The Pharma Innovation Journal 2021; 10(9): 1437-1446

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(9): 1437-1446

www.thepharmajournal.com
Received: 06-07-2021
Accepted: 19-08-2021

HR Galande
M.Sc. Student, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

AM Bhosale
Assistant Professor, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

SJ Syed
Agriculture Assistant, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Corresponding Author:
AM Bhosale
Assistant Professor, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Response of growth parameters and crop duration of tomato (*Lycopersicon esculentum* L.) to graded level of zinc and zinc solubilizing microbial cultures

HR Galande, AM Bhosale and SJ Syed

Abstract
The experiment was laid out in Factorial RBD with two factor *i.e.* factor first is zinc solubilizer and factor second is levels of zinc, it has twelve treatments replicated three times. The tomato variety 'Shivam' was used for the study. Recommended dose of fertilizer (250:250:250 kg NPK /ha) was applied through urea, SSP and mop. The effect of zinc solubilizer on growth parameters of tomato indicated that the zinc solubilizer B_2 (*Trichoderma viride*) recorded maximum plant height (91.41 cm), stem diameter (1.65 cm), Internodal length (12.23 cm), number of leaves per plant (71.22), number of branches per plant (18.09), leaf area per plant (577.54 cm^2),crop duration (147.93 days). The effect of different levels of zinc on growth parameters of tomato indicated that the levels of zinc Zn_3 (30 kg $ZnSO_4$/ha) recorded maximum plant height (88.35 cm), stem diameter (1.53 cm), Internodal length (11.21 cm), number of leaves per plant (68.44), number of branches per plant (16.90), leaf area per plant (541.39 cm^2),crop duration (144.87 days), The interaction effect of different zinc solubilizer and levels of zinc on growth, yield and quality parameters of tomato indicated that the B_2Zn_3 (*Trichoderma viride* + 30 kg $ZnSO_4$/ha) recorded maximum plant height (96.15 cm), stem diameter (1.81 cm), Internodal length (13.43 cm), number of leaves per plant (75.83), number of branches per plant (18.87), leaf area per plant (613.30 cm^2),crop duration (149.49 days).

Keywords: Zinc, Tomato, leaf area, FRBD, *Trichoderma viride, Pseudomonas striata*

Introduction
Tomato (*Lycopersicon eculentum* L.) belonging to solanaceae family. Its chromosome number is 24. South America (Peru) is native origin of tomato and before Columbus its plants were brought to Europe by Red Indians and started cultivation.

It is herbaceous plant with alternate leaves. The flowers are present in cluster on the stem between the nodes. Fruit of tomato is berry type, it has fleshy placenta and small kidney shaped seeds which are covered with short hairs. Tomato is a self pollinated crop. It is susceptible to high temperature, especially the large fruited fresh varieties. High night temperature may lead to lower fruit set of small and seedless fruit development. Most favorable temperature for fruit set is 25-30 °C. It is neither tolerate to frost nor to water logged condition. It will not performed well if the temperature goes above 35 °C and below 15 °C. Lycopene is highest at 21-24 °C while production of this pigment drops off rapidly above 27 °C. A well drained loamy soil is ideal for its growth. The best soil pH is 6.00-7.00.

Zinc is an essential Micronutrient required for plants, it plays a key role as a structural constituent or regulatory co-factor which contents a wide range of different enzymes and protein in many important biochemical pathways are these are mainly concerned with carbohydrate metabolism, both in photosynthesis and in the conversion of sugars to starch and protein metabolism.(Samreen, *et al*.,2017) [1] Zinc is one of the most important essential micronutrients required in the range of 5 to 100 mg kg^{-1} concentrations in tissues for the management of nutrients, growth and reproduction of plants (Samreen, *et al*.,2017; Sharma, *et al*., 2013; Goteti *et al*., 2013) [1, 15, 4] . Zinc deficiency is the major constraints in obtaining high yield, growth and quality of tomato. Zinc reported to play a vital role in modifying the growth and development of many horticultural crops (Sathiyamurthy, 2017) [12]. Few zinc solubilizing bacterial genera *viz. Bacillus spp.*, *Pseudomonas spp.*, *Thiobacillus spp.*, etc. and facultative thermophilic iron oxidizers were reported as zinc solubilizer.

Pseudomonas sp. is omnipresent bacteria in agricultural soils and has many traits that make them well suited as zinc solubilisation. *Pseudomonas* strain used to suppress soil borne diseases and promote plant growth. *Pseudomonas* has been used for their beneficial effects on plant growth. *Pseudomonas* whose beneficial effects on the plant result from different mechanism *i.e*. direct mechanism (Solubilization of phosphorus, potassium, zinc, nitrogen fixation, sequestration of iron by siderophores, production of growth regulators etc.) or indirect mechanisms such as antibiotic production. *Pseudomonas* spp. were reported for promoting zinc and phosphorus bioavailability to plants which are globally widespread micronutrient deficiencies (Shahid, *et al*., 2020) [14]. *Trichoderma* spp. is free living in nature. They are filamentous fungi and some of them are the most potent agents for the biocontrol of soil borne plant pathogens. They produce a wide range of antibiotic substance and that they parasitize other fungi. There are relatively few strains of Trichoderma that has the ability to stimulate plant growth response (Lo and Lin, *et al*., 2002). They also inhibit or degrade pectinases and other enzymes that are essential for plant pathogenic fungi (Duc, *et al*., 2017) [3].

Material and Methods

The field experiment entitled "Response of tomato (*Lycopersicon esculentum* L.) cv. Shivam to graded levels of zinc and zinc solubilizing microbial cultures.." was carried out during summer season, 2021 at Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The field trial was laid out in Factorial randomized block design (FRBD) with 12 treatments and three replications Distance between two treatments and replications(50 cm and 1.6 m respectively). The size of plot was 4.5 m × 0.8 m. spacing adopted was 60 cm × 60 cm. Experimental field was laid out as per the plan after preparation of land. The layout consisted of 36 experimental units.

Treatment details

Sr. No.	Treatment	Treatment Details
Factor		
A	**Zinc Solubilizer**	
	B_0	Control
	B_1	*Pseudomonas striata* (liquid)
	B_2	*Trichoderma viride* (liquid)
B	**Levels of zinc (kg/ha)**	
	Zn_0	00 kg/ha
	Zn_1	10 kg/ha
	Zn_2	20 kg/ha
	Zn_3	30 kg/ha

Treatment No.	Treatment combination
T_1	Control : Control
T_2	Control : 10 kg $ZnSO_4$/ha.
T_3	Control : 20 kg $ZnSO_4$/ha.
T_4	Control : 30 kg $ZnSO_4$/ha.
T_5	*Pseudomonas striata* : Control
T_6	*Pseudomonas striata* : 10 kg $ZnSO_4$/ha.
T_7	*Pseudomonas striata* : 20 kg $ZnSO_4$/ha.
T_8	*Pseudomonas striata* : 30 kg $ZnSO_4$/ha.
T_9	*Trichoderma viride* : Control
T_{10}	*Trichoderma viride*: 10 kg $ZnSO_4$/ha.
T_{11}	*Trichoderma viride*: 20 kg $ZnSO_4$/ha.
T_{12}	*Trichoderma viride*: 30 kg $ZnSO_4$/ha.

Treatments and fertilizer application: Recommended dose Nitrogen, phosphorus and potash were applied through urea, single superphosphate and muriate of potash, at 250 kg N/ha, 250 kg P_2O_5/ha and 250 kg K_2O/ha.respectively. Chemical fertilizers, full dose of P_2O_5 and K_2O were applied respectively through single super phosphate and muriate of potash at the 8 DAT in the rows while application of nitrogen was made through urea was in two equal split doses i.e. 50% at the 8 DAT and remaining 50% at the time of flowering. Quantity of fertilizers applied per plot was common and uniform. Fertilizers were applied at the depth of 5 cm and were properly mixed with soil. Plots were irrigated immediately after application of fertilizers. *Pseudomonas striata* (1 lit/ha) and *Trichoderma viride* (1 liter/ha) was applied as per treatments (Drenching at 15 DAT) zinc sulphate was applied as per treatments (soil application at 15 DAT).

Raising the nursery: The seeds of tomato were sown in pro tray filled with cocopeat. After germination, 21-25 days old seedlings with well root development and uniform growth were selected and used transplanting.

Seedling treatment: Tomato seedlings was treated with mixture of *Pseudomonas striata* + *Trichoderma viride*. The seedlings were treated with mixture of *Pseudomonas striata* + *Trichoderma viride* by dipping 20 min. and after that remove seedlings from solution and then immediately after that transplanting is done.

Observations recorded: Five plants were randomly selected from each of 36 plots and were labeled. The following observations were recorded on the different characters which are given as follows.

Growth parameters

Height of plant (cm): Height of plant from the base of the plant to tip of the main stem was measured with scale. Plant height was measured at 30, 60, and 90 days after transplanting respectively and mean values were expressed in centimeter.

Stem diameter (cm): The data on the stem diameter was measured in each five randomly selected plants were counted and was recorded. Stem diameter was measured at 30, 60, and 90 DAT. The mean value of five plants was taken for statistical analysis.

Inter nodal length (cm): The distance between two nodes is measured in centimeter on the main stem in each five randomly selected plants and the mean value of five plants were calculated and expressed in centimeter at 30, 60, and 90 DAT.

Number of leaves per plant: Number of leaves was counted at 30 DAT, 60 DAT, 90 DAT at from selected plants. The mean was calculated.

Number of branches per plant: The total number of branches per plant was counted at 30 DAT, 60 DAT, 90 DAT from selected plants and the mean was worked out.

Leaf area per plant: The leaf area per plant was measured at 30 DAT, 60 DAT, 90 DAT from selected plants and the mean was worked out.

Crop Duration: Crop Duration was recorded in a days between from transplanting to final harvesting. It is expressed in a days.

Results and Discussion
The observations recorded on growth parameters along with the statistical test and their scientific interpretations are presented in this chapter under appropriate heads.

Growth Parameters
Plant Height (Cm)
Plant height was recorded at 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage as influenced by different zinc solubilizing bacteria, different levels of zinc and their interaction effect is given in Table 1.

Effect of zinc solubilizer
The different zinc Solubilizer resulted in significant differences in plant height at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum plant height (34.33 cm), (59.93 cm), (83.32 cm) and (91.41 cm) was observed in B_2 (*Trichoderma viride*) which was at par with B_1 (*Pseudomonas striata*) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum plant height (29.84 cm), (49.33 cm), (72.72 cm) and (78.28 cm) was observed in B_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.
The above result indicated that zinc solubilizer i.e. B_2 (*Trichoderma viride*) recorded maximum plant height as compared to B_1 (*Pseudomonas striata*) and B_0 (Control). The *Trichoderma viride* influence the vegetative growth and more response to solubilize the immobile zinc and uptake more nutrient as compare to *Pseudomonas striata* and Control. These results were in conformity with the results obtained by Haque *et al.*, (2012) [7] in tomato where T_7 i.e. the combination of 50% nitrogen and *Trichoderma harzianum* coated wheat grains. These results revealed that in maximum plant height (71.17 cm), Molla *et al.*, (2012) [7] in tomato where significantly increased plant height (95.06 cm) by appling 50% Trichoderma enriched biofertilizer and 50% NPK , Colla *et al.*, (2014) in tomato where significantly increased plant height appling co-inoculation of *Trichoderma atroviride and Glomus intraradices*.

Effect of levels of zinc
The different levels of zinc resulted in significant differences in plant height at 30 DAT, 60 DAT, 90DAT and at final harvesting stage of tomato. Maximum plant height (33.97 cm), (57.16 cm), (80.08 cm) and (88.35 cm) was observed in Zn_3 (30 kg $ZnSO_4$/ha) which was at par with Zn_2 (20 kg $ZnSO_4$/ha) in a a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum plant height (29.84 cm), (50.76 cm), (74.02 cm) and (80.71 cm) was observed in Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.
The above result indicated that there was a increase in the height of the plant due to increase in the levels of zinc i.e. Zn_3 (30 kg $ZnSO_4$/ha.). Zinc is a essential micronutrient which helps in the formation of tryptophan, precursor of IAA responsible for growth stimulation. Similar results were reported by Yadav, *et al.*, (2001) [19] in tomato, Gurmani, *et al.*, (2012) [5] in tomato where significantly increased plant growth by the zinc application at 10mg kg^{-1} , Ali, *et al.*, (2015) [1] in tomato where significantly increased plant height (106.9 cm) in a treatment of zinc application, Prasad and Subbarayappa, *et al.*, (2017) in tomato where expressively increased plant height (115.29 cm) in a treatment of soil application of zinc at 20 kg $ZnSO_4$ per ha.

Interaction effect of zinc solubilizer and levels of zinc
It is evident from the data presented in a Table 1 that interaction effect of zinc solubilizer and levels of zinc was revealed to be significant on plant height at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage. Maximum plant height (37.36 cm), (63.29 cm), (88.02 cm) and (96.15 cm) was observed in B_2Zn_3 which was at par with B_2Zn_2 in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively and minimum plant height (28.17 cm), (44.94 cm), (72.42 cm) and (75.35 cm) was observed in B_0Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively.

Table 1: Effect of different zinc solubilizer and levels of zinc on plant height (cm) of tomato.

Treatment	Plant Height (cm)			
	30 DAT	60 DAT	90 DAT	At final Harvest
Zinc Solubilizer (B)				
B_0	29.84	49.33	72.72	78.28
B_1	33.74	59.14	83.13	91.15
B_2	34.33	59.93	83.32	91.41
S.E m +	0.21	0.28	0.06	0.09
CD at 5% Level	0.62	0.82	0.20	0.28
Levels of zinc (Zn)				
Zn_0	29.84	50.76	74.02	80.71
Zn_1	31.35	54.33	76.08	82.97
Zn_2	33.29	56.23	79.87	88.09
Zn_3	33.97	57.16	80.08	88.35
S.E m +	0.24	0.32	0.07	0.11
CD at 5% Level	0.71	0.95	0.23	0.32
Interaction (B×Zn)				
B_0Zn_0	28.17	44.94	71.41	75.35
B_0Zn_1	29.85	49.11	72.28	77.38
B_0Zn_2	30.20	51.28	73.05	79.15
B_0Zn_3	31.13	51.97	74.14	81.23
B_1Zn_0	29.89	51.81	73.33	80.89
B_1Zn_1	31.84	54.20	75.65	83.57
B_1Zn_2	32.23	55.14	76.49	85.75
B_1Zn_3	33.44	56.25	78.09	87.68
B_2Zn_0	31.47	55.23	77.31	85.89
B_2Zn_1	32.37	59.69	80.31	87.98
B_2Zn_2	36.13	61.62	87.63	96.62
B_2Zn_3	37.36	63.29	88.02	96.15
S.E m +	0.42	0.56	0.13	0.19
CD at 5% Level	1.26	1.69	0.41	0.57

Stem Diameter (cm)
Stem diameter was recorded at 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage as influenced by different zinc solubilizing bacteria, different levels of zinc and their interaction effect is given in Table 2.

Effect of zinc solubilizer
The different zinc solubilizer resulted in significant differences in stem diameter at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum stem diameter (1.14 cm), (1.24 cm), (1.37 cm) and (1.65 cm) was observed in B_2 (*Trichoderma viride*) which was at par with B_1 (*Pseudomonas striata*) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum stem diameter (1.03 cm), (1.10 cm), (1.16 cm) and (1.27 cm) was observed in B_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.
The above result indicated that zinc solubilizer i.e. B_2 (*Trichoderma viride*) recorded maximum stem diameter as compared to B_1 (*Pseudomonas striata*) and B_0 (Control). The

Trichoderma viride influence the vegetative growth and helps to development and function of growth regulators as compare to *Pseudomonas striata* and Control. These results were in conformity with the results obtained by Ozbay and Newman, *et al.*,(2004) in tomato where T_4 i.e. (*T. harzianum* T95) observed maximum stem diameter (6.06mm) as compared to other.

Effect of levels of zinc

The different levels of zinc resulted in significant differences in stem diameter at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum stem diameter (1.14 cm), (1.22 cm), (1.33 cm) and (1.53cm) was observed in Zn_3 (30 kg $ZnSO_4$/ha) which was at par with Zn_2 (20 kg $ZnSO_4$/ha) in a a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum stem diameter (1.04 cm), (1.11 cm), (1.19 cm) and (1.29 cm) was observed in Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that there was a increase in the stem diameter of the plant due to increase in the levels of zinc i.e. Zn_3 (30 kg $ZnSO_4$/ha.). Zinc is a essential micronutrient which helps in the formation of tryptophan, precursor of IAA responsible for growth stimulation and cell elongation. Similar results were reported by Yadav, *et al.*, (2001) [19] in tomato, Gurmani, *et al.*, (2012) [5] in tomato where significantly increased plant growth by the zinc application at 10mg kg^{-1} .

Interaction effect of zinc solubilizer and levels of zinc

It is evident from the data presented in a Table 2 that interaction effect of zinc solubilizer and levels of zinc was revealed to be significant on stem diameter at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage. Maximum stem diameter (1.17 cm), (1.30 cm), (1.45 cm) and (1.81 cm) was observed in B_2Zn_3 which was at par with B_2Zn_2 in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively and minimum stem diameter (0.94 cm), (1.04 cm), (1.10 cm) and (1.20 cm) was observed in B_0Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively.

Table 2: Effect of different zinc solubilizer and levels of zinc on stem diameter (cm) of tomato.

Treatment	Stem Diameter (cm)			
	30 DAT	**60 DAT**	**90 DAT**	**At final Harvest**
Zinc Solubilizer (B)				
B_0	1.03	1.10	1.16	1.27
B_1	1.13	1.23	1.36	1.64
B_2	1.14	1.24	1.37	1.65
S.E m +	0.005	0.002	0.004	0.002
CD at 5% Level	0.015	0.007	0.011	0.005
Levels of zinc (Zn)				
Zn_0	1.04	1.11	1.19	1.29
Zn_1	1.09	1.14	1.24	1.39
Zn_2	1.12	1.21	1.32	1.52
Zn_3	1.14	1.22	1.33	1.53
S.E m +	0.006	0.003	0.005	0.002
CD at 5% Level	0.017	0.008	0.013	0.006
Interaction (B×Zn)				
B_0Zn_0	0.94	1.04	1.10	1.20
B_0Zn_1	1.03	1.06	1.12	1.23
B_0Zn_2	1.06	1.13	1.18	1.28
B_0Zn_3	1.11	1.15	1.23	1.35
B_1Zn_0	1.07	1.12	1.18	1.29
B_1Zn_1	1.11	1.16	1.26	1.36
B_1Zn_2	1.12	1.20	1.30	1.39
B_1Zn_3	1.14	1.22	1.33	1.43
B_2Zn_0	1.12	1.20	1.29	1.40
B_2Zn_1	1.13	1.23	1.35	1.58
B_2Zn_2	1.14	1.29	1.43	1.80
B_2Zn_3	1.17	1.30	1.45	1.81
S.E m +	0.01	0.005	0.008	0.004
CD at 5% Level	0.03	0.015	0.023	0.01

Internodal Length (cm)

Internodal length was recorded at 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage as influenced by different zinc solubilizing bacteria, different levels of zinc and their interaction effect is given in Table 3.

Effect Of Zinc Solubilizer

The different zinc solubilizer resulted in significant differences in internodal length at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum internodal length (5.71 cm), (8.58 cm), (9.60 cm) and (12.23 cm) was observed in B_2 (*Trichoderma viride*) which was at par with B_1 (*Pseudomonas striata*) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum internodal length (5.01 cm), (7.03 cm), (7.88 cm) and (8.10 cm) was observed in B_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that zinc solubilizer i.e. B_2 (*Trichoderma viride*) recorded maximum internodal length as compared to B_1 (*Pseudomonas striata*) and B_0 (Control). The *Trichoderma viride* influence the vegetative growth and helps to development and function of growth regulators as compare to *Pseudomonas striata* and Control. These results were in conformity with the results obtained by Ozbay and Newman, *et al.*,(2004) in tomato where T_4 *i.e.* (*T. harzianum* T95) observed maximum internodal length as compared to other.

Effect of levels of zinc

The different levels of zinc resulted in significant differences in internodal length at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum internodal length (5.69 cm), (8.15 cm), (9.08 cm) and (11.2cm) was observed in Zn_3 (30 kg $ZnSO_4$/ha) which was at par with Zn_2 (20 kg $ZnSO_4$/ha) in a a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum internodal length (5.07 cm), (7.23 cm), (8.10 cm) and (9.44cm) was observed in Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that there was a increase in the internodal length of the plant due to increase in the levels of zinc i.e. Zn_3 (30 kg $ZnSO_4$/ha.). Zinc is a essential micronutrient which helps in the formation of tryptophan, precursor of IAA responsible for growth stimulation and internodal elongation. Similar results were reported by Yadav, *et al*., (2001) [19] in tomato, Haleema, *et al*., (2017) in tomato where significantly increased internodal length with increasing concentration of zinc.

Interaction effect of zinc solubilizer and levels of zinc

It is evident from the data presented in a Table 3 that interaction effect of zinc solubilizer and levels of zinc was revealed to be significant on internodal length at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage. Maximum internodal length (5.88 cm), (9.4 cm), (10.29 cm) and (13.43 cm) was observed in B_2Zn_3 which was at par with B_2Zn_2 in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively and minimum internodal length (4.43 cm), (6.79 cm), (7.49 cm) and (8.52 cm) was observed in B_0Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively.

Table 3: Effect of different zinc solubilizer and levels of zinc on internodal length (cm) of tomato.

Treatment	Internodal Length (cm)			
	30 DAT	60 DAT	90 DAT	At final Harvest
Zinc Solubilizer (B)				
B_0	5.01	7.03	7.88	8.10
B_1	5.62	8.38	9.56	12.17
B_2	5.71	8.58	9.60	12.23
S.E m +	0.03	0.07	0.01	0.02
CD at 5% Level	0.10	0.21	0.03	0.06
Levels of zinc (Zn)				
Zn_0	5.07	7.23	8.10	9.44
Zn_1	5.34	7.50	8.44	10.04
Zn_2	5.58	7.93	9.04	11.14
Zn_3	5.69	8.15	9.08	11.21
S.E m +	0.04	0.08	0.01	0.02
CD at 5% Level	0.12	0.24	0.03	0.07
Interaction (B×Zn)				
B_0Zn_0	4.43	6.79	7.49	8.52
B_0Zn_1	4.85	6.95	7.68	8.74
B_0Zn_2	5.29	7.18	8.08	9.11
B_0Zn_3	5.49	7.21	8.25	9.24
B_1Zn_0	5.29	7.15	8.18	9.17
B_1Zn_1	5.48	7.42	8.38	9.85
B_1Zn_2	5.55	7.73	8.61	10.15
B_1Zn_3	5.58	7.86	8.72	10.98
B_2Zn_0	5.52	7.76	8.64	10.63
B_2Zn_1	5.61	8.14	9.26	11.53
B_2Zn_2	5.69	8.99	10.23	13.31
B_2Zn_3	5.88	9.41	10.29	13.43
S.E m +	0.07	0.14	0.02	0.04
CD at 5% Level	0.21	0.43	0.06	0.12

Number of Leaves per Plant

Number of leaves per plant was recorded at 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage as influenced by different zinc solubilizing bacteria, different levels of zinc and their interaction effect is given in Table 4.

Effect of Zinc Solubilizer

The different zinc solubilizer resulted in significant differences in number of leaves per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum number of leaves per plant (23.71), (48.48), (58.05) and (71.22) was observed in B_2 (*Trichoderma viride*) which was at par with B_1 (*Pseudomonas striata*) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum number of leaves per plant (16.73), (37.78), (51.71) and (60.08) was observed in B_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that zinc solubilizer i.e. B_2 (*Trichoderma viride*) recorded maximum number of leaves per plant as compared to B_1 (*Pseudomonas striata*) and B_0 (Control). The *Trichoderma viride* influence the vegetative growth and helps to development and function of growth regulators as compare to *Pseudomonas striata* and Control. These results were in conformity with the results obtained by Ozbay and Newman, *et al.*,(2004) in tomato where T_4 i.e. (*T. harzianum* T95) observed maximum number of leaves (4.16) as compared to other, Azarmi, *et al.*, (2011) [2] in tomato where Trichoderma harzianum observed maximum number of leaves (5.67) as compared to other.

Effect of levels of zinc

The different levels of zinc resulted in significant differences in number of leaves per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum number of leaves per plant (22.25), (47.20), (55.86) and (68.44) was observed in Zn_3 (30 kg $ZnSO_4$/ha) which was at par with Zn_2 (20 kg $ZnSO_4$/ha) in a a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum number of leaves per plant (18.12), (39.06), (51.95) and (61.48) was observed in Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that there was a increase in the number of leaves per plant due to increase in the levels of zinc i.e. Zn_3 (30 kg $ZnSO_4$/ha.). Zinc is a essential micronutrient which responsible for growth stimulation. Similar results were reported by Ali, *et al.*, (2015) [1] in tomato where significantly increased number of leaves per plant (68.9) with increasing concentration of zinc, Shnain, *et al.*, (2015) in tomato where significantly increased number of leaves per plant (39.33) with increasing concentration of zinc.

Interaction effect of zinc solubilizer and levels of zinc

It is evident from the data presented in a Table 4 that interaction effect of zinc solubilizer and levels of zinc was revealed to be non significant on number of leaves per plant at 30 DAT and significant on number of leaves per plant at 60 DAT, 90 DAT and at final harvesting stage. Maximum number of leaves per plant (25.86), (51.27), (61.07) and (75.83) was observed in B_2Zn_3 which was at par with B_2Zn_2 in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively and minimum number of leaves per plant (14.73), (33.33), (51.00) and (59.11) was observed in B_0Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively.

Table 4: Effect of different zinc solubilizer and levels of zinc on number of leaves per plant of tomato.

Treatment	Number of leaves per plant			
	30 DAT	60 DAT	90 DAT	At final Harvest
Zinc Solubilizer (B)				
B_0	16.73	37.78	51.71	60.08
B_1	22.37	48.18	57.92	71.21
B_2	23.71	48.48	58.05	71.22
S.E m +	0.46	0.12	0.05	0.003
CD at 5% Level	1.38	0.37	0.16	0.008
Levels of zinc (Zn)				
Zn_0	18.12	39.06	51.95	61.48
Zn_1	19.80	42.00	53.77	63.50
Zn_2	20.92	46.78	55.71	68.43
Zn_3	22.25	47.20	55.86	68.44
S.E m +	0.54	0.14	0.06	0.003
CD at 5% Level	1.59	0.43	0.18	0.009
Interaction (B×Zn)				
B_0Zn_0	14.73	33.33	51.00	59.11
B_0Zn_1	16.33	33.67	51.40	59.78
B_0Zn_2	17.23	41.60	52.07	60.05
B_0Zn_3	18.62	42.53	52.40	61.38
B_1Zn_0	17.83	40.53	51.47	60.98
B_1Zn_1	20.00	43.73	52.93	61.85
B_1Zn_2	21.40	45.13	53.53	63.09
B_1Zn_3	22.28	47.80	54.13	68.11
B_2Zn_0	21.81	43.33	53.40	64.35
B_2Zn_1	23.07	48.60	57.00	68.89
B_2Zn_2	24.12	50.73	60.75	75.81
B_2Zn_3	25.86	51.27	61.07	75.83
S.E m +	0.93	0.25	0.11	0.006
CD at 5% Level	NA	0.76	0.33	0.017

Number of branches per plant

Number of branches per plant was recorded at 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage as influenced by different zinc solubilizing bacteria, different levels of zinc and their interaction effect is given in Table 5.

Effect of zinc solubilizer

The different zinc solubilizer resulted in significant differences in number of branches per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum number of branches per plant (7.20), (12.20), (14.00) and (18.09) was observed in B_2 (*Trichoderma viride*) which was at par with B_1 (*Pseudomonas striata*) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum number of branches per plant (4.79), (8.50), (9.87) and (12.46) was observed in B_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that zinc solubilizer i.e. B_2 (*Trichoderma viride*) recorded maximum number of branches per plant as compared to B_1 (*Pseudomonas striata*) and B_0 (Control). The *Trichoderma viride* influence the vegetative growth and helps to development and function of growth regulators and enhance the secondary metabolism as compare to *Pseudomonas striata* and Control. These results were in conformity with the results obtained by Haque, *et al.*,(2012) [7] in tomato where T_7 i.e. (50% N + *T. harzianum* coated wheat grains) observed maximum number of Branches per plant (9.92) as compared to other, Uddin, *et al.*, (2015) [17] in tomato where Trichoderma (100g/m^2) observed maximum number of branches (6.00) as compared to other treatments.

Effect of levels of zinc

The different levels of zinc resulted in significant differences in number of branches per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum number of branches per plant (6.70), (11.37), (12.73) and (16.90) was observed in Zn_3 (30 kg $ZnSO_4$/ha) which was at par with Zn_2 (20 kg $ZnSO_4$/ha) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum number of branches per plant (4.87), (9.10), (10.33) and (14.06) was observed in Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that there was a increase in the number of branches per plant due to increase in the levels of zinc i.e. Zn_3 (30 kg $ZnSO_4$/ha.). Zinc is a essential micronutrient which responsible for growth stimulation. Similar results were reported by Ali, *et al.*, (2015) [1] in tomato where significantly increased number of branches per plant (11.9) with increasing concentration of zinc, Ullah, *et al.*, (2015) [18] in tomato where significantly increased number of branches per plant (7.36) with increasing concentration of zinc at 0.4% as compared to other treatments.

Interaction effect of zinc solubilizer and levels of zinc

It is evident from the data presented in a Table 5 that interaction effect of zinc solubilizer and levels of zinc was revealed to be significant on number of branches per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage. Maximum number of branches per plant (8.40), (13.53), (15.40) and (18.87) was observed in B_2Zn_3 which was at par with B_2Zn_2 in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively and minimum number of branches per plant (4.26), (7.53), (9.20) and (11.15) was observed in B_0Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively.

Table 5: Effect of different zinc solubilizer and levels of zinc on number of branches per plant of tomato.

Treatment	Number of Branches per plant			
	30 DAT	60 DAT	90 DAT	At final Harvest
Zinc Solubilizer (B)				
B_0	4.79	8.50	9.87	12.46
B_1	6.88	12.02	13.91	17.98
B_2	7.20	12.20	14.00	18.09
S.E m +	0.12	0.07	0.04	0.04
CD at 5% Level	0.35	0.21	0.11	0.13
Levels of zinc (Zn)				
Zn_0	4.87	9.10	10.33	14.06
Zn_1	5.69	10.03	11.53	15.43
Zn_2	6.33	11.14	12.65	16.78
Zn_3	6.70	11.37	12.73	16.90
S.E m +	0.13	0.08	0.04	0.05
CD at 5% Level	0.40	0.25	0.13	0.15
Interaction (B×Zn)				
B_0Zn_0	4.26	7.53	9.20	11.15
B_0Zn_1	4.53	8.40	9.47	11.95
B_0Zn_2	4.96	8.73	10.20	12.35
B_0Zn_3	5.40	9.33	10.60	14.38
B_1Zn_0	4.88	9.07	10.07	14.20
B_1Zn_1	5.41	10.27	11.47	16.37
B_1Zn_2	6.26	10.93	11.73	16.96
B_1Zn_3	6.32	11.27	12.33	17.47
B_2Zn_0	5.47	10.72	11.73	16.85
B_2Zn_1	7.12	11.43	13.67	17.98
B_2Zn_2	7.79	13.10	15.18	18.64
B_2Zn_3	8.40	13.53	15.40	18.87
S.E m +	0.24	0.14	0.08	0.09
CD at 5% Level	0.70	0.44	0.24	0.27

Leaf Area (cm^2)

Leaf area per plant was recorded at 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage as influenced by different zinc solubilizing bacteria, different levels of zinc and their interaction effect is given in Table 6.

Effect of zinc solubilizer

The different zinc solubilizer resulted in significant differences in leaf area per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum leaf area per plant (280.01 cm^2), (462.20 cm^2), (536.37 cm^2) and (577.54) was observed in B_2 (*Trichoderma viride*) which was at par with B_1 (*Pseudomonas striata*) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum leaf area per plant (212.07 cm^2), (352.78cm^2), (420.23 cm^2) and (466.81 cm^2) was observed in B_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.

The above result indicated that zinc solubilizer i.e. B_2 (*Trichoderma viride*) recorded maximum leaf area per plant as compared to B_1 (*Pseudomonas striata*) and B_0 (Control). The *Trichoderma viride* influence the vegetative growth and helps to development of plant tissue as compare to *Pseudomonas striata* and Control. These results were in conformity with the results obtained by Azarmi, *et al.*,(2011) [2] in tomato where *T. harzianum* significantly increased leaf area (333.8 cm^2) as compared to other treatments.

Effect of levels of zinc

The different levels of zinc resulted in significant differences

in leaf area per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage of tomato. Maximum leaf area per plant ($270.65 cm^2$), ($439.97 cm^2$), ($511.56 cm^2$) and ($541.39 cm^2$) was observed in Zn_3 (30 kg $ZnSO_4$/ha) which was at par with Zn_2 (20 kg $ZnSO_4$/ha) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively, whereas, minimum leaf area per plant ($218.18 cm^2$), ($371.04 cm^2$), ($449.08 cm^2$) and ($482.25 cm^2$) was observed in Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at the final harvesting stage respectively.
The above result indicated that there was a increase in leaf area per plant due to increase in the levels of zinc i.e. Zn_3 (30 kg $ZnSO_4$/ha.). Zinc is a essential micronutrient which responsible for growth stimulation. Similar results were reported by Yadav, *et al.*, (2001) [19] in tomato where significantly increased leaf area per plant with increasing concentration of zinc at 7.5 ppm as compared to other treatments.

Interaction effect of zinc solubilizer and levels of zinc
It is evident from the data presented in a Table 6. That interaction effect of zinc solubilizer and levels of zinc was revealed to be significant on leaf area per plant at 30 DAT, 60 DAT, 90 DAT and at final harvesting stage. Maximum leaf area per plant ($309.96 cm^2$), ($488.73 cm^2$), ($557.52 cm^2$) and ($613.20 cm^2$) was observed in B_2Zn_3 which was at par with B_2Zn_2 in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively and minimum leaf area per plant (166.91 cm^2), (311.40 cm^2), (387.03 cm^2) and (450.09 cm^2) was observed in B_0Zn_0 (Control) in a 30 DAT, 60 DAT, 90 DAT and at final harvesting stage respectively.

Table 6: Effect of different zinc solubilizer and levels of zinc on leaf area per plant of tomato.

Treatment	Leaf Area per plant (cm^2)			
	30 DAT	60 DAT	90 DAT	At final Harvest
Zinc Solubilizer (B)				
B_0	212.07	352.78	420.23	466.81
B_1	269.76	457.20	532.88	577.40
B_2	280.01	462.20	536.37	577.54
S.E m +	3.51	1.77	1.20	0.05
CD at 5% Level	10.29	5.20	3.51	0.15
Levels of zinc (Zn)				
Zn_0	218.81	371.04	449.08	482.25
Zn_1	244.71	399.66	470.49	504.60
Zn_2	258.81	434.50	509.30	541.25
Zn_3	270.65	439.97	511.56	541.39
S.E m +	4.05	2.04	1.38	0.05
CD at 5% Level	11.89	6.00	4.06	0.17
Interaction (B×Zn)				
B_0Zn_0	166.91	311.40	387.03	450.09
B_0Zn_1	217.35	337.87	405.77	468.18
B_0Zn_2	226.56	378.00	424.32	473.81
B_0Zn_3	237.48	383.87	463.81	475.15
B_1Zn_0	234.37	376.33	454.07	471.20
B_1Zn_1	251.65	404.60	478.79	487.17
B_1Zn_2	260.02	422.73	485.14	520.21
B_1Zn_3	264.53	447.33	513.37	535.74
B_2Zn_0	255.16	425.40	506.15	525.49
B_2Zn_1	265.15	456.53	526.91	558.44
B_2Zn_2	289.77	478.15	554.88	613.08
B_2Zn_3	309.96	488.73	557.52	613.30
S.E m +	7.02	3.54	2.40	0.10
CD at 5% Level	21.05	10.63	7.19	0.30

Crop Duration (Days)
Crop duration was recorded at the final harvesting stage as influenced by different zinc solubilizing bacteria, different levels of zinc and their interaction effect is given in Table 7

Effect of Zinc Solubilizer
The different zinc solubilizer resulted in significant differences in crop duration at final harvesting stage of tomato. Maximum crop duration (147.93 days) was observed in B_2 (*Trichoderma viride*) which was at par with B_1 (*Pseudomonas striata*) whereas, minimum crop duration (127.60 days) was observed in B_0 (Control) at the final harvesting stage.
The above result indicated that zinc solubilizer i.e. B_2 (*Trichoderma viride*) recorded maximum crop duration as compared to B_1 (*Pseudomonas striata*) and B_0 (Control). The *Trichoderma viride* increases duration of crop as compare to *Pseudomonas striata* and Control. These results were in conformity with the results obtained by Sujata kumari, *et al.* (2019) [13] in bell papper where soil application of *T. harzianum* significantly increased crop duration as compared to other treatments.

Effect of Levels of Zinc
The different levels of zinc resulted in significant differences in crop duration at final harvesting stage of tomato. Maximum crop duration (144.87 days) was observed in Zn_3 (30 kg $ZnSO_4$/ha) which was at par with Zn_2 (20 kg $ZnSO_4$/ha) at the final harvesting stage whereas, minimum crop duration (133.71 days) was observed in Zn_0 (Control) at the final harvesting stage.
The above result indicated that there was a increase in crop duration due to increase in the levels of zinc i.e. Zn_3 (30 kg $ZnSO_4$/ha.). Zinc is a essential micronutrient which responsible for increasing crop duration. Similar results were reported by Yadav, *et al.*, (2001) [19] in tomato where

significantly increased crop duration with increasing concentration of zinc at 7.5 ppm as compared to other treatments.

Interaction effect of zinc solubilizer and levels of zinc

It is evident from the data presented in a Table 7 that interaction effect of zinc solubilizer and levels of zinc was revealed to be significant on crop duration at final harvesting stage. Maximum crop duration (149.49 days) was observed in B_2Zn_3 which was at par with B_2Zn_2 at final harvesting stage and minimum crop duration (120.08 days) was observed in B_0Zn_0 (Control) at final harvesting stage.

Table 7: Effect of different zinc solubilizer and levels of zinc on crop duration of tomato.

Treatment	Crop Duration (Days)
Zinc Solubilizer (B)	
B_0	127.60
B_1	147.64
B_2	147.93
S.E m +	0.11
CD at 5% Level	0.32
Level of Zinc (Zn)	
Zn_0	133.71
Zn_1	137.10
Zn_2	144.56
Zn_3	144.87
S.E m +	0.12
CD at 5% Level	0.37
Interaction (B×Zn)	
B_0Zn_0	120.08
B_0Zn_1	124.17
B_0Zn_2	129.07
B_0Zn_3	137.10
B_1Zn_0	135.03
B_1Zn_1	140.07
B_1Zn_2	144.11
B_1Zn_3	148.04
B_2Zn_0	146.04
B_2Zn_1	147.08
B_2Zn_2	148.89
B_2Zn_3	149.49
S.E m +	0.22
CD at 5% Level	0.67

References

1. Ali MR, Mehraj H, Jamal Uddin AFM. Effects of foliar application of zinc and boron on growth and yield of summer tomato. J Biosci. Agric. Res 2015;6(1):512-517.
2. Azarmi R, Hajieghrari B, Giglou A. Effect of Trichoderma isolates on tomato seedling growth response and nutrient uptake. African Journal of Biotechnology 2011;10(31):5850-5855.
3. Duc NH, Mayer Z, Pék Z, Helyes L, Posta K. Combined inoculation of arbuscular mycorrhizal fungi, *Pseudomonas fluorescens* and *Trichoderma* spp. for enhancing defense enzymes and yield of three pepper cultivars. Applied ecology and environmental research 2017;15(3):1815-1829.
4. Goteti PK, Emmanuel LDA, Desai S, Shaik MHA. Prospective zinc solubilising bacteria for enhanced nutrient uptake and growth promotion in maize (*Zea mays* L.). International journal of microbiology, Article ID 869697, 2013, 1-7.
5. Gurmani AR, Khan SU, Andaleep R, Waseem K, Khan A. Soil application of zinc improves growth and yield of tomato. International Journal of Agriculture and biology 2012;14(1).
6. Haleema B, Rab A, Hussain SA. Effect of Calcium, Boron and Zinc Foliar Application on Growth and Fruit Production of Tomato. Sarhad Journal of Agriculture 2018;34(1):19-30.
7. Haque MM, Ilias GNM, Molla AH. Impact of *Trichoderma*-enriched biofertilizer on the growth and yield of mustard (*Brassica rapa* L.) and tomato (*Solanum lycopersicon* Mill.). The Agriculturists A Scientific Journal of Krishi Foundation 2012;10(2):109-119.
8. Lee SW, Ahn IP, Sim SY, Lee SY, Seo MW, Kim S, *et al*. *Pseudomonas* sp. LSW25R, antagonistic to plant pathogens, promoted plant growth, and reduced blossom-end rot of tomato fruits in a hydroponic system. *European* journal of plant pathology 2010;126(1):1-11.
9. Ozbay N, Newman SE, Brown WM. August. The effect of the *Trichoderma harzianum* strains on the growth of tomato seedlings. In XXVI International Horticultural Congress: Managing Soil-Borne Pathogens: A Sound Rhizosphere to Improve Productivity in 2002;635:131-135.
10. Prasad PS, Subbarayappa CT. Effect of soil application of zinc on growth and quality of Tomato (*Solanum lycopersicon* L.) in different zinc fertility soils of eastern dry zone (Zone V) of Karnataka. Journal of Pharmacognosy and Phytochemistry 2018;7(4):298-302.
11. Samreen T, Shah HU, Ullah S, Javid M. Zinc effect on growth rate, chlorophyll, protein and mineral contents of hydroponically grown mungbeans plant (*Vigna radiata*). Arabian Journal of Chemistry 2017;10:S1802-S1807.
12. Sathiyamurthy VA, Shanmugasundaram T, Rajasree V, Arumugam T. Effect of Foliar Application of Micronutrients on Growth, Yield and Economics of Tomato (*Lycopersicon esculentum* Mill.). Madras Agricultural Journal 2017;104(4-6):188-193.
13. Sujata K, Bharat NK, Chauhan DS. Efficacy of PGPR and Trichoderma on growth and yield parameters of bell pepper (*Capsicum annuum* L.). Journal of Plant Development Science 2019;11(9):493-499.
14. Shahid I, Tariq K, Mehnaz S. Zinc solubilizing fluorescent Pseudomonads as biofertilizer for Tomato (*Solanum lycopersicum* L.) under controlled conditions. Asian Journal of Plant Science and Research 2020;10(1):1-7.
15. Sharma A, Patni B, Shankhdhar D, Shankhdhar SC. Zinc–an indispensable micronutrient. Physiology and Molecular Biology of Plants 2013;19(1):11-20.
16. Shnain RS, Prasad VM, Saravanan S. Effect of zinc and boron on growth, yield and quality of tomato (*Lycopersicon esculentum*. Mill) cv. Heem Sohna, under protected cultivation. European Academic Research 2014;73(3):78-79.
17. Uddin AFMJ, Hussain MS, Rahman SKS, Ahmad H, Roni MZK. Effect of Trichoderma concentration on the growth and yield of tomato. Bangladesh Research publication Journal 2015;11(3):228-232.
18. Ullah R, Ayub G, Ilyas M, Ahmad M, Umar M, Mukhtar S, Farooq S. Growth and yield of tomato (*Lycopersicon esculentum* L.) as influenced by different levels of zinc and boron as foliar application. American-Eurasian J Agric. and Environ. Sci 2015;15(12):2495-2498.

19. Yadav PVS, Tikkoo A, Sharma NK. Effect of zinc and boron application on growth, flowering and fruiting of tomato (*Lycopersicon esculentum* Mill). Haryana Journal of Horticultural Sciences 2001;30(1-2):105-107.