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Effect of micronutrients and biofertilizers growth on yield and yield attributes character of tomato

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Abstract

The maximum number of flowers per cluster, number of fruits per cluster and percentage of fruit set was highest in T₇ (Mixture of all). T₁₀ (Azotobacter + Azospirillum @ 1 kg/ha each as seedling treatment) recorded highest number of flowers per cluster and number of fruits per cluster. While percentage of fruit set did not vary significantly due to biofertilizers. Maximum fruit diameter, fruit length, fruit weight and number of fruits per plant were observed for T₇ (Mixture of all) amongst treatments of micronutrients. Maximum fruit diameter, fruit length, and fruit weight was highest in T₁₀ (Azotobacter + Azospirillum @ 1 kg/ha each as seedling treatment) whereas number fruits per plant were higher in T₈ (Azotobacter @ 1 kg/ha as seedling treatment) amongst treatments of biofertilizers. T₇ (Mixture of all) recorded the highest yield per plant and yield q/ha followed by T₆ (Manganese sulphate (Mn) @ 100 ppm as foliar spray) and T₅ (Ferrus sulphate (Fe) @ 100 ppm as foliar spray). Yield per plant and yield q/ha did not vary significantly due to biofertilizers.

Keywords: Yield, yield attributes, biofertilizers, micronutrients

Introduction

High yield is the ultimate goal in all crops with good qualities and tomato is no exception. Among the various yield increasing factor i.e. variety, time of planting, use of major and minor nutrient, the use of trace elements seems worthwhile to study in connection with tomato cultivation. The micronutrients play an important role as that of major nutrients for increasing production and quality of tomato. The production and productivity of tomato is being adversely affected in different areas due to deficiencies of micronutrients.

The deficiencies of trace elements i.e. zinc, manganese, iron, boron, molybdenum and copper may be prove to be limiting in production of tomato. The method of application of fertilizer is one of the basic factor for getting maximum yield potential. In recent advances in improved agriculture techniques, the foliar application of fertilizer plays a vital role in improving the quantity and quality of horticultural crops especially in tomato crop. Micronutrients are required in minute quantity for increasing growth, yield and quality of tomato, when micronutrients are applied in the field the required quantity of nutrients are utilized by the plants and remaining quantity is fixed in the soil. To over come this problem the foliar application of Micronutrients is one of the efficient method to provide the desired elements in standing crop. The method of foliar spray of Micronutrients is quick and efficient and required less time for assimilation. The foliar sprays are convenient and require less quantity of elements than that of soil application and cheapest method of fertilizer application Zenlorekuzi and Minami (1984) reported that foliar application of micronutrients (Cu, Mn and B) had advantageous effects than soil application.

Fertilizer application also plays a major role for harnessing optimum yields per unit area in tomato crop. At present, chemical fertilizers are in short supply and expensive too. Although these fertilizers contribute a lot in fulfilling the nutrient requirement of tomato but their regular, excessive and unbalanced use may lead to health and ecological hazards, deterioration of physico-chemical properties of the soil and ultimately poor crop yields. The problem of the nutrient drain from the soil is becoming so acute and is beyond the capacity of any single fertilizer to accept the challenge of appropriate nutrient supply. There is a need to enhance the yield without having adverse effects on soil properties. Hence, the present studies were undertaken to judge the effect of Azotobacter and Azospirillum on plant growth, yield and quality of tomato. Carrier based inoculants are used as seedling dipping in Azotobacter and Azospirillum.

Material and Method

The experiment was conducted to study the effect of Micronutrients and Biofertilizers on yield and yield attributes in Tomato (*Lycopersicon esculentum* Mill.) variety "JT-99" on farmers field of Panagar, Jabalpur (M.P.). During rabi season 2008-09 and 2009-10. Soil

analysis was done to know the present status of micronutrients of the experimental area. The experiment was laid out in randomized block design with eleven treatments including control replicated three times.

The details of treatments are given below:

Table 1: Details of the treatments

S. No.	Symbol	Treatments
1.	T ₀	Control
2.	T ₁	Boric acid (B) @ 100 ppm as foliar spray
3.	T ₂	Zinc sulphate (Zn) @ 100 ppm as foliar spray
4.	T ₃	Ammonium molybdate (Mo) @ 50 ppm as foliar spray
5.	T ₄	Copper sulphate (Cu) @ 100 ppm as foliar spray
6.	T ₅	Ferrus sulphate (Fe) @ 100 ppm as foliar spray
7.	T ₆	Manganese sulphate (Mn) @ 100 ppm as foliar spray
8.	T ₇	Mixture of all
9.	T ₈	Azotobacter @ 1 kg/ha as seedling treatment
10.	T ₉	Azospirillum @ 1 kg/ha as seedling treatment
11.	T ₁₀	Azotobacter + Azospirillum @ 1 kg/ha each as seedling treatment

At the time of field preparation farm yard manure was applied @ 200 quintal/ha before second harrowing. N: P: K was applied @ 120 kg N₂, 60 kg P₂O₅ and 60 kg K₂O per hectare. Phosphorus and potash were given as basal dose at the time of planting, whereas, half of the nitrogen was applied as basal dose and remaining half quantity in two split doses at 25 days and 50 days after transplanting. 100gm of biofertilizers dissolved in one liter of water and root was dipped for 15 minutes. The seedlings root were dipped before transplanting in both biofertilizer Azotobacter and Azospirillum separately as @ 1 kg/ha and in mixture of both biofertilizers (Azotobacter + Azospirillum) ½ parts of both biofertilizer were collected in separate open pan. Plant protection measures were adopted as per recommendation. Three sprays of micronutrient were given at an interval of 10 days starting from 30 days after transplanting. In control no micronutrient and biofertilizers was applied. The observation recorded were flowers per cluster, fruits per cluster, percentage of fruit set, fruit diameter, fruit length, fruit weight, fruits per plant, fruit yield per plant, and fruit yield per hectare.

Result and Discussion

It was observed that the application of micronutrients resulted not only in better vegetative growth but also exhibited higher number of flowers per cluster, number of fruits per cluster and percentage of fruit set. It is obvious from the data presented in Table 5.3 that all the micronutrients possessed higher number of flowers per

cluster, number of fruits per cluster and percentage of fruit set as compared to control.

Data presented in Table elucidates that T₇ had highest number of flowers per cluster (5.33) followed by T₆ (5.19) whereas it was lowest in T₀ (4.27). Amongst the micronutrients the minimum effect of copper was noticed on this trait (4.85) followed by boron (4.90) which were at par. Zinc and iron also had almost similar effect on this trait (5.04 and 5.05 respectively) while molybdenum proved better (5.11) than zinc and iron.

As regards the number of fruits per cluster T₇ (4.06) was found to be significantly superior to all other treatments. T₃ (3.60), T₅ (3.61) and T₆ were found at par with each other but better than T₁ (3.25), T₂ (3.44) and T₄ (3.27). On the other hand in control only 2.77 fruits per cluster were noted. In respect to percentage of fruit set it was recorded that T₇ gave the highest percentage of fruit set (76.26%) followed by T₅ (71.46%) and T₃ (70.33%). However amongst the micronutrients minimum percentage of fruit set was observed in T₁ (66.31%) followed by T₄ (67.37%), T₂ (68.31%) and T₆ (68.87%). Although all the treatments exhibited greater percentage of fruit set as compared to control.

Increase in flowers per cluster, number of fruits per cluster and percentage of fruit set may be probably because of role of boron and zinc which they play in flowering. Boron increases RNA and DNA contents in reproductive tissues. The pollen germinates properly which leads to fruit setting.

Table 2: Effect of micronutrients and biofertilizers on yield and yield attributes of tomato

Treatments	Flowers/cluster	Fruits/cluster	% of fruit set	Fruit diameter (cm)	Fruit length (cm)	Fruit weight (g)	No. of fruits/plant	Yield /plant (Kg)	Yield (q/ha)
T ₀ Control	4.27	2.77	65.03	4.40	4.31	41.78	16.01	0.98	209.82
T ₁ Boric acid (B) @ 100 ppm as foliar spray	4.90	3.25	66.31	5.01	5.05	51.55	20.10	1.23	257.39
T ₂ Zinc sulphate (Zn) @ 100 ppm as foliar spray	5.04	3.44	68.31	4.67	4.96	52.47	19.90	1.13	220.84
T ₃ Ammonium molybdate (Mo) @ 50 ppm as foliar spray	5.11	3.60	70.33	4.98	5.08	54.47	20.95	1.20	242.29
T ₄ Copper sulphate (Cu) @ 100 ppm as foliar spray	4.85	3.27	67.37	5.04	5.00	58.25	20.90	1.22	250.55
T ₅ Ferrus sulphate (Fe) @ 100 ppm as foliar spray	5.05	3.61	71.46	5.06	5.23	51.29	21.48	1.29	270.58
T ₆ Manganese sulphate (Mn) @ 100 ppm as foliar spray	5.19	3.58	68.87	5.26	5.22	45.08	20.25	1.32	272.73
T ₇ Mixture of all	5.33	4.06	76.26	6.21	6.28	67.62	24.66	1.43	288.77
T ₈ Azotobacter @ 1 kg/ha as seedling treatment	4.79	3.39	70.95	5.48	5.13	52.03	22.18	1.28	274.11
T ₉ Azospirillum @ 1 kg/ha as seedling treatment	4.77	3.38	70.82	5.46	5.26	53.18	21.48	1.27	275.96
T ₁₀ Azotobacter + Azospirillum @ 1 kg/ha each as seedling treatment	5.02	3.54	70.69	5.72	5.71	54.70	21.93	1.24	275.50
SEm±	0.02	0.03	0.66	0.07	0.06	0.17	0.74	0.01	1.19
C.D. 5%	0.06	0.10	1.97	0.21	0.19	0.53	0.25	0.05	3.54

Dhanasekaran and bhuvanewari (2005) ^[3] found highest number of flowers per cluster and highest fruit set with combined application of humic acid, NAA and micronutrient mixture. The respective maximum and minimum number of flowers per cluster was noted in T₁₀ (5.02) and control (4.27). T₈ (4.79) and T₉ (4.77) were found at par regarding this trait. Similarly number of fruits per cluster were also recorded highest in T₁₀ (3.4) followed by T₈ (3.39) and T₉ (3.38), whereas under control 2.77 fruits per cluster were observed. All treatments of biofertilizers did not exhibit any differences amongst them for percentage of fruit set, although effect of biofertilizers was found significant over control. Application of Azotobacter + Azospirillum increases the microbial activity in root zone which ultimately enhances the nutrient uptake better nitrogen fixation and results in better root system development and possible synthesis of plant growth hormones. Thus better development of plant and phenological parameters takes place. Similar findings of biofertilizers on phenological characters have also been reported by Sudhakar and Purushottam (2008) ^[8].

A perusal of data clearly indicates that T₇ exhibited maximum fruit diameter (6.21 cm) followed by T₆ (5.26 cm). T₅ and T₆ were at par. On the other hand the lowest fruit diameter was exhibited by control (4.40 cm) followed by T₂ (4.67 cm) and T₃ (4.98 cm). Similarly fruit length was also highest in T₇ (6.28 cm) followed by T₅ (5.23 cm) and T₆ (5.22 cm) which was significantly maximum than recorded in control (4.31 cm). All the micronutrients had significant effect on fruit weight. The maximum fruit weight was noticed under T₇ (67.62 g) followed by T₄ (58.25 g) and T₃ (54.47 g). T₆ exhibited the minimum effect (45.08 g) followed by T₅ (51.29 g) and T₂ (51.55 g). Similar to the fruit weight maximum number of fruits per plant were also noted for T₇ (24.66) followed by T₅ (21.48), T₃ (20.95) and T₄ (20.90) had almost similar effect on fruits per plant. The minimum effect T₂ (19.90) was noticed on this attribute. T₁ (20.10) and T₆ (20.25) were also found to be at par but had more number of fruits per plant than control and T₂.

In present investigation maximum fruit diameter, fruit length and fruit weight was found in T₇ i.e. mixture of all micronutrients which is probably because boron along with other micronutrients not only affect the formation and accumulation of different fraction of carbohydrate but also affect the normal physiological and metabolic process of the plant. Combination of micronutrients particularly boron increase the level of sugar on stigma of flower which helped in fruit set due to the better pollen germination and pollen tube growth. These results are in agreement with the findings of Tanaka *et al.* (2003), Dhanasekaran and Bhuvanewari (2005) ^[3].

Effect of micronutrients on yield per plant is obvious from the data presented in Table 5.4. As noticed for yield attributes T₇ had maximum effect on yield per plant also (1.43 Kg) and proved to be significantly superior to other treatments of micronutrients. T₆ (1.32 Kg) ranked second for yield per plant followed by T₅ (1.29), T₁ (1.23 Kg), T₃ (1.20 Kg) and T₄ (1.22 Kg) were found at par. T₂ exhibited the minimum effect on yield per plant (1.13 Kg). Similarly maximum yield of 288.77 q/ha was noted for T₇ which was significantly higher than all treatments followed by T₆ (272.73 q/ha) and T₅ (270.58 q/ha). T₂ exhibited the minimum effect on yield (220.84 q/ha) followed by T₃ (242.29 q/ha), T₄ (250.55 q/ha) and T₁ (257.39 q/ha). These

findings are in conformity with those of Devis *et al.* (2003) ^[2], Alexander *et al.* (2004) ^[1], Kumaresan and Kalamani (2004) ^[5].

All the treatments of biofertilizers had significant effect on yield and yield components as compared to control. Fruit diameter increased considerably due to use of biofertilizers. The respective maximum and minimum fruit diameter was recorded for T₁₀ (5.72 cm) and T₀ (4.40 cm). T₈ (5.48 cm) and T₉ (5.46 cm) were found to be at par but significantly superior to control and significantly inferior to T₁₀. Similarly fruit length was also higher in T₁₀ (5.71 cm) followed by T₉ (5.26 cm). T₈ (5.13 cm) exhibited minimum effect on fruit length. Fruit weight increased significantly due to biofertilizers. The maximum fruit weight was observed under T₁₀ (54.70g) followed by T₉ (53.18g), whereas T₈ (52.03g) had minimum effect on it. Number of fruits per plant also increased appreciably due to biofertilizers. The maximum fruits per plant were noted for T₈ (22.18) followed by T₁₀ (21.93) and T₉ (21.48). A considerable increase was observed in yield per plant and yield q/ha due to use of biofertilizers over control. But the effect of all the treatments of biofertilizers did not differ significantly for these parameters of study.

In present investigation highest yield was obtained with use of biofertilizers which is probably due to better plant stand and direct contribution of biofertilizers in improving the fertility condition of the soil because of bacterial activity. The increase in yield might be attributed to increased availability of nitrogen and phosphorus as well as accumulation of plant hormones synthesized by biofertilizers which in turn might have increased carbohydrate supply and nutrient mobility by improving better root activity, leaf area, chlorophyll content and photosynthetic rate in addition to increasing hormonal levels in the active sinks viz; flowers fruits etc.

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