

Screening of Growth and Development of Various *Trichoderma* Isolates on Tomato Crop

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Abstract: *Trichoderma* species are widely used to control phytopathogenic fungi and some isolates can increase plant growth. Tested the effects of tomato seedling germination, vegetation, plant height, number of branches, fruit weight, shoot fresh and dry shoot weight and root fresh and dry weight in tomato crop, when seedlings are treated and sprayed in a field *Trichoderma* isolates were interestingly increased growth of plants. The seedling treated and crop spraying with *Trichoderma* isolates (T6) had marked super significantly increase in Plant height, number of branches, number of fruits, fruits weight, and increase in fresh weight and dry weight of shoot and root and checked the disease severity after the application of *Trichoderma* isolates in field and the found that seedling treatment with *Trichoderma* isolates and application of *Trichoderma* isolates in field by spraying had control the disease in the field. As per observation of data It was noticed that in treatment (T6) is less disease severity comparison to others treatment.

Keywords: Isolates; *Trichoderma*; Tomato crop; Growth, Disease, Severity

1. Introduction:

One of the world's most important common vegetables is tomato (*Lycopersicon esculentum*) belongs to nightshade family solanaceae. It comes from the Aztec word Tomatl, which is native of Peru in South America. The crop is primarily migrating birds, and is then distributed to various countries in the Americas. The largest concentration of wild tomatoes is found in Mexico. Although often grown outdoors in temperate climates as an annual, it is perennial in its native habitat. An average common tomato weighs around 100grms. Tomato is used in variety of ways, including raw as an ingredient in many foods, sauces, salads, and drinks. Tomato crop is likely to be infected by bacteria, virus, nematodes and fungal diseases. Among all of that fungal disease, One of the most common foliar disease of tomato is early blight caused by the fungal pathogen *Alternaria solani* (Ellis & Martin; Jones & Groux). This disease is most prevalent over a wide range of climate conditions in areas with heavy dumping, rainfall, and high relative humidity. On tomatoes, foliar *Alternaria solani* symptoms are usually present in the oldest leaves and start with small lesions that are dark to brown. The spots are circular, brown and dark brown. When the disease progresses, the typically early blight symptoms show characteristics of a concentric marking inside spots. *Trichoderma* is more effective against *A. solani* (Gardener and Fravel, 2002) (Mukerji and Garg, 1988). *Trichoderma* species inhibit the growth and development of fungi (Samuels, 2006 & Tomer *et al.*, 2015). So, the *in vitro* study of the physiological effects on the growth of *Trichoderma* has been greatly realized as an important subject to determine the best time of application considering all the physiological factors influencing its growth and development.

2.Materials and Methodology:

Field experiments were conducted during the *Rabi* season 2017-2018 with a design consisting of Sygenta Heemsohna variety at farm of Lovely Professional University. In this experiment different *Trichoderma* isolates were taken. Seedling treatment with seven treatments base materials such as *Trichoderma* isolates. Seedlings transplanting without any treatment served as control. The inoculum was mixed with the seedlings before the time of transplanting of seedlings. Growth and development and early blight disease of plants was carefully monitored after the emergence of seedling to crop maturity, disease severity, percent control and percent increase in yield over check also observed.

2.1Seedling Biopriming:

Seedlings were bio primed with bio agents just before transplanting in field experiments. After properly mixing up these base materials with seedling, transplanting was done as per randomization.

T1: Seedling treatment with *Trichoderma* isolate from Uttar Pradesh

T2: Seedling treatment with *Trichoderma* isolate from Rajasthan

T3: Seedling treatment with *Trichoderma* isolate from Himachal Pradesh

T4: Seedling treatment with *Trichoderma* isolate from Haryana

T5: Seedling treatment with *Trichoderma* isolate from Punjab

T6: Seedling treatment with *Trichoderma* isolate from Uttarakhand

T7: Control

3.Results and Discussion:**3.1.1Effect of application of different *Trichoderma* isolates:****3.2.1.1Effect on seedling germination percentage:**

Use of different *Trichoderma* isolates in tomato field, resulted in highest germination seedling percentage of tomato (96.00%) (T6). Germination seedling percentage in T6 is highest than control (80.00%). Second Germination seedling percentage (92.00%), (92.00%) was observed of tomato plants in T1 and T3. Germination seedling percentage from T6 and T1 and T3 were significantly different from each other. Tomato germination seedling percentage was identified from the plants provided with *Trichoderma* in T2 with (90.00%), but significantly less than T6 and T1. Application of *Trichoderma* isolates in T4 with (90.00%), whereas in T-5 with (88.00%). but significantly less than T6 and T1 and T3. However germination seedling percentage noticed in control plot were (80.00%) (T7). (Tomer, A et.al, 2014).

3.2.1.2. Root length effect - Application of different *Trichoderma* isolates in tomato field, resulted in highest root length of tomato (51.00cm) (T6). Root length in (T6) is highest than control (25.00cm). Second highest root length (34.00cm) was observed of tomato plants in T1. Root length from T6 and T1 were different from each other. Tomato root length noticed from the plants provided with *Trichoderma* in T2 with (26.00cm) and where root length identified in T3 (33.00cm), but significantly less than T6 and T1. Application of *Trichoderma* isolates in T4 with (29.00cm), where as in T5 with (24cm). but significantly less than T6 and T1. However root length noticed in control plot was (25.00cm) (T7).

3.2.1.3. Effect on shoot length- Effect of shoot length- application of different *Trichoderma* isolates in tomato field, resulted in highest shoot length of tomato (145cm) (T-6). Shoot length in T-6 is highest than control (100cm). Second highest shoot length (141cm) were observed of tomato plants in T4. Shoot length from T6 and T4 were significantly different from each other. Tomato shoot length noticed from the plants provided with *Trichoderma* in T2 with (105cm) and where shoot length noticed in T3 (131cm), but significantly less

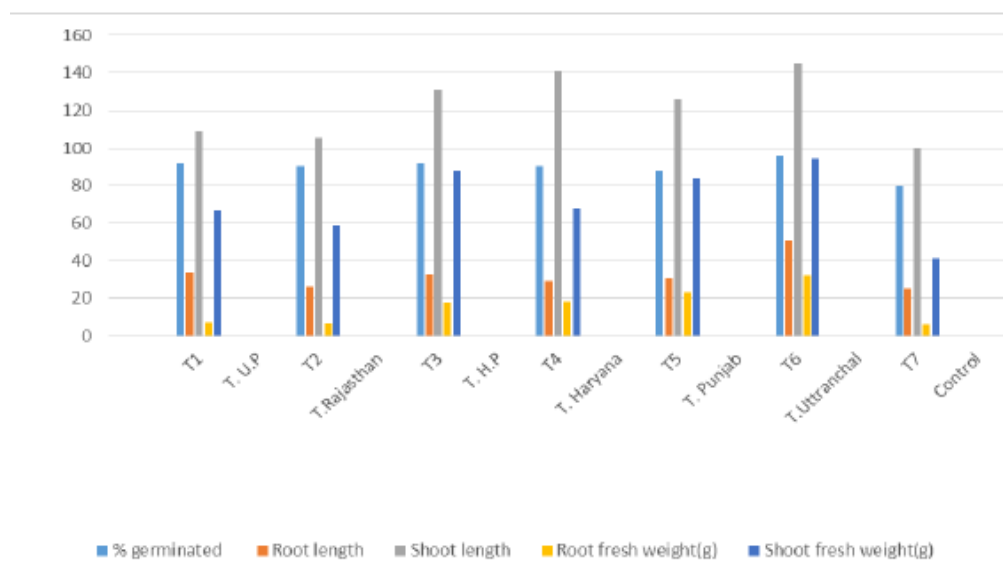
than T6 and T4. Application of *Trichoderma* isolates in T1 with (109cm), whereas in T5 with (126). But significantly less than T6 and T4. However shoot length noticed in control plot was (100cm) (T7).

3.2.1.4.Effect on root fresh weight - Use of different *Trichoderma* isolates in tomato field, resulted in highest root fresh weight of tomato (32.24g) (T6). Root fresh weight in T6 is highest than control (5.98g). Second highest root fresh weight (23.06g) was observed of tomato plants in T5. Root fresh weight from T6 and T5 were significantly different from each other. Tomato root fresh weight noticed from the plants provided with *Trichoderma* in T2 with (6.32g) and where root fresh weight noticed in T3 (17.67g), but significantly less than T6 and T5. Application of *Trichoderma* isolates in T1with (7.07g), where as in T4 with (18.66g). But significantly less than T6 and T5.However root fresh weight noticed in control plot was (5.98g) (T7).

3.2.1.5Effect on shoot fresh weight - Application of different *Trichoderma* isolates in tomato field resulted in highest Shoot fresh weight of tomato (94.45g) (T6). Shoot fresh weight in T6 is highest than control (40.88g). Second highest shoot fresh weight (88.15g) were observed of tomato plants in T3 Shoot fresh weight from T6 and T3 were significantly different from each other. Tomato Shoot fresh weight noticed from the plants applied with *Trichoderma* in T2 with (58.67g) and where Shoot fresh weight noticed in T5 (83.86g), but significantly less than T6 and T3. Application of *Trichoderma*isolates in with (67.04g), whereas in T4 with (68.05g).but significantly less than T6 and T3.However Shoot fresh weight noticed in control plot were (40.88g) (T7).

Treatment	seedling germination (%)	Root length (cm)	Percentage Increase	Shoot length (cm)	Percentage Increase	Root fresh weight(g)	Percentage Increase	Shoot fresh weight(g)	Percentage Increase
T1 T. U.P	92	34	36	109	9	7.07	18.22	67.04	63.99
T2 T. Rajasthan	90	26	4	105	5	6.32	5.68	58.67	43.51
T3 T. H.P	92	33	32	131	31	17.67	195.48	88.15	115.63
T4 T. Haryana	90	29	16	141	41	18.66	212.04	68.05	66.46
T5 T. Punjab	88	31	24	126	26	23.06	285.61	83.86	105.13
T6 T. Uttaranchal	96	51	104	145	45	32.24	439.13	94.45	131.04
T7 Control	80	25		100		5.98		40.88	
CD value	1.341	2.648		6.347		5.042		5.770	

Figure showing the percentage increase in root and shoot length and fresh weight along with seedling percentage.



3.2.1.6.Effect on root dry weight – Application of different *Trichoderma* isolates in tomato field, resulted in highest root dry weight of tomato (8.69) (T6). Root dry weight in T6 is highest than control (2.37g). Second highest root dry weight (7.54g) was observed of tomato plants in T5. Root dry weight from T6 and T5 were significantly different from each other. Tomato root dry weight noticed from the plants applied with *Trichoderma* in T2 with (2.72g) and where root dry weight noticed in T3 (5.83g), but significantly less than T6 and T5.

Application of *Trichoderma* isolates in T1 with (6.20g), whereas in T4 with (5.69g).but significantly less than T6 and T5. However root dry weight noticed in control plot were (2.37g) (T7).

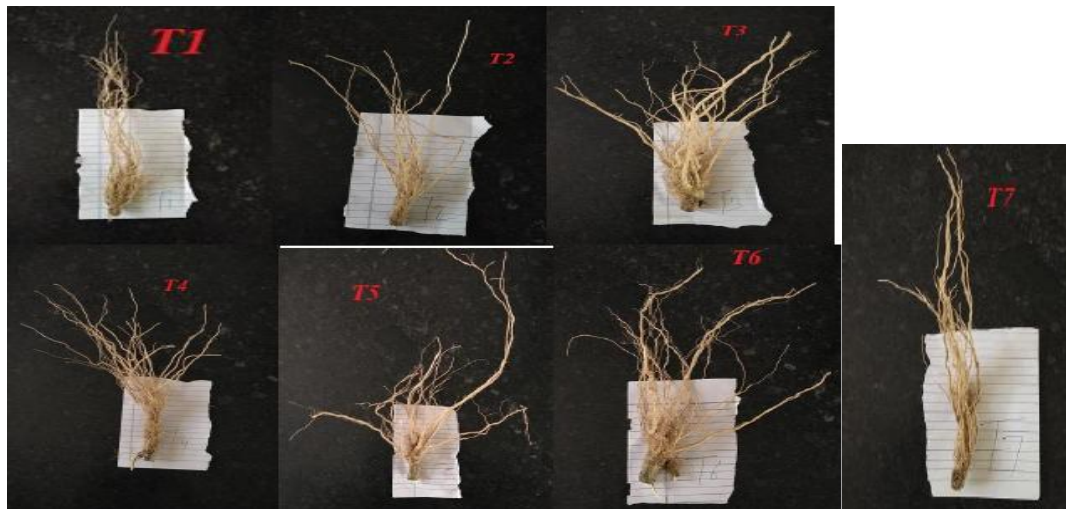
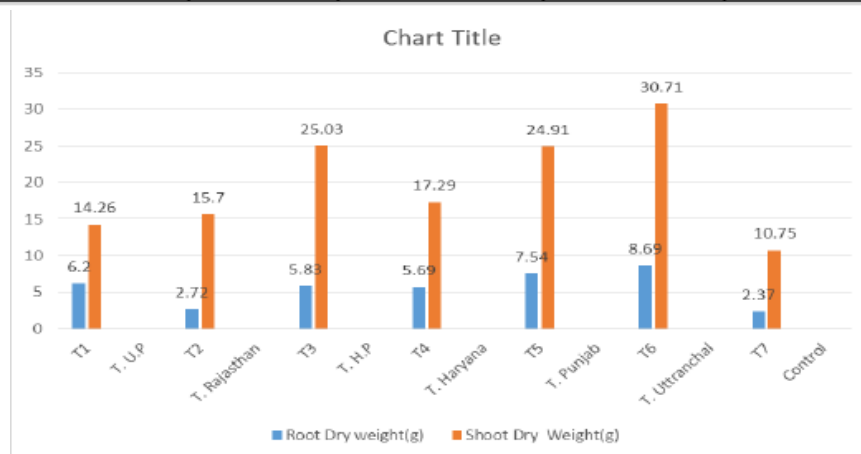


Figure showing the effects of different isolates on roots.

3.2.1.7Effect on shoot dry weight - Treatment of different *Trichoderma* isolates in tomato field, resulted in highest shoot dry weight of tomato (30.71g) (T6). Shoot dry weight in T6 is highest than control (10.75g). Second highest shoot dry weight (25.03g) was observed of tomato plants in T3 Shoot dry weight from T6 and T3 were significantly different from each other. Tomato shoot dry weight noticed from the plants applied with *Trichoderma* in T2 with (15.70g) and where shoot dry weight noticed in T5 (24.91g), but significantly less than T6 and T3. Application of *Trichoderma* isolates in T1 with (14.26 g), whereas in T4 with (17.29g).but significantly less than T6 and T3. However Shoot dry weight noticed in control plot was (10.75g) (T7).

3.2.2.1Effect of application of *Trichoderma* isolates on root dry weight, shoot dry weight on tomato fruit:

Treatment	Root Dry weight(g)	Percentage Increase	Shoot Dry Weight(g)	Percentage Increase
T1 T. U.P	6.20	161.60	14.26	32.65
T2 T. Rajasthan	2.72	14.76	15.70	46.04
T3 T. H.P	5.83	145.99	25.03	132.83
T4 T. Haryana	5.69	140.08	17.29	60.83
T5 T. Punjab	7.54	218.14	24.91	131.72
T6 T. Uttaranchal	8.69	266.66	30.71	185.67
T7 Control	2.37		10.75	
CD value	0.986		2.828	





Effect of *Trichoderma* isolates on fruit of Tomato crop

3.2.3. Disease Severity Treatment wise calculated (PDI)-

While evaluation the disease severity the highest PDI is observed is 51.22 % which is considered as control T7, where in T3 the PDI is evaluated is 46.77 %, in T1 and T2 is 45.22% and 43.44 %, where the lowest PDI is observed in T4 and T6 is 40.44 % and 35.44%.

Table 4.5 Disease Severity Treatment wise calculated (PDI)

Treatment	PDI		
	15	30	45
T1 <i>T. Uttar Pradesh</i>	22.22	26.66	45.22
T2 <i>T. Rajasthan</i>	27.77	31.11	43.44
T3 <i>T. Himachal Pradesh</i>	22.05	33.33	46.77
T4 <i>T. Haryana</i>	22.22	27.77	40.44
T5 <i>T. Punjab</i>	22.05	28.88	41.33
T6 <i>T. Uttaranchal</i>	20.11	22.21	35.44
T7 Control	25.92	42.22	51.22
CD Value	3.134	4.607	2.601

Attempt were made to isolates and maintain different isolates of *Trichoderma* from several states of India. The isolates confirmed as *Trichoderma* isolates were subjected to testing of antagonistic activity of *Trichoderma* isolates against early blight disease of Tomato pathogen. In general there was increase in the plants height and vigour of the Tomato Plants. However application of (T6) soil resulted in highest increase of Tomato plants height followed by (T4). The application of (T1) isolates resulted in lowest increase of Tomato plant height. Similarly the highest fruit yield of tomato was also recorded due to application of *Trichoderma* isolates (T6) followed by (T2). Application of *Trichoderma* isolates resulted lowest fruit yield of Tomato. Several workers such as Chang *et. al*, 1986; Yedidia *et. al*, 2001 and Adams *et. al*, (2007) Tomer *et, al.*, (2018) have already recorded the plant growth enhancement activity of *T. harzianum* due to suppression of deleterious root microflora, production of growth stimulating factors and increase nutrient uptake through solubilization and sequestration of nutrition and also by enhancing the root growth. (Cornejo *et al.* 2009, Tomer, *et. al*, 2014 &2015) have revealed the role of auxins in growth and development of *Arabidopsis thaliana* in response to inoculation with *T. virens* and *T. atroviride*. Thus the result of growth promotion in tomato plant by

T. harzianum during present investigation is quite in accordance with the findings of previous workers reported in above paragraphs. *In-vivo* tomato seedlings are treated with these different *Trichoderma* spp. from different location, whereas the (T6) *Trichoderma* of Uttaranchal gives best result in growth and development of tomato in all the parameters. Shoot dry weight in T6 (30.71g) is highest than control (10.75g). Second highest shoot dry weight (25.03g) was observed of tomato plants. Root dry weight in T6 is highest than control (2.37g). Second highest root dry weight (7.54g) was observed of tomato plants in T5. The highest PDI is observed is 51.22 % which is considered as control T-7, where in T-3 the PDI is evaluated is 46.77 %, in T-1 and T-2 is 45.22% and 43.44 % , where the lowest PDI is observed in T-4 and T-6 is 40.44 % and 35.44%.

In-vivo by evaluating the disease severity, there is less disease outcome in T6.

4.Conclusion:

From all the analysis of various data has been collected during the experiment it has been clearly seen that the various isolates collected from different regions have shown a great changes in various aspects of tomato crops. Although every character of tomato plants has been improved by some of the content either it will be fruit shape and size or root-shoot fresh or dry weight. The overall growth of the tomato crops has been improved by the use of various isolates under natural conditions.

In the present study lastly we have provided the tips for the tomato cultivating farmers.

1. Seeds must be treated with *Trichoderma* .before plantation.

2. Use disease resistant varieties for cultivation practices recommended by Agricultural University.
3. To make field sanitation before plantation.
4. Collect remaining parts of the plants from the field, burn it outside the field for reducing fungal population in a field.
5. To avoid cultivation of tomato crop where there is cultivation of potato crop in neighbouring field because tomato crop is more susceptible if cultivated nearby potato crop.
6. To make proper irrigation facilities for tomato field.
7. Crop rotation method reducing disease virulence in a field.
8. Keep proper spacing in between the two rows for free circulation of air.
9. To avoid unnecessarily visits of outsiders, visitors, entry of animals in the tomato field.

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