

Original Research Article

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Study on Effect of Plant Growth Regulators and Boron on Fruit Yield Attributes of Tomato (*Solanum lycopersicum* Mill.)

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ABSTRACT

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An experiment Study on effect of Plant Growth Regulators and Boron on Growth, Yield and Quality of Tomato (*Solanum lycopersicum* Mill.) was conducted at Horticultural Research cum Instructional Farm, Barrister Thakur Chhedilal College of Agriculture & Research Station, Bilaspur (C.G.) during Rabi season of 2017-18. The experiment was laid out in Randomized Block Design (RBD) replicated thrice including ten treatments viz., treatments T1 (control), T2 (GA3 @ 50 ppm), T3 (GA3 @ 75 ppm), T4 (NAA @ 75 ppm), T5 (NAA @ 100 ppm) T6 (Boron @ 75 ppm), T7 (GA3 @ 50 ppm + Boron @ 75 ppm), T8 (GA3 @ 75 ppm + Boron @ 75 ppm), T9 (NAA @ 75 ppm + Boron @ 75 ppm) and T10 (NAA @ 100 ppm + Boron @ 75 ppm). The significantly maximum number of fruit per cluster (8.33), maximum number of fruit per plant (26.46), fruit length (7.92 cm), fruit diameter (4.47 cm), fruit weight (56.22 g), average yield per plant (1.69 kg), yield (490.81 q/ha) was recorded in T10(NAA @ 100 ppm + Boron @ 75 ppm).

Introduction

Tomato (*Solanum lycopersicum* MILL.) is one of the most important solanaceous vegetable crop grown throughout the world because of its wider adaptability, high yielding potential and suitability for various uses in fresh as well as processed food industries. In world, it ranks second in importance after potato, but tops in the list of processed vegetables. Tomato being a moderate nutritional crop is considered as good source of potassium, folate, vitamin E, soluble and insoluble dietary fibers, vitamin A, C including calcium and carotene.

Plant growth regulators (PGRs) are used extensively in horticulture to enhance plant growth and improve yield by increasing number of fruits, fruit set and size (Batlang, 2008 and Serrani *et al.*, 2007). Plant growth substances are essential for growth and development of plants. Similarly it plays an important role in flowering, fruit setting, ripening and physiochemical changes during storage of tomato.

In India, tomato is grown on an area of 0.79 million hectare with an annual production of 17.39 million tonnes (Anon. 2015). In Chhattisgarh, tomato is being cultivated in

area of 52.89 thousand hectare and production of 868.60 thousand tonnes with a productivity of 15.89 tonne/ha (Anon. 2015). It is cultivated in almost all districts of Chhattisgarh viz., Raigarh, Durg, Jashpur, Sarguja, Jagdalpur, Bemetra, Balodabazar, Kabirdham, Raipur, Kondagaon, Mungeli, Balod, Bilaspur, Surajpur and Rajnandgaon.

Plant growth regulators and micronutrients are an important part of plants and affect their physiology in several ways. Micronutrients and plant growth regulators together play an important role. They help in both vegetative and reproductive growth and are indispensable for the product of foliage flowers, fruits and seeds.

Materials and Methods

Number of fruits per cluster

The number of fruits per cluster on five tagged plants was recorded under each treatment combination.

Number of fruits per plant

Fruits from all the picking were counted for each selected plants.

Fruit length (cm)

From five selected plants, five fruits were randomly selected and with the help of Vernier calipers the length of fruit, from tip to the base was measured of each fruit, then the mean length was worked out.

Fruit diameter (cm)

Five fruits from the selected plants were selected randomly and with the help of Vernier calipers the fruit diameter, of all fruits was measured respectively. Then the mean breadth was worked out.

Fruit weight

Fruit from the tagged plants were selected randomly, and average weight per fruit was calculated.

Average yield per plant (kg)

The fruits picked in each harvest were weighed and cumulative yield was expressed in kilograms. The values were recorded of five randomly selected plants in a plot and averaged.

Yield (q/ha)

The total yield obtained from the experimental area was expressed in quintals/hectare.

Results and Discussion

Number of fruit per cluster

The data regarding number of fruits per cluster are presented in Table 1. The data on minimum and maximum number of fruit per cluster of tomato ranges from 6.06 to 8.33. The maximum number of fruit per cluster 8.33 was obtained from NAA @ 100 ppm + Boron @ 75 ppm (T₉) which was at par with T₉ (NAA @ 75 ppm + Boron @ 75 ppm) (8.33), T₈ (GA₃ @ 75 ppm + Boron @ 75 ppm) 8.20, T₇ (GA₃ @ 50 ppm + Boron @ 75 ppm) 7.93, T₅ (NAA @ 100 ppm) 7.20, The minimum number of fruit per cluster 6.40 was obtained from control (T₁).

Number of fruit per plant

The data accessible on number of fruits per plant of tomato as influenced by different plant growth regulator and boron spray are presented in Table 2. The number of fruits per plant varied from 14.60 to 26.46. The maximum (26.46) fruits per plant were

recorded at NAA @ 100 ppm + Boron @ 75 ppm (T₁₀), which was at par with T₉ (NAA @ 75 ppm + Boron @ 75 ppm) (25.66), T₈ (GA₃ @ 75 ppm + Boron @ 75 ppm) (25.13), T₇ (GA₃ @ 50 ppm + Boron @ 75 ppm) (24.66), T₅ (NAA @ 100 ppm) 24.06 and T₄ (NAA @ 75 ppm) 23.53, whereas minimum number of fruits per plant 14.60 was obtained from control (T₁).

In case of combine effect of plant growth regulators and boron there was significantly increased in number of fruit per cluster and fruit per plant in tomato plants was because of NAA which had protected the flower and premature fruit drop and increased length of fruit size in tomato plants (Mukharji and Roy, 1966). And also NAA is effective in cell elongation and there by increased cell enlargement, cell division and differentiation which in turn results into increase in number of flowers, fruit size, number of fruits and weight it was also reported by (Rodrigues *et al.*, 2001). Similarly GA₃ spray on tomato plants reduced fruit drop and contributes better number of fruits per cluster in plants. and also GA₃ become more active in presence of extra plant food and hence the number of fruits seems to have increased (Uddain and Hossain, 2009). These findings are in support from the Patel *et al.*, (2012), Ranjeet *et al.*, (2014) and Akand *et al.*, (2015). The Boron application influenced to increase number of flowers, number of inflorescence and number of fruits. Similar findings were reported by Singh *et al.*, (2011) and Shukla *et al.*, (2017)

Fruit length (cm)

The observation on fruit length in tomato was recorded on at harvest and presented in Table 3. The minimum fruit length (4.55 cm) was recorded under the T₁ (control) and the maximum fruit length (7.92 cm) was recorded under the treatment (T₁₀) NAA @ 100 ppm + Boron @ 75 ppm which is followed by T₉

(NAA @ 75 ppm + Boron @ 75 ppm) (7.57 cm), T₈ (GA₃ @ 75 ppm + Boron @ 75 ppm) (7.55 cm) and T₅ (NAA @ 100 ppm) (7.41 cm) and T₇ (GA₃ @ 50 ppm + Boron @ 75 ppm) (7.30 cm).

Fruit diameter (cm)

The result on fruit diameter has been presented in Table 4. The growth regulators, boron and their combined use were found to be significant in increase of fruit diameter. The assessment of data revealed that fruit diameter (cm) ranged from 4.47 (cm) to 7.43 (cm). A maximum fruit diameter of 7.43 cm was reported by NAA @ 100 ppm + Boron @ 75 ppm (T₁₀), which was significantly at par with T₉(NAA @75 ppm + Boron @ 75 ppm) 6.95 cm and T₈(GA₃ @ 75 ppm + Boron @ 75 ppm) 6.55 cm., However the minimum fruit diameter recorded was 4.47 cm under the T₁(control).

Fruit weight

The results on average fruit weight have been presented in Table 5. The data was recorded minimum and maximum weight of tomato ranges from 41.59 g to 56.22 g. A maximum fruit weight of 56.22 g was reported by NAA @ 100 ppm + Boron @ 75 ppm (T₁₀), which is statically at par with T₉ (NAA @ 75 ppm + Boron @ 75 ppm) 55.78 g, T₈ (GA₃ @ 75 ppm + Boron @ 75 ppm) 55.15 g, T₅ (NAA @ 100 ppm) 55.06 g, T₇ (GA₃ @ 50 ppm + Boron @ 75 ppm) 53.29 g, T₄(NAA @ 75 ppm) 52.52 g and T₃ (GA₃ @ 75 ppm) 52.20 g. Minimum fruit weight of 41.59 g was reported in (T₁) control.

Combination of plant growth regulators and boron were significantly influence the fruit length, fruit diameter and fruit weight of tomato. GA₃ might be increased accumulation of carbohydrates owing to greater photosynthesis. Gibberellin also be induce

cell division, cell elongation, cell enlargement and ultimately led to better growth of plants resulted the superior fruit length, fruit diameter and fruit weight of tomato (Choudhary *et al.*, 2004). NAA attributed to the increased supply of photosynthetic materials and efficient mobilization in plants giving rise to increased stimulation of fruit growth ultimately resulting in increased fruit weight, fruit width and fruit length (Bhosle *et*

al., 2002) and (Pundir and Yadav, 2001). On the other hand Boron also needed by the crop plants for cell division, nucleic acid synthesis, uptake of calcium and transport of carbohydrates (Bose and Tripathi 1996), which helped to increase the fruit length, fruit diameter and fruit weight. These results are in close conformity by Meena (2008), Desai *et al.*, (2012), Prasad *et al.*, (2013), Ranjeet *et al.*, (2014) and Verma *et al.*, (2014).

Table.1 Effect of plant growth regulator and boron on number of fruit per cluster of tomato

Treatment	Treatment details	Fruit per cluster
T ₁	Control	6.40
T ₂	GA ₃ @ 50 ppm	6.46
T ₃	GA ₃ @ 75 ppm	6.60
T ₄	NAA @ 75 ppm	7.13
T ₅	NAA @ 100 ppm	7.20
T ₆	Boron @ 75 ppm	6.40
T ₇	GA ₃ @ 50 ppm + Boron @ 75 ppm	7.93
T ₈	GA ₃ @ 75 ppm + Boron @ 75 ppm	8.20
T ₉	NAA @ 75 ppm + Boron @ 75 ppm	8.31
T ₁₀	NAA @ 100 ppm + Boron @ 75 ppm	8.33
SEm±		0.42
CD (P=0.05)		1.26

Table.2 Effect of plant growth regulator and Boron on number of fruit per plant of tomato

Treatment	Treatment details	No. of fruit per plant
T ₁	Control	14.60
T ₂	GA ₃ @ 50 ppm	18.86
T ₃	GA ₃ @ 75 ppm	19.80
T ₄	NAA @ 75 ppm	23.53
T ₅	NAA @ 100 ppm	24.06
T ₆	Boron @ 75 ppm	16.46
T ₇	GA ₃ @ 50 ppm + Boron @ 75 ppm	24.66
T ₈	GA ₃ @ 75 ppm + Boron @ 75 ppm	25.13
T ₉	NAA @ 75 ppm + Boron @ 75 ppm	25.66
T ₁₀	NAA @ 100 ppm + Boron @ 75 ppm	26.46
SEm±		1.78
CD (P=0.05)		5.28

Table.3 Effect of plant growth regulator and boron on fruit length of tomato

Treatment	Treatment details	Fruit length (cm)
T ₁	Control	4.55
T ₂	GA ₃ @ 50 ppm	6.45
T ₃	GA ₃ @ 75 ppm	6.56
T ₄	NAA @ 75 ppm	7.20
T ₅	NAA @ 100 ppm	7.41
T ₆	Boron @ 75 ppm	5.83
T ₇	GA ₃ @ 50 ppm + Boron @ 75 ppm	7.30
T ₈	GA ₃ @ 75 ppm + Boron @ 75 ppm	7.55
T ₉	NAA @ 75 ppm + Boron @ 75 ppm	7.57
T ₁₀	NAA @ 100 ppm + Boron @ 75 ppm	7.92
SEm±		0.22
CD (P=0.05)		0.67

Table.4 Effect of plant growth regulator and boron on fruit diameter (cm) of tomato

Treatment	Treatment details	Fruit diameter (cm)
T ₁	Control	4.47
T ₂	GA ₃ @ 50 ppm	5.33
T ₃	GA ₃ @ 75 ppm	5.71
T ₄	NAA @ 75 ppm	5.79
T ₅	NAA @ 100 ppm	6.38
T ₆	Boron @ 75 ppm	5.10
T ₇	GA ₃ @ 50 ppm + Boron @ 75 ppm	5.87
T ₈	GA ₃ @ 75 ppm + Boron @ 75 ppm	6.55
T ₉	NAA @ 75 ppm + Boron @ 75 ppm	6.95
T ₁₀	NAA @ 100 ppm + Boron @ 75 ppm	7.43
SEm±		0.33
CD (P=0.05)		0.98

Table.5 Effect of plant growth regulator and boron on fruit weight of tomato

Treatment	Treatment details	Fruit weight (g)
T ₁	Control	41.59
T ₂	GA ₃ @ 50 ppm	46.86
T ₃	GA ₃ @ 75 ppm	52.20
T ₄	NAA @ 75 ppm	52.52
T ₅	NAA @ 100 ppm	55.06
T ₆	Boron @ 75 ppm	42.36
T ₇	GA ₃ @ 50 ppm + Boron @ 75 ppm	53.29
T ₈	GA ₃ @ 75 ppm + Boron @ 75 ppm	55.15
T ₉	NAA @ 75 ppm + Boron @ 75 ppm	55.78
T ₁₀	NAA @ 100 ppm + Boron @ 75 ppm	56.22
SEm±		2.82
CD (P=0.05)		8.38

Table.6 Effect of plant growth regulator and boron on average yield per plant of tomato

Treatment	Treatment details	Average yield per plant (kg)
T ₁	Control	0.62
T ₂	GA ₃ @ 50 ppm	1.03
T ₃	GA ₃ @ 75 ppm	1.24
T ₄	NAA @ 75 ppm	1.30
T ₅	NAA @ 100 ppm	1.37
T ₆	Boron @ 75 ppm	0.88
T ₇	GA ₃ @ 50 ppm + Boron @ 75 ppm	1.33
T ₈	GA ₃ @ 75 ppm + Boron @ 75 ppm	1.42
T ₉	NAA @ 75 ppm + Boron @ 75 ppm	1.49
T ₁₀	NAA @ 100 ppm + Boron @ 75 ppm	1.69
SEm±		0.07
CD (P=0.05)		0.21

Table.7 Effect of plant growth regulator and boron on average yield (q/ha) of tomato

Treatment	Treatment details	yield (q/ha)
T ₁	Control	203.09
T ₂	GA ₃ @ 50 ppm	286.55
T ₃	GA ₃ @ 75 ppm	338.43
T ₄	NAA @ 75 ppm	404.52
T ₅	NAA @ 100 ppm	440.52
T ₆	Boron @ 75 ppm	226.15
T ₇	GA ₃ @ 50 ppm + Boron @ 75 ppm	431.53
T ₈	GA ₃ @ 75 ppm + Boron @ 75 ppm	457.96
T ₉	NAA @ 75 ppm + Boron @ 75 ppm	470.33
T ₁₀	NAA @ 100 ppm + Boron @ 75 ppm	490.81
SEm±		22.79
CD (P=0.05)		67.74

Average yield per plant

The result on yield per plant has been presented in the Table 6. Maximum yield 1.69 kg per plant was obtained with NAA @ 100 ppm + Boron @ 75 ppm (T₁₀) and lowest yield 0.62 kg per plant was obtained with control (T₁).

Yield (q/ha)

The result on yield per hectare has been presented in the Table 7. The maximum yield

490.81 q/ha was obtained by NAA @ 100 ppm + Boron @ 75 ppm (T₁₀), which was at par with T₉ (NAA @ 75 ppm + Boron @ 75 ppm) 470.33 q/ha, T₈ (GA₃ @ 75 ppm + Boron @ 75 ppm) 457.96 q/ha, T₅ (NAA @ 100 ppm) 440.52 q/ha and T₇ (GA₃ @ 50 ppm + Boron @ 75 ppm) 431.53 q/ha. And the lowest yield 203.09 q/ha was obtained with control (T₁).

The yield was significantly affected by plant growth regulators and Boron. The increased

in yield was attributed might be due to enhanced the plant growth and faster rate of the plant development by the action of NAA in the cell elongation, cell division and cell differentiation which in turn result into increase in number of flowers, fruit set, size and weight of fruit. Similar increase in yield had also been reported by Raj *et al.*, (2012), Nibhavanti *et al.*, (2004) and Singh and Sant (2005.)

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