

## Original Research Article

### **Optimization of Boron and Zinc on the growth and yield parameters of tomato in Nalanda district.**

#### **ABSTRACT:-**

The field experiment ~~wasis~~ carried out to overcome the poor growth and yield of tomato due to imbalance use of fertilizer and micronutrient deficiency. The ~~main~~ objective to conduct this experiment ~~wasis~~ soil application of micronutrients alongwith nitrogen, phosphorus and potash for growth and yield enhancement. ~~After soil testing of experimental plot we applied the different doses of micronutrients and we recorded the results on various parameters such as-~~The maximum ~~90.39 cm~~ plant height ~~90.39 cm~~, the highest ~~14.38~~ number of branches ~~14.38~~, the maximum ~~29.50~~ number of fruits per plant ~~29.50~~, highest fruit weight per plant 2.46 kg per plant with yield of 518.25 quintal per hectare in case of technology option three application of ~~N:P:K~~, 120.80.80 kg ~~N:P:K~~/ha<sup>1</sup> alongwith 10kg zinc and 1 kg boron per hectare as basal dose in comparison to other treatments. ~~We recoded lesser-~~The lowest ~~80.45 cm~~ plant height, ~~80.45 cm~~, least number of branches per plant 8.13, lesser number of fruit per plant 24.13, least fruit weight 2.18 kg per plant with minimum yield of 450.50 quintal per hectare.

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**Key Words:** Nitrogen, ~~p~~Phosphorus, ~~p~~Potash, ~~z~~Zinc, ~~b~~Boron, ~~f~~Tomato, ~~g~~Growth, ~~y~~Yield

#### **INTRODUCTION:**

Tomato (*Solanum lycopersicum* L.) is the second most important vegetable crop next to potato (*Solanum tuberosum* L.) belongs to the family Solanaceae. The approx production was 182.3 million tonnes of tomato fruit from 4.85 million hectare each year (FAOSTAT,2019)[1]. Asia contributes about 61.1% of global tomato production. The major tomato consuming countries are India, China, North Africa, The middle east, The US and Brazil with consumption of 61.9 to 198.9 kg per capita (FAOSTAT 2019) [1]. Bihar contributes 5.28 % with production of 964 thousand tonnes in overall production of the country(Source:State directorate of horticulture). Tomato is rich in nutritional value due to various bioactive compounds, vitamins, carotenoids and phenolic compounds (Liu et al.,2016[2-4]; Marti et al.,2016[3]; Li et al.,2018b[4]). It is rich source of lycopene in daily diet of human being (Viuda-Martos et al.,2014[5]). It also have the naturally occurring antioxidants, vitamin C and E, large amounts of metabolites such as sucrose, hexoses, citrate,malate and ascorbic acid (Agarwal and Rao 2000[3, 4,6],Marti et al.,2016[3] and Li et al.,2018b[4]). The demand of tomato consumption is increasing day by day to its raw use and in various products such as soups,ketch up,sauce, marmalade,chutney and juice etc.It is used extensively in canning industry for canned products. It is consumed to meet the requirement of vitamin A,B, and C, carotenoids, lycopene and minerals (calcium) up to some extent due to its good nutritional value (Bose and Sen,1990[7, 8]; Rashid,1983[8]). It is also used as flavouring agent.

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The fruit quality of tomato is affected by various factors such as plant growing conditions, scarcity of water resources, soil salinization and abiotic stresses(Diouf et al.,2018[9-12],Fahad et al.,2017[10];

[Charbi et al.,2017\[11\]](#); [Zhou et al.,2019\[12\]](#)). Boron is an important element to enhance the yield and quality of tomato. It affects directly and indirectly in improving quality and enhancing yield by checking various types of physiological disorders and different types of diseases ([Magalhaes et al.,1980](#)[13]). It affects various parameters in terms of quality like shape and size,color,firmness,smoothness, shelf life and chemical composition. The same results was also reported by [Demoranville and Deubert \(1987\)](#) [14] in case of boron deficiency in tomato.It also influence vegetative growth like higher vegetative growth, synthesis of pectin ,imbalance in water relation in plant,affects metabolism of protein, resynthesis of adenosine triphosphate(ATP) and affects translocation of sugar at flowering and fruiting stages([Bose and Tripathi,1996](#)[15]).Boron plays an important role in various plant functions and maintaing quality of produce such as hormone movement in plants, active absorption of salt, fruit set and flowering process in plants,pollen germination, metabolism of nitrogen and carbohydrates etc. It deficiency leads to lesser growth of roots, brittle leaves and necrotic spots on shoot apex. As per findings of [Naresh \(2002\)](#) [16] the quality parameters of tomato is affected by boron application. It improves overall growth and development of crop.

Zinc is also an another important micronutrient for increasing dry biomass ,fruit yield, number of fruits and fresh weight of fruits as per findings of [Curmani et al.,\(2012\)](#) [17].The other basic function of zinc in plants are metabolism of proteins ,phosphates and carbohydrates and also synthesis of auxins, RNA and ribosome formations as per findings of [Shkolnik,\(1974\)](#) [18].

## MATERIALS AND METHODES

### **SOIL PROPERTIES OF THE DISTRICT AND INITIAL AND FINAL VALUE OF SOIL PROPERTIES OF FARMERS FIELD:**

The initial value of soil properties of the experimental plot(farmers field) varies in the range of pH from 7.08 to 7.33, EC 0.018 to 0.038 deci simon per meter, organic carbon 0.543 to 0.620%, available nitrogen 236 to 259 kg/ha, available phosphorous 24.25 to 34.40 kg/ha<sup>-1</sup> available potassium 144 to 196 kg/ha<sup>-1</sup>, available Zinc 0.613 to 0.815 mg/kg<sup>-1</sup> and available boron 0.363 to 0.519 mg/kg<sup>-1</sup>.

The post harvest soil properties of experimental plot(farmers field) as per table no 1 shows that effect of soil application of zinc and boron on available soil nutrients in tomato. The organic carbon ,available nitrogen, available pottasium, available zinc and available boron shows significant increase over farmers practice and ph, available phosphorus shows non significant increse over the farmer practices. The highest boron and zinc was recorded in technology option two(farmers practice,N:P:K @ 120:80:80 kg/ha and 5kg zinc plus 2 kg boron per hectare as basal dose).

## MATERIALS AND METHODES:

This on farm trial was conducted on eight farmers field in different villages of Nalanda distric for improving growth, enhancing yield and productivity of tomato. The design used for this experiment are randomized block design. The soil samples from different farmers plots were collected and tested for pH by 1:2 soil water suspension through pH meter,EC by 1:2 soil water suspension through EC meter, organic carbon

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by [wet digestion method](#), [Walkley and black method](#), Available N by (Subbiah and Asija [method](#) 1956), Available P by Olsen's method, Available K by ammonium acetate method, available Zn by DTPA extraction method and available Boron by azomethine-H method after selection of plot for experiment. The analysed result of soil properties is mentioned in soil details. After raising of tomato seedlings the twenty five days old seedlings were transplanted in the field with application of N:P:K @ 120:80:80 kg/ha<sup>1</sup> in farmers practice. In technology option one we applied zinc 5kg/ha and one kg boron/ha, in technology option two zinc 10 kg/ha and boron 1kg/ha and in technology option three zinc 5kg/ha and boron 2kg/ha as basal dose in addition to farmers practice. The gap filling was done after 10 to 12 days in case seedling damage. After transplanting data on different parameters are recorded at regular interval such as Plant height (cm), number of branches per plant, number of fruits per plant, fruit weight per plant (kg) and yield (Q/ha). After completion of harvesting the sampling of different experimental plots were done. The results of soil testing is mentioned in table number 1.

**Comment [T1]:** Walkley and Black, 1934

**Comment [T2]:** ???

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Table no-1. Effect of boron and zinc on post-harvest soil properties of experimental field plot (farmers field)

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Technology option	pH	EC(ds/m)	Avalible nutrients(kg/ha)			Avalible micronutrients (mg/kg)	
			N	P2O5	K2O	Zn	B
Farmers practice	7.22	0.563	254	27.13	159.6	0.668	0.439
TO-1	7.21	0.566	260	28.40	165.9	0.832	0.442
TO-2	7.20	0.567	262	28.65	167.9	0.765	0.465
TO-3	7.18	0.571	266	29.28	171.0	0.793	0.473
SEm+-	0.02	0.002	2.25	0.58	2.65	0.004	0.008
C.D(P=0.05)	NS	0.006	6.78	NS	7.96	0.011	0.024

**NS=**

**Graphical representation of table no.1**

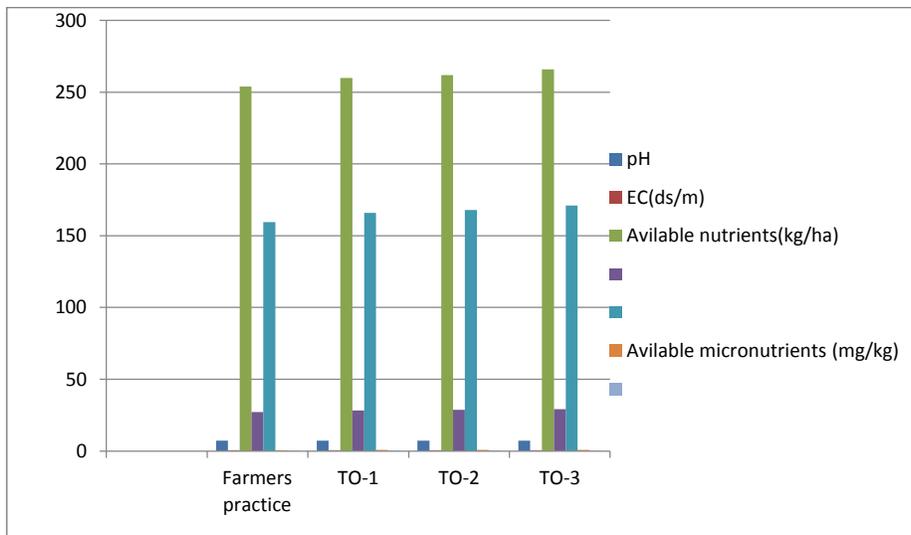


Figure 1.

## RESULTS AND DISCUSSION:

This experiment was conducted to overcome the problem of poor growth and lesser yield of tomato due to imbalance use of manures, fertilizers and micronutrient deficiency in soil. We recorded following observations at regular intervals such as The maximum 90.39 cm plant height 90.39 cm, the highest 14.38 number of branches 14.38, higher 29.50 number of fruits per plant 29.50, the maximum 2.46 kg average weight of fruit per plant 2.46 kg and maximum 518.25 quintal per hectare yield 518.25 quintal per hectare was recorded in case of application of N:P:K @120:80:80 kg N:P:K /ha<sup>1</sup>, zinc 10kg /ha<sup>1</sup> and boron 1kg /ha<sup>1</sup> as compared to other treatments. The lowest 80.45 cm plant height 80.45 cm, least number of branches 8.13, lesser number of fruits per plant 24.13, least average fruit weight 2.18 kg/plant<sup>1</sup> and minimum yield 450.50 q/ha<sup>1</sup> was recorded in case of technology option one (farmers practice) as per Table no. 2.

As per findings of Pandav et al. (2016) [19-21], Acharya et al. (2015) [20] and Sliman et al. (1999) [21] the higher plant height, maximum average fruit weight, number of fruits per plant and highest yield was recorded in case of boron and zinc application in soil. As per report of Gogoi et al. (2014) [22,23] and Raj et al. (2001) [23] the positive effect of micronutrient (zinc) on higher number of fruit set and increasing the weight of brinjal in case of increasing the level of zinc. As per findings of Ume kalsan Afridi (2015) [24] the increase in fruit yield and fruits per cluster was recorded in case of 0.2%, 0.5% zinc sulphate application.

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The increase in number of fruits per plant, fruit weight and total yield in brinjal crop was also reported by [Bhuvaneshwari et.al.\(2020\)](#) [25] in case of soil application of zinc. The similar result was also found by [Solanki et.al.\(2017\)](#) [26]. The combined application of boron and zinc leads to increase in plant height in tomato was reported by [Bose and Tripathi\(1996\)](#) [15,27, 28], [Verma et.al.\(1973\)](#) [27] and [Padma et. al.\(1989\)](#) [28] also reported increase in number of leaves in tomato and french bean by application of boron. [Ingle et.al.\(1993\)](#) [29] also reported increase in plant height by combined application of boron and zinc.

Table no-2, Effect of boron and zinc on growth and yield of tomato.

Treatments	Plant height(cm)	Number of brances per plant	Number of fruits per plant	Fruit weight per plant(kg)	Yield (Q/ha <sup>-1</sup> )
TO-1(Farmers practice,120:80:80 kg/ha)	80.45	8.13	24.13	2.18	450.50
TO-2(Farmers practice+5 kg zinc+1kg boron/ha as basal dose)	83.40	10.88	26.25	2.24	491.13
TO-3(Farmers practice+10 kg zinc+1kg boron/ha as basal dose)	90.39	14.38	29.50	2.46	518.25
TO-4(Farmers practice+5 kg zinc+2kg boron/ha as basal dose)	86.38	12.00	27.13	2.33	497.88
SE(d)	0.335	0.222	0.747	0.077	8.183
Cd	0.693	0.458	1.542	0.160	16.889

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Graphical representation of table no.2

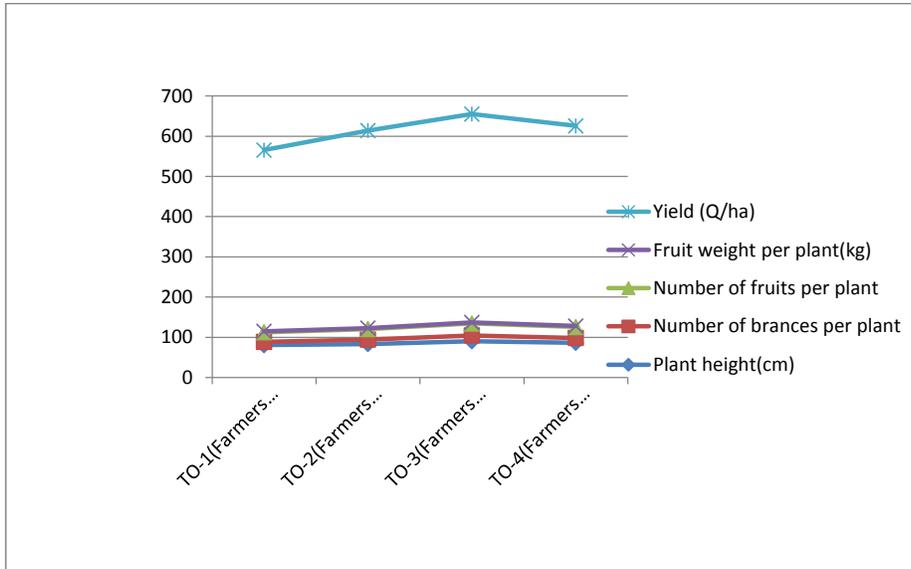


Figure 2.

#### CONCLUSION:

We can conclude that The micronutrients plays an important role in plant growth and yield of crop. Application of we must apply micronutrients along with macronutrients for better growth and yield of the crop. Micronutrients are such type of nutrients that are required in trace amount. If deficiency of micronutrients occurs plants show deficiency symptoms and various types of physiological disorders in it. We got The maximum 518.25 quintal per hectare yield 518.25 quintal per hectare with highest 90.39 cm plant height 90.39 cm and more number of branches 14.38 was recorded in case of application of N:P:K, 120:80:80 kg N:P:K /ha<sup>-1</sup> with 10 kg zinc and 1 kg boron per hectare as basal dose.

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