Biopriming of Tomato Seeds with Native *Trichoderma* Species for Enhanced Seedlings Vigour

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**Abstract**

The present research was carried out to investigate the effect of tomato seed biopriming using six native *Trichoderma* isolates under laboratory conditions. The seeds of tomato were primed in *Trichoderma* isolates and as a control treatment seeds were treated in sterile distilled water. It was observed that all the six native *Trichoderma* isolates showed good performance with respect to growth, germination percentage and vigour index of tomato seedlings as compared to control. Among the different *Trichoderma* isolates tested, T5 isolate showed highest shoot growth (5.44 cm), root growth (3.74 cm), germination percentage (90.0%) and seedling vigour index (826.37) followed by T4 isolate. The lowest shoot growth (4.22 cm), root growth (3.07 cm), germination percentage (56.7%) and seedling vigour index (412.70) were recorded in untreated control.

**Keywords:** Biopriming, Seedling vigour, *Solanum lycopersicum* L., Tomato, *Trichoderma* species, Vegetable crop

**Introduction**

The tomato (*Solanum lycopersicum* L.) holds significance as a crucial vegetable crop within the agricultural landscape of India and is widely cultivated across the country. It is not only a staple vegetable in Indian cuisine but also contribute significantly to the economy. It belongs to solanaceous family and a native from Mexico. Tomato holds a significant position as one of the primary horticultural crops in India, grown on 844 thousand hectares, producing 21,180 thousand MT during the year of 2020-21 (Anonymous, 2022). Numerous biotic and abiotic stresses; however, have a significant impact on tomato production. Major diseases spread through the seeds that cause a significant loss in yield include fusarium wilt (*Fusarium oxysporum* f. sp. *lycopersici*), early blight (*Alternaria solani*), bacterial wilt (*Ralstonia solanacearum*), damping off of seedlings (*Pythium* sp., *Phytophthora* sp., etc.), and leaf mosaic (*Tomato mosaic virus*) (Bhagat et al., 2013). So, it is necessary to control various seed borne diseases with the help of different procedure of seed treatment. Biological seed treatment is the most suitable method by using antagonistic microorganisms to protect the seeds from pathogenic microorganisms. It also has a lower likelihood of relying on chemical pesticides to control disease (Callan et al., 1997; Pill et al., 2009). Seed treatment stands out as widely used techniques for introducing biological control agents. When compared to drenching, seed treatment is more cost-effective and efficient because it requires a smaller amount of inoculums (Bennett et al., 1992; Pill et al., 2009). Various biocontrol agents, viz., *Trichoderma viride*, *T. harzianum*, *Psedomonas fluorescens* and *Bacillus subtilis* are used for biopriming treatment (Sharma et al., 2023). *Trichoderma* spp. stands out as the most prevalent free-living saprophytic fungus among these biocontrol agents; it is widely used as an antagonistic microorganism or biocontrol agents in the biopesticide industry (Woo et al., 2014) as well as in the development of plant growth. Seed biopriming is a potential method to improve plant health by seed coating with *Trichoderma* spp. and may provide a number of agronomic and economic benefits (Kthiri et al., 2020). It provides protection to the seed against diverse seed-borne and soil-borne pathogens by reducing the occurrence of diseases in an ecological manner (Harman and Taylor, 1988; Jensen et al., 2004). This approach has
proven success as a non-chemical and eco-friendly method in promoting sustainable agricultural production.

Considering all these factors, the current study was conducted with an objective to evaluate effects of seed biopriming by using six native *Trichoderma* isolates in tomato.

**Materials and Methods**

The experiment took place at the Plant Pathology Laboratory, Regional Research and Technology Transfer Station, Odisha University of Agriculture and Technology (OUAT), located in Chiplima, Sambalpur, Odisha. Six numbers of native *Trichoderma* spp. were isolated from various rhizosphere soil of different crops of RRTTS, Chiplima designated as CHP1 to CHP6 (Table 1) are used for the study. 1 g of rhizospheric soil was suspended in 10 ml of sterile distilled water and thoroughly stirred. From this suspension, 1 ml of the suspension was poured onto 90 mm glass petriplates containing a *Trichoderma*-specific medium (TSM, Elad *et al*., 1981; modified by Saha and Pan, 1997) and the petriplates were incubated at a temp. of 25±2 °C for a period of 7 days. Regular observations of the petriplates were made and morphological characteristics of the *Trichoderma* colonies were used to identify them. For confirmation, these were examined in more detail using a trinocular light microscope, looking for filamentous and hyphal characteristics. Individual colonies were picked up from petriplates once they surfaced and sub cultured in PDA slants or petriplates for working as stock. This culture is stored at -20 °C for further use.

Seed biopriming were done by preparing broth culture of respective *Trichoderma* isolates. *Trichoderma* broth cultures were made from seven-day-old cultures, and a haemocytometer was used to adjust the suspensions to 1×10⁴ spore ml⁻¹. Seeds of the test crop (Tomato var. Pusa rubi) were rinsed with sterile distilled water, allowed to air dry and subsequently immersed in the respective *Trichoderma* broth culture suspension for a few minutes. The seeds were thoroughly stirred to ensure uniform coverage with the bio-agent suspension. Separate treatments were made for all six native *Trichoderma* sp.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the treatment</th>
<th>Name of the isolate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T₁ (CHP1)</td>
<td><em>Trichoderma asperellum</em></td>
</tr>
<tr>
<td>2</td>
<td>T₂ (CHP2)</td>
<td><em>Trichoderma asperellum</em></td>
</tr>
<tr>
<td>3</td>
<td>T₃ (CHP3)</td>
<td><em>Trichoderma harzianum</em></td>
</tr>
<tr>
<td>4</td>
<td>T₄ (CHP4)</td>
<td><em>Trichoderma asperellum</em></td>
</tr>
<tr>
<td>5</td>
<td>T₅ (CHP5)</td>
<td><em>Trichoderma asperellum</em></td>
</tr>
<tr>
<td>6</td>
<td>T₆ (CHP6)</td>
<td><em>Trichoderma erinaceum</em></td>
</tr>
<tr>
<td>7</td>
<td>T₇ (Control)</td>
<td>-</td>
</tr>
</tbody>
</table>

The treated seeds were then placed on clean blotting paper and left to air dry in the shade. Subsequently, the dried seeds were transferred to petridishes containing a double layer of moist blotting paper and the petridishes were incubated at a temp. of 25±2 °C for a period of 10 days. Seeds treated with sterile distilled water were used as control treatment in the experiment.

The vigor index of the respective seedlings was calculated based on the root and shoot length, using the following method (Abdul-Baki and Anderson, 1973),

\[
\text{Vigour index (VI)} = (\text{Shoot length} + \text{Root length}) \times \frac{1}{100}
\]

**Results and Discussion**

The experimental results represented in table 2 indicates the impact of seed biopriming after 10 days of inoculation with native *Trichoderma* isolate on shoot length, root length, germination percentage and seedling vigour index. The experimental finding shows that significant increase in shoot length was observed after seed biopriming with different native *Trichoderma* isolates as compared to untreated control. Within the various treatments, the maximum shoot length growth was noticed in T₅ treatment (5.44 cm); however, T₅ (5.32 cm) was at par with T₆ followed by T₇ (5.21 cm) and T₈ (4.95 cm); whereas, they did not differ significantly. The minimum shoot length growth was observed in untreated control. The highest root length growth was recorded in T₅ treatment (3.74 cm), followed by T₅ (3.67 cm) and T₄ (3.53 cm) which was statistically significant to each other. In case of germination percentage, highest germination percentage was recorded in T₅ treatment (90.0%), followed by T₄ (86.7%) and T₆ (80.0%) treatment. Regarding seedling vigour index, maximum seedling vigour index was observed in T₅ treatment (826.37) followed by T₄ (779.09) and T₆ (680.74). The lowest seedling vigour index was observed in untreated control (412.70).

The present experimental results align with the findings observed by Yadav *et al.* (2013), who found that, in comparison to non-primed control plants, seed biopriming increased plant growth and germination percentage. Additionally, Raju *et al.* (1999) proposed that biopriming sorghum seeds with *Trichoderma harzianum* led to an improvement in both germination percentage and plant vigor compared to untreated control seeds.

Substantiatted increase in germination, plant growth and seedling vigour were recorded by the seed inoculation of the bioccontrol agents which was in agreement with the earlier findings (Nezarat and Gholami, 2009; Saxena *et al*., 2015). Harman (2000) also noted that the shoot and root lengths of maize crops were significantly increased by biopriming seed with *Trichoderma harzianum*. The experimental results are consistent with the investigation recorded by Sehim *et al.* (2023), who claimed that treating tomato seeds with *Trichoderma asperellum* improved seed germination, root and shoot length and vigour index.
### Table 2: Effects of biopriming of different *Trichoderma* isolate on tomato seedlings

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Shoot length (cm)</th>
<th>Root length (cm)</th>
<th>Germination (%)</th>
<th>Seedling vigour index</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>4.77</td>
<td>3.53</td>
<td>76.7 (61.14)**</td>
<td>636.07</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>5.21</td>
<td>3.39</td>
<td>75.3 (58.88)</td>
<td>630.80</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>4.60</td>
<td>3.37</td>
<td>66.7 (54.75)</td>
<td>531.31</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>5.32</td>
<td>3.67</td>
<td>86.7 (68.65)</td>
<td>779.09</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>5.44</td>
<td>3.74</td>
<td>90.0 (71.56)</td>
<td>826.37</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>4.95</td>
<td>3.57</td>
<td>80.0 (63.43)</td>
<td>680.74</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;</td>
<td>4.22</td>
<td>3.07</td>
<td>56.7 (48.83)</td>
<td>412.70</td>
</tr>
<tr>
<td>S.Em±</td>
<td>0.22</td>
<td>0.11</td>
<td>0.96</td>
<td>19.78</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>0.69</td>
<td>0.35</td>
<td>2.94</td>
<td>60.59</td>
</tr>
</tbody>
</table>

*Mean data of three replications; **Figures in parentheses are angular transformed values

### Conclusion

Thus, it can be said that, in comparison to untreated seeds, biopriming of tomato seed with native *Trichoderma* species can increase the germination percentage and seedling vigour index. Among the isolate tested the T<sub>4</sub> isolate was found as the best isolate with respect to shoot growth, root growth, germination percentage and seedling vigour index, followed by T<sub>5</sub> isolate and will be helpful for better establishment of the plant and defence against biotic and abiotic factors also.

### References

- Sehmi, A.E, Hewedy, O.A., Altammar, K.A., Alhumaidi, M.S.,

