

Original Research Article

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

Comment [f1]: Include Nutrient Symbol for Boron (B) and Zinc (Zn)

Comment [f2]: Include Tomato Scientific name in bracket

Comment [f3]: Include State Name and Country Name

ABSTRACT:-

The field experiment is 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 is 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 maximum plant height 90.39 cm, the heighest number of branches 14.38, the maximum number of fruits per plant 29.50, heighest fruir weight per plant 2.46 kg per plant with yield of 518.25 quintal per heactare in case of technology option three application of N:P:K, 120.80.80 kg/ha alongwith 10kg zinc and 1 kg boron per hectare as basal dose in comparision to other treatments. We recoded lesser 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 kgper plant with minimum yield of 450.50 quintal per hectare.

Comment [f4]: Delete the word

Comment [f5]: Mention the treatments

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Key Words: Nitrogen, Phosphorus, Potash, Zinc, Boron, Tomato, Growth, 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]; 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 occuring antioxidants, vitamin C and E, large amounts of metabolites such as sucrose, hexoses, citrate,malate and ascorbic acid (Agarwal and Rao 2000[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 Som,1990[7]; Rashid,1983[8]). It is also used as flavouring agent.

The fruit quality of tomato is affected by various factores such as plant growing conditions, scarcity of water resources, soil salinization and abiotic stresses(Diouf et al.,2018[9],Fahad et al.,2017[10]; Gharbi 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 difficiency 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 maintaining 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. Its 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 another important micronutrient for increasing dry biomass, fruit yield, number of fruits and fresh weight of fruits as per findings of Gurmani 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].

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

Comment [f7]: Mention the District Name

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 available potassium 144 to 196kg/ha, available Zinc 0.613 to 0.815 mg/kg and available boron 0.363 to 0.519 mg/kg.

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 potassium, available zinc and available boron shows significant increase over farmers practice and pH, available phosphorus shows non significant increase 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:

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This on farm trial was conducted on eight farmers field in different villages of Nalanda district for improving growth, enhancing yield and productivity. 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 by 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 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

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Comment [f10]: Mention the Table Number were soil details included

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.

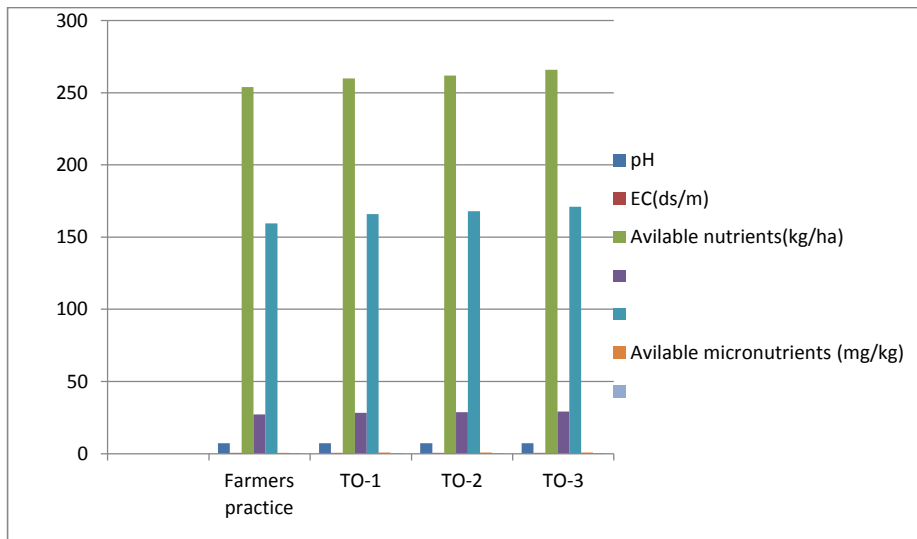
Table no-1, Effect of boron and zinc on post-harvest soil properties of experimental plot(farmers field)

Technology option	pH	EC(ds/m)	Avilable nutrients(kg/ha)			Avilable 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

Comment [f11]: Explain the presented table in 3 to 4 lines, Highlight the titles in the table, while writing chemical name of Nutrients maintain the suffixes.

Graphical representation of table no.1

Comment [f12]: The graph is not clear and upto the mark, some of the components is missing, change the graph style, scale and include all the components as shown in table.



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 maximum plant height 90.39 cm, highest number of branches 14.38, higher number of fruits per plant 29.50, the maximum average weight of fruit per plant 2.46 kg and maximum yield 518.25 quintal per hectare was recorded in case of application of N:P:K @120:80:80 kg/ha, zinc 10kg/ha and boron 1kg/ha as compared to other treatments. The lowest 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 and minimum yield 450.50 q/ha was recorded in case of technology option one(farmers practice) as per table no 2.

As per findings of Pandav et.al.(2016) [19], 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] 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 kalson Afridi (2015) [24] the increase in fruit yield and fruits per cluster was recorded in case of 0.2%, 0.5% zinc sulphate application. 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]. 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.

Comment [f13]: Correct the spelling

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

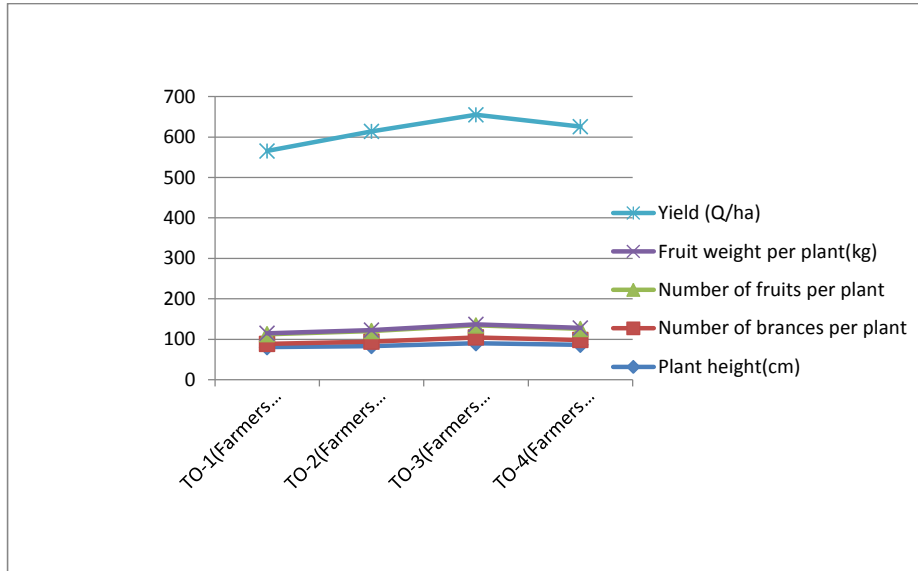
Treatments	Plant height(cm)	Number of brances per plant	Number of fruits per plant	Fruit weight per plant(kg)	Yield (Q/ha)
TO-1(Farmers practice,120:80:80 kg/ha)	80.45	8.13	24.13	2.18	450.50
TO-2(Farmers practice+5 kg zinc+1kg boron/ha as basal dose)	83.40	10.88	26.25	2.24	491.13
TO-3(Farmers practice+10 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

Comment [f14]: At table No. 1 you mentioned Farmers practice with NPK as first and remaining farmers practice as Technology Option 1,2 & 3. Here in table No. 2 you mentioned all the farmer practices as Technology Option 1,2,3 & 4. Kindly maintain and follow the same titles for the treatment throughout the paper for better understanding. Highlight the titles of table.

Explain this table clearly in 3 parts as follows.
1. Compare the results between TO3 & TO1.
2. Compare the results among TO2, TO3 & TO4
3. Overall comparison Highest and lowest

Graphical representation of table no.2

Comment [f15]: The graph is not clear and upto the mark, components shown are not clearly visible, change the graph style, scale and include all the components as shown in table.



CONCLUSION:

We can conclude that micronutrients plays an important role in plant growth and yield of crop. we must apply micronutrients alongwith 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 shows deficiency symptom and various types of physiological disorder in it. We got maximum yield 518.25 quintal per hectare with highest 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/ha with 10kg zinc and 1 kg boron per hectare as basal dose.

Comment [f16]: Correct the spelling

Comment [f17]:

Comment [f18]: Correct the spelling

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