DOI: 10.54083/ResBio/5.3.2023/113-116

Res. Bio., 2023, 5(3):113-116

Research Biotica

e-ISSN: 2582-6743

September, 2023

Article ID: RB189

Research Article

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

Dipankar Mandal*, Rini Pal and Sanjukta Mohapatra

Regional Research and Technology Transfer Station, Odisha University of Agriculture and Technology, Chiplima, Sambalpur, Odisha (768 025), India

Open Access

Corresponding Author

Dipankar Mandal

✉: dipankarpatho@gmail.com

Conflict of interests: The author has declared that no conflict of interest exists.

How to cite this article?

Mandal *et al.*, 2023. Biopriming of Tomato Seeds with Native *Trichoderma* Species for Enhanced Seedlings Vigour. *Research Biotica* 5(3): 113-116.

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, T_5 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 T_4 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 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

Article History

RECEIVED on 25th June 2023 RECEIVED in revised form 14th August 2023 ACCEPTED in final form 21st August 2023

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 was extracted and subsequent serial dilutions (10^{-1} to 10^{-6}) were prepared. From the required dilution, 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 1×10^{8} 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 1: List of treatments used in seed biopriming experiment

Sl. No.	Name of the treatment	Name of the isolate
1.	T_1 (CHP1)	*Trichoderma asperellum*
2.	T_2 (CHP2)	*Trichoderma asperellum*
3.	T_3 (CHP3)	*Trichoderma harzianum*
4.	T_4 (CHP4)	*Trichoderma asperellum*
5.	T_5 (CHP5)	*Trichoderma asperellum*
6.	T_6 (CHP6)	*Trichoderma erinaceum*
7.	T_7 (Control)	-

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),

Vigour index (VI) = (Shoot length + Root length) × Germination %

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 T_5 treatment (5.44 cm); however, T_4 (5.32 cm) was at par with T_5 followed by T_2 (5.21 cm) and T_6 (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 T_5 treatment (3.74 cm), followed by T_4 (3.67 cm) and T_1 (3.53 cm) which was statistically significant to each other. In case of germination percentage, highest germination percentage was recorded in T_5 treatment (90.0%), followed by T_4 (86.7%) and T_6 (80.0%) treatment. Regarding seedling vigour index, maximum seedling vigour index was observed in T_5 treatment (826.37) followed by T_4 (779.09) and T_6 (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.

Substantiated increase in germination, plant growth and seedling vigour were recorded by the seed inoculation of the biocontrol 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

Treatment	Shoot length* (cm)	Root length* (cm)	Germination (%)	Seedling vigour index
T_1	4.77	3.53	76.7 (61.14)**	636.07
T_2	5.21	3.39	75.3 (58.88)	630.80
T_3	4.60	3.37	66.7 (54.75)	531.31
T_4	5.32	3.67	86.7 (68.65)	779.09
T_5	5.44	3.74	90.0 (71.56)	826.37
T_6	4.95	3.57	80.0 (63.43)	680.74
T_7	4.22	3.07	56.7 (48.83)	412.70
S.Em±	0.22	0.11	0.96	19.78
CD at 5%	0.69	0.35	2.94	60.59

*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_5 isolate was found as the best isolate with respect to shoot growth, root growth, germination percentage and seedling vigour index, followed by T_4 isolate and will be helpful for better establishment of the plant and defence against biotic and abiotic factors also.

References

Abdul-Baki, A.A., Anderson, J.D., 1973. Vigor determination in soybean seed multiple criteria. *Crop Science* 13(6), 630-633. DOI: https://doi.org/10.2135/cropsci1973.0011183X001300060013x.

Anonymous, 2022. Agricultural Statistics at a Glance 2022. Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare, Economics & Statistics Division, New Delhi (110 001), India. URL: www.agricoop.nic.in, https://desagri.gov.in.

Bennett, M.A., Fritz, V.A., Callan, N.W., 1992. Impact of seed treatments on crop stand establishment. *HortTechnology* 2(3), 345-349. DOI: https://doi.org/10.21273/HORTTECH.2.3.345.

Bhagat, S., Bambawale, O.M., Tripathi, A.K., Ahmad, I., Srivastava, R.C., 2013. Biological management of fusarial wilt of tomato by *Trichoderma* spp. in Andamans. *Indian Journal of Horticulture* 70(3), 397-403.

Callan, N.W., Mathre, D.E., Miller, J.B., Vavrina, C.S., 1997. Biological seed treatments: factors involved in efficacy. *Horticultural Science* 32(2), 179-183.

Elad, Y., Chet, I., Henis, Y., 1981. A selective medium for improving quantitative isolation of *Trichoderma* spp. from soil. *Phytoparasitica* 9, 59-67. DOI: https://doi.org/10.1007/BF03158330.

Harman, G.E., 2000. Myths and dogmas of biocontrol: Changes in perceptions derived from research on *Trichoderma harzianum* T-22. *Plant Disease* 84(4), 377-393. DOI: https://doi.org/10.1094/PDIS.2000.84.4.377.

Harman, G.E., Taylor, A.G., 1988. Improved seedling performance by integration of biological control agents at favorable pH levels with solid matrix priming. *Phytopathology* 78(5), 520-525. DOI: https://doi.org/10.1094/Phyto-78-520.

Jensen, B., Knudsen, I.M.B., Madsen, M., Jensen, D.F., 2004. Biopriming of infected carrot seed with an antagonist, *Clonostachys rosea*, selected for control of seed borne *Alternaria* spp. *Phytopathology* 94(6), 551-560. DOI: https://doi.org/10.1094/PHYTO.2004.94.6.551.

Kthiri, Z., Jabeur, M.B., Omri, N., Hamada, W., 2020. Effect of coating seeds with *Trichoderma harzianum* (S. INAT) on the oxidative stress induced by *Fusarium culmorum* in durum wheat. *Journal of New Sciences: Agriculture and Biotechnology* 77(5), 4150-4522.

Nezarat, S., Gholami, A., 2009. Screening plant growth promoting rhizobacteria for improving seed germination, seedling growth and yield of maize. *Pakistan Journal of Biological Sciences* 12(1), 26-32. DOI: https://doi.org/10.3923/pjbs.2009.26.32.

Pill, W.G., Collins, C.M., Goldberger, B., Gregory, N., 2009. Responses of non-primed or primed seeds of 'Marketmore 76' cucumber (*Cucumis sativus* L.) slurry coated with *Trichoderma* species to planting in growth media infested with *Pythium aphanidermatum*. *Scientia Horticulturae* 121(1), 54-62. DOI: https://doi.org/10.1016/j.scienta.2009.01.004.

Raju, N.S., Niranjana, S.R., Janardhana, G.R., Prakash, H.S., Shetty, H.S., Mathur, S.B., 1999. Improvement of seed quality and field emergence of *Fusarium moniliforme* infected sorghum seeds using biological agents. *Journal of the Science of Food and Agriculture* 79(2), 206-212. DOI: https://doi.org/10.1002/(SICI)1097-0010(199902)79:2<206::AID-JSFA167>3.0.CO;2-Y.

Saha, D.K., Pan, S., 1997. Qualitative evaluation of some specific media of *Trichoderma* and *Gliocladium* spp. *Journal of Mycopathological Research* 35, 7-13.

Saxena, A., Raghuwanshi, R., Singh, H.B., 2015. *Trichoderma* species mediated differential tolerance against biotic stress of phytopathogens in *Cicer arietinum* L. *Journal of Basic Microbiology* 55(2), 195-206. DOI: https://doi.org/10.1002/jobm.201400317.

Sehim, A.E, Hewedy, O.A., Altammar, K.A., Alhumaidi, M.S., Abd Elghaffar, R.Y., 2023. *Trichoderma asperellum* empowers tomato plants and suppresses *Fusarium oxysporum* through priming responses. *Frontiers in Microbiology* 14, 1140378. DOI: https://doi.org/10.3389/fmicb.2023.1140378.

Sharma, A., Shukla, A., Gupta, M., 2023. Effect of bioagents on cucumber seed mycoflora, seed germination, and seedling vigour. *Scientific Reports* 13, 6052. DOI: https://doi.org/10.1038/s41598-023-30253-3.

Woo, S.L., Ruocco, M., Vinale, F., Nigro, M., Marra, R., Lombardi, N., Pascale, A., Lanzuise, S., Manganiello, G., Lorito, M., 2014. *Trichoderma*-based products and their widespread use in agriculture. *The Open Mycology Journal* 8, 71-126. DOI: https://doi.org/10.2174/1874437001408010071.

Yadav, S.K., Dave, A., Sarkar, A., Singh, H.B., Sharma, B.K., 2013. Co-inoculated biopriming with *Trichoderma*, *Pseudomonas* and *Rhizobium* improves crop growth in *Cicer arietinum* and *Phaseolus vulgaris*. *International Journal of Agriculture, Environment and Biotechnology* 6(2), 255-259.