Fresh blank was used to set zero in the spectrophotometer at 503 nm. The A503 of the upper layers of the lycopene samples were determined[8].

Lycopene (mg 100g-1 fresh wt.) = (A503 x 537 x 8 x 0.55)/ (0.10 x 172) = A503 x 137.4

Where 537 g mole^{-1} is the molecular weight of lycopene, 8 mL is the volume of mixed solvent, 0.55 is the volume ratio of the upper layer to the mixed solvents, 0.10 g is the weight of tomato added, and 172 mM is the extinction coefficient for lycopene in hexane.

Ascorbate content in the tomato samples was estimated by using the method of[1] which is based on the reduction of 2, 6-dichlorophenol indophenol (2, 6-DCPIP) by ascorbate.

A tissue sample of 1 gram was macerated with 4 ml of 3 per cent metaphosphoric acid in a chilled mortar and pestle. The homogenate was centrifuged for 20 minutes at 1000 rpm and then the supernatant was carefully decanted into a flask and final volume was made up to 25 ml with 3 per cent Metaphosphoric acid. An aliquot sample of the extract was titrated with 2, 6-dichlorophenol indophenol reagent until a pink end-point, which persists for 15 seconds, was reached. A standard curve was prepared by titrating a known amount of ascorbate (1-50 mg) with 2, 6-dichlorophenol indophenols reagent. The total amount of ascorbate present in the sample was calculated from the standard curve. The results were expressed in mg ascorbic acid per 100g fresh weight.

RESULTS AND DISCUSSION

Total soluble solids (Brix), titratibale acidity and lycopene content varied significantly due to the application of different sources and levels of boron and results are presented in the Table: 2. The total soluble solid (Brix), lycopene and ascorbic acid of tomato fruit was significantly influenced by soil and foliar application of boron. The highest value of lycopene content, ascorbic acid and total soluble sugars (TSS) were recorded in treatment that received T_1 + 1.1 kg ha^{-1}B through borax as soil application + 0.05% B through boron metalosate as foliar application where as the lowest value of above were recorded in control.

Table 2: Quality parameters of tomato as influenced by different sources and levels of boron

Treatments	Quality parameters		
	TSS (Brix^0)	**Lycopene (mg/kg)**	**Ascorbic acid (mg/100g)**
T_1	3.99	43.25	31.32
T_2	4.03	44.05	33.48
T_3	4.08	45.01	34.66
T_4	4.55	46.50	35.40
T_5	4.57	47.86	37.23
T_6	4.76	48.88	41.20
T_7	4.92	50.06	43.56
T_8	4.69	48.57	39.23
T_9	5.39	51.24	45.23
T10	5.44	54.16	47.26
S. Em ±	0.29	1.71	2.64
CD (5%)	0.86	5.08	7.83

In the present study, the perceptible increase in total soluble solid (Brix), lycopene and ascorbic acid of tomato plant due to metalosate source which is amino acid chelated product, neutral in pH and 100% soluble in water there by enhance the concentration of boron in tissue which resulted in higher translocation of sugar from source to sink there by improvement in quality parameters. Similar findings were reported by Paithankar *et al.*[7], Further, they also reported that boron played an important role in the pigment formation.

Jyolsna *et al*.[4], reported that quality parameters like total soluble solid (Brix), lycopene and ascorbic acid content improved significantly by following boron application. Dube *et al.*[3], opined that ascorbic acid content of fruits improves with borax @ 20 kg ha^{-1}.

CONCLUSION

From the above study it was concluded that application of boron significantly enhances the quality parameters of tomato. The treatment which received NPK+ FYM + 1.1 kg ha^{-1} B through borax as soil application + 0.05% B through boron metalosate as foliar application was recorded significantly higher quality parameters. The study will recommend boron should be applied through soil and foliar to get improved quality fruits.

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