

Influence of *Trichoderma harzianum* on the growth of watermelon seedlings (*Citrullus lanatus* Thunb.)

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ABSTRACT

Objective: To evaluate the growth of watermelon seedlings of the Charleston cultivar inoculated with four doses of *Trichoderma harzianum*.

Design/methodology/approach: A randomized complete block design with ten replicates was established. Watermelon seeds of the Charleston cultivar were sown in germination trays, and four doses of *Trichoderma harzianum* (T1: 1 g L⁻¹, T2: 1.5 g L⁻¹, T3: 2 g L⁻¹, and T4: 2.5 g L⁻¹), along with a control (0 g L⁻¹), were evaluated as treatments. The variables assessed were stem diameter, leaf fresh weight, stem fresh weight, root ball weight, number of leaves, stem length, robustness index, stem dry weight, leaf dry weight, and root dry weight.

Results: The most outstanding treatment was T1, which produced the greatest seedling growth, followed by T2, which also contributed favorably to plant quality.

Limitations on study/implications: The results are limited to only four doses of *Trichoderma harzianum* for promoting the growth of watermelon seedlings; however, they provide valuable information for optimizing microorganism-based biostimulant doses for seedling production under greenhouse conditions.

Findings/conclusions: The application of *Trichoderma harzianum* exhibited a growth-promoting effect on watermelon seedlings. High doses of *Trichoderma harzianum* (T3 and T4) showed a limited effect on growth and, in some cases, may be less effective than lower doses.

Keywords: biofertilizer, greenhouse, biostimulant, microorganism, Steiner nutrient solution.

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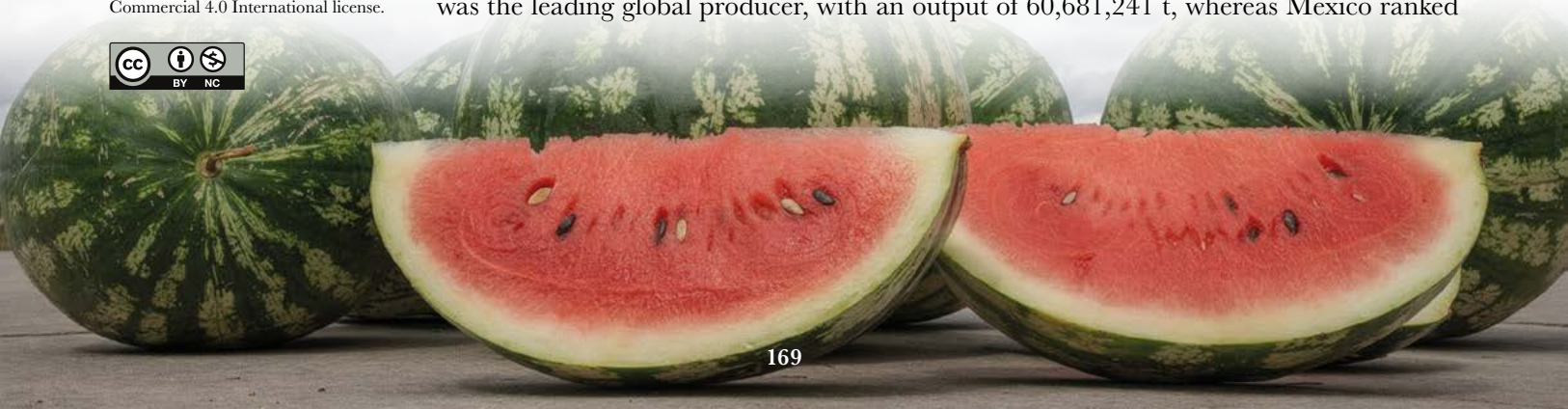
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INTRODUCTION

Watermelon (*Citrullus lanatus* Thunb.) (Cucurbitaceae) is a widely cultivated species consumed worldwide because of its nutritional value, health benefits, and importance in the pharmaceutical sector (Sorokina *et al.*, 2021; Nkoana *et al.*, 2022). In 2024, China was the leading global producer, with an output of 60,681,241 t, whereas Mexico ranked



eleventh, with 1,345,705 t and an average yield of 42.6 t ha⁻¹ (FAOSTAT, 2024). At the national level, the principal producing states are Sonora, Chihuahua, Veracruz, Jalisco, and Sinaloa, with yields ranging from 21.42 to 51.76 t ha⁻¹ (SIAP, 2025).

The yield of watermelon and other vegetable crops depends to a great extent on the quality of the seedlings used for transplanting (Araméndiz-Tatis *et al.*, 2013). Seedlings are produced under controlled conditions to ensure optimal germination and early growth; however, once transplanted to open-field or protected environments, their development may be affected by biotic factors, such as diseases and pests, and abiotic factors, such as drought, extreme temperatures, and salinity, among others, all of which influence the essential biochemical and physiological processes of the plant.

These conditions generate stress situations that reduce productive potential, since the plant must allocate additional resources to adapt and survive under adverse conditions rather than directing them toward growth, fruit production, or biomass accumulation (Valero *et al.*, 2023). For this reason, one of the available alternatives to mitigate the negative effects of these factors is the use of biostimulant or osmoprotective substances, including beneficial microorganisms such as the fungus *Trichoderma*, a soil probiotic capable of improving crop physiological traits, promoting growth, and enhancing yield and quality (Liu *et al.*, 2025).

In addition, it acts as a biocontrol agent by reducing disease severity and improving enzymatic activity and tolerance to abiotic stress, thereby indirectly contributing to plant growth and vigor (Andrade-Hoyos *et al.*, 2023). Mahmoodian *et al.* (2022) reported that inoculation with *Trichoderma harzianum* in bean seedlings increased total biomass, seedling height, root length, root area, root diameter, root number, and overall seedling growth. *Trichoderma harzianum* can also reduce the need for chemical fertilization from the seedling stage onward, thereby promoting sustainable agricultural production (Calin *et al.*, 2019; Guzmán-Guzman *et al.*, 2025). Accordingly, the growth of Charleston cultivar watermelon seedlings inoculated with four doses of *Trichoderma harzianum* was evaluated.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the facilities of the Faculty of Agriculture of Valle del Fuerte, located in the municipality of Juan José Ríos, Sinaloa, Mexico (108° 49' 23" W and 25° 45' 57" N, at an altitude of 10 m), in a tunnel-type greenhouse with a metal structure and a polyethylene plastic cover (75% light transmission). Temperature inside the greenhouse was recorded with a Steren[®] digital thermometer; maximum and minimum temperatures ranged from 38 to 22 °C.

Plant material

Watermelon seeds (*Citrullus lanatus* Thunb.) of the Charlestone variety, from the commercial brand El Trébol[®], were used. Sowing was carried out on June 29, 2024, in 128-cell polystyrene trays, each cavity having a volume capacity of 46 mL and a depth of 6.5 cm. The trays were filled with non-sterilized peat substrate (BM2 Euro Berger[®]), composed of sphagnum peat moss. One seed was placed per cavity, and the

seed was subsequently covered with a vermiculite-based substrate to preserve moisture and promote germination.

Experimental design and treatments

A completely randomized design was established, consisting of 10 replicates, with two plants per replicate. Four doses were used as treatments: T1 (1 g L⁻¹), T2 (1.5 g L⁻¹), T3 (2 g L⁻¹), and T4 (2.5 g L⁻¹) of a commercial product based on the fungus *Trichoderma harzianum*, with a composition of 300 g kg⁻¹ active ingredient and 1.2 × 10⁷ colony-forming units (CFU) per gram of dry weight, as well as a control treatment (T0).

Each treatment was applied manually at the base of the stem. The first application of *Trichoderma* was performed at sowing, and the second application was carried out 10 days after sowing (DAS). All treatments received the same basal fertilization, consisting of Steiner nutrient solution (Steiner, 1984) without micronutrients (pH=6.4 and EC=1.6 dS m⁻¹), with a composition of 167, 30.9, 276, 117, 48.9, and 64.5 mg L⁻¹ of N, P, K, Ca, Mg, and S, respectively. Two applications of this solution were performed, at 10 and 15 DAS. The Steiner solution was prepared with potable water (0.30 dS m⁻¹), and irrigation was applied manually.

Agronomic management

Pest control was carried out with the commercial product Controla 480 (chlorpyrifos ethyl 44.5%; 5 mL L⁻¹). For the control of fungal diseases, the commercial fungicide Carbenpro (carbendazim 50%; 2.5 mL L⁻¹) was applied, whereas bacterial control was performed with Curamycín 500 (streptomycin 2.19% + oxytetracycline 0.23%; 1.5 g L⁻¹) at 12 DAS.

Evaluated variables

Growth variables were evaluated at 22 DAS: stem diameter (SD, mm), stem length (SL, cm), plant robustness index (RI), root ball weight (RBW, g), leaf fresh weight (LFW, mg), stem fresh weight (SFW, mg), number of leaves (NL), stem dry weight (SDW, mg), leaf dry weight (LDW, mg), and root dry weight (RDW, mg).

Stem diameter (SD, mm) was measured with a digital caliper (Stern[®]) at 0.5 cm above the base of the stem. For the variables LFW, SFW, and RBW, a Lcd[®] precision digital balance was used. Subsequently, these samples were placed in paper bags and dried in a wooden dryer with lamps at an average temperature of 65 °C to obtain dry weight. The number of leaves (NL) was counted manually, and stem length (SL, cm) was measured with a graduated ruler. Finally, stem dry weight (SDW, mg), leaf dry weight (LDW, mg), and root dry weight (RDW, mg) were determined using a Lcd[®] precision digital balance.

Statistical analysis

Analysis of variance (ANOVA) was performed using InfoStat version 2020. The recorded data were subjected to the Shapiro and Wilk (1965) normality test. Growth variables that showed normal distribution were analyzed by one-way ANOVA, and mean separation was conducted using Tukey's Studentized Range test at the 5% significance level.

RESULTS AND DISCUSSION

According to the analysis of variance, significant differences ($p \leq 0.05$) were observed for stem diameter, stem length, plant robustness index, root ball weight, stem fresh weight, number of leaves, and leaf dry weight in watermelon seedlings treated with different doses of the biostimulant based on *T. harzianum*. In contrast, no significant differences ($p > 0.05$) were found for leaf fresh weight, stem dry weight, and root dry weight (Table 1).

The effect of the different doses of the biostimulant based on the fungus *Trichoderma harzianum* on watermelon seedlings showed variation across the growth variables evaluated. Stem diameter was greatest under treatment T2 (1.5 g L^{-1}) (Figure 1A), followed by T3 (2 g L^{-1}), which showed a similar response and outperformed the remaining treatments, T0, T1, and T4. Quesada and Méndez (2005) indicate that stem diameter is an indicator of seedling vigor, as it is associated with greater strength and resistance during transplanting.

Treatment T1 (1 g L^{-1}) resulted in the greatest stem length (Figure 1B), being significantly higher (37%) than the other treatments, including the control. This suggests that, under the conditions in which this study was conducted, the lowest dose of *Trichoderma* (T1) was the most effective in promoting stem or shoot growth. In addition, T2, T3, and T4 were also significantly higher than the control treatment (T0). In contrast to these results, in which greater stem length was obtained with the lowest dose of *Trichoderma*, Hidayat *et al.* (2024), when evaluating different doses of *Trichoderma harzianum* on watermelon plant growth, reported greater stem elongation with the highest dose (40 mL L^{-1}). Likewise, Waheed *et al.* (2020) obtained greater stem length in watermelon plants (cv. Sugar Baby) with the highest concentration of *T. harzianum*, 1.50×10^4 CFU, which represented an 18% increase relative to the control.

Regarding the plant quality or robustness index, the highest values were recorded under treatments T1 (1 g L^{-1}) and T3 (2 g L^{-1}), both of which surpassed the control (T0) (Figure 1C). These results demonstrate that such doses were sufficient to produce high-quality, more vigorous seedlings in terms of stem length and diameter, since higher doses may become counterproductive for the crop. In this regard, Liu *et al.* (2025), when evaluating different doses of *Trichoderma viride* (1.0×10^4 , 8.0×10^4 , 6.4×10^5 , and 5.12×10^6 CFU g^{-1}) in melon, determined that excessive doses may be counterproductive; therefore, regulating the applied amount is essential, with the optimal dose identified as 6.4×10^5 CFU g^{-1} . Liu *et al.* (2025) further reported that inoculation with *Trichoderma viride* (6.4×10^5 CFU g^{-1}) in melon (*Cucumis melo* L.) exerted a positive effect on seedling morphology, reflected in increases in stem diameter, leaf area, total dry weight, as well as in the root-to-shoot ratio

Table 1. Mean squares for the growth of Charleston variety watermelon seedlings (*Citrullus lanatus* Thunb.) treated with a biostimulant based on *Trichoderma harzianum*.

Source of variation (SV)	SD	SL	RI	RBW	LFW	SFW	NL	SDW	LDW	RDW
Treatments	0.34**	12.5**	0.67**	67.99**	ns	0.06*	0.86*	ns	2196.48*	ns
CV (%)	7.52	13.31	14.07	11.61	15.14	14.41	10.65	19.34	15.32	14.71
Tukey ($p \leq 0.05$)	0.29	1.2	0.52	2.94	0.19	0.16	0.7	25.62	30.61	20.42

SD: stem diameter; SL: stem length; RI: plant robustness index; RBW: root ball weight; LFW: leaf fresh weight; SFW: stem fresh weight; NL: number of leaves; SDW: stem dry weight; LDW: leaf dry weight; RDW: root dry weight.

and seedling vigor. Similarly, Metwally and Al-Amri (2020) observed in onion (*Allium cepa*) that the combined application of *Trichoderma viride* and arbuscular mycorrhizal fungi was both compatible and synergistic, promoting improvements in growth parameters such as fresh weight, total dry weight, root and stem length, and leaf area in comparison with the control plants.

Root ball weight, including the roots and the soil adhered to them, is a key indicator of root development. Treatment T1 (1 g L^{-1}) showed the greatest root ball weight (Figure 1D), indicating superior root development compared with the other treatments and the control. A larger and heavier root system suggests a greater capacity of the plant to absorb water and nutrients (Vazallo *et al.*, 2013).

All *Trichoderma* doses (T1, T2, T3, and T4) produced leaf fresh weight (Figure 2A) and stem dry weight (Figure 2B) values similar to those of the control (T0). In contrast to these results, Waheed *et al.* (2020) observed a significant increase relative to the control in leaf fresh weight, from 759.1 g to 903.8 g (a 19% increase), and in stem dry weight, from 71.3 g to 93.3 g (a 30.9% improvement).

The number of leaves (Figure 2C) and stem fresh weight (Figure 2D) were greater in seedlings treated with T4 (2.5 g L^{-1}), as well as in those treated with T1, T2, and T3, all of which showed significant differences relative to the control. Treatment T4 exhibited the greatest shoot growth, suggesting that the highest dose (2.5 g L^{-1}) was the most effective in promoting vegetative growth. In this regard, Tambe and Bhosale (2020) and Hidayat *et al.* (2024) reported that the use of high concentrations of *T. harzianum* enhances the vegetative growth of watermelon plants, as well as fruit productivity and quality, with improvements

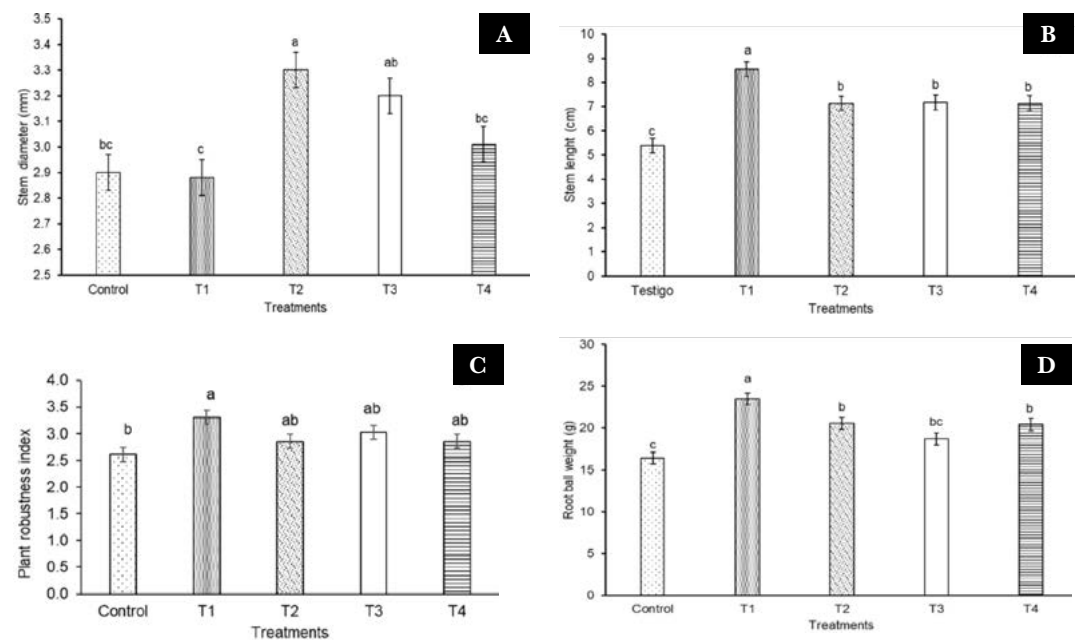


Figure 1. A: Stem diameter (mm); B: Stem length (cm); C: Plant robustness index; D: Root ball weight of watermelon seedlings treated with different doses of *Trichoderma harzianum*. Control (0 g L^{-1}), T1 (1 g L^{-1}), T2 (1.5 g L^{-1}), T3 (2 g L^{-1}), and T4 (2.5 g L^{-1}). Means followed by the same letter within each column are not statistically different (Tukey, $p \leq 0.05$).

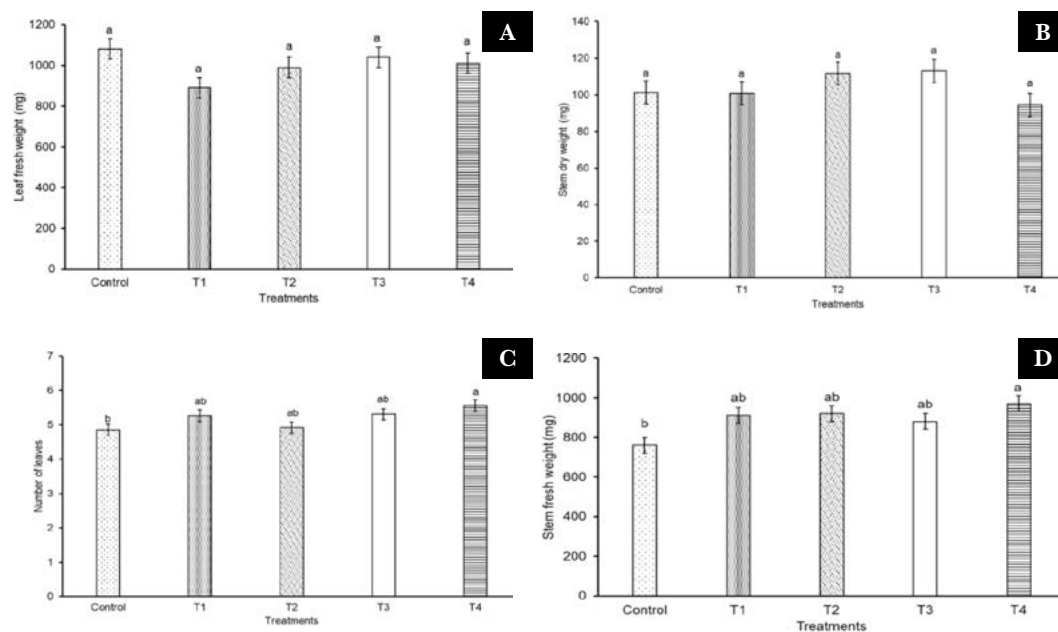


Figure 2. A: Leaf fresh weight (mg); B: Stem dry weight (mg); C: Number of leaves; D: Stem fresh weight of watermelon seedlings treated with different doses of *Trichoderma harzianum*. Control (0 g L^{-1}), T1 (1 g L^{-1}), T2 (1.5 g L^{-1}), T3 (2 g L^{-1}), and T4 (2.5 g L^{-1}). Means followed by the same letter within each column are not statistically different (Tukey, $p \leq 0.05$).

in nutritional content and physiological parameters. Waheed *et al.* (2020) further noted that increases in the vegetative growth of watermelon plants are directly associated with the ability of *T. harzianum* to improve nutrient uptake and stimulate the production of plant hormones such as auxins, cytokinins, and gibberellins. Likewise, Tariq Javeed *et al.* (2021) indicated that the plant-*Trichoderma* interaction exerts a beneficial effect on plant physiology, thereby stimulating vegetative growth.

Leaf dry weight was greater under doses T2 (1.5 g L^{-1}) and T4 (2.5 g L^{-1}), with no differences between treatments T1 (1 g L^{-1}) and T3 (2 g L^{-1}), being 26.6%, 27.5%, 19.7%, and 16% higher than the control, respectively (Figure 3A). However, dose T3 (2 g L^{-1}) showed a slight reduction in foliage dry weight compared with the other doses, although it remained significantly higher than the control. This may suggest mild inhibition at that specific dose, which constitutes an important finding for optimizing the application of this fungus. In contrast to these results, in other cucurbit species, no significant differences were found among treatments with different doses of *Trichoderma harzianum* (0 -, 5 -, and 10 -mL L^{-1}) (Muñoz-López and Monge-Pérez, 2024).

Root dry weight was statistically similar across all evaluated treatments; however, all applied doses resulted in greater root dry weight compared with the control (Figure 3B). In contrast, Muñoz-López and Monge-Pérez (2024) reported greater root dry weight in the control ($2,523.06 \text{ mg}$ per plant) than in treatments with 5 - and 10 -mL L^{-1} of *T. harzianum* (704.12 and $1,175.21 \text{ mg}$ per plant, respectively), concluding that the application of this fungus exerted a negative effect on root development in tacaco cuttings under shade-house conditions.

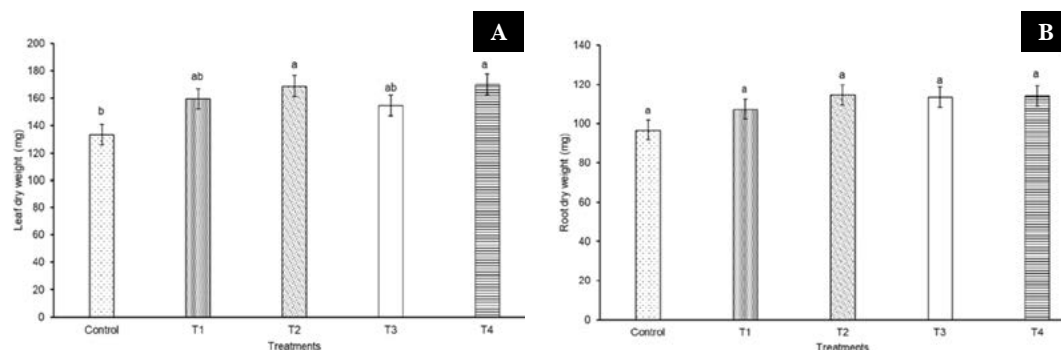


Figure 3. A: Leaf dry weight (mg); B: Root dry weight (mg) of watermelon seedlings treated with different doses of *Trichoderma harzianum*. Control (0 g L⁻¹), T1 (1 g L⁻¹), T2 (1.5 g L⁻¹), T3 (2 g L⁻¹), and T4 (2.5 g L⁻¹). Means followed by the same letter within each column are not statistically different (Tukey, $p \leq 0.05$).

In the present study, all *Trichoderma* concentrations proved equally effective in stimulating root development from the perspective of root dry biomass. This finding is highly relevant because root growth is directly associated with greater nutrient and water uptake, which could explain the increase observed in foliar biomass (Figure 3A). This trend has also been reported in maize, in which the fungus *T. harzianum* stimulated both shoot and root growth (Harman *et al.*, 2004). In this regard, López-Bucio *et al.* (2015) and Montalvão *et al.* (2020) suggest that the phytostimulatory mechanism of *Trichoderma* consists of an association between the root and shoot systems, as it releases auxins, peptides, volatiles, and other active metabolites into the rhizosphere, thereby promoting root branching and enhancing nutrient uptake capacity, which ultimately increases plant growth and yield.

CONCLUSIONS

The application of *Trichoderma harzianum* exerted a growth-promoting effect on watermelon seedlings. The most effective treatment was T1 (1 g L⁻¹), which resulted in the greatest stem length, the highest robustness index, and the greatest root ball weight. Treatment T2 (1.5 g L⁻¹) was effective in increasing stem diameter, which is likewise considered an indicator of plant quality. These findings suggest that there is an optimal dose of *Trichoderma* for maximizing watermelon growth, and that very high doses (such as T3 and T4) do not necessarily improve the results and, in some cases, may be less effective than lower doses.

REFERENCES

- Sorokina, M., McCaffrey, K. S., Deaton, E. E., Ma, G., Ordovás, J. M., Perkins-Veazie, P. M., & Parnell, L. D. (2021). A catalog of natural products occurring in watermelon-*Citrullus lanatus*. *Frontiers in nutrition*, 8, 729822. <https://doi.org/10.3389/fnut.2021.729822>
- Nkoana, D. K., Mashilo, J., Shimelis, H., & Ngwepe, R. M. (2022). Nutritional, phytochemical compositions and natural therapeutic values of citron watermelon (*Citrullus lanatus* var. *citroides*): a review. *South African Journal of Botany*, 145, 65-77. <https://doi.org/10.1016/j.sajb.2020.12.008>
- FAOSTAT. (2024). Food and Agriculture Organization Corporate Statistical Database. Base de datos estadísticos. Consultado en <http://www.fao.org/faostat/es/#data/QC>
- SIAP. (2025). Servicio de información Agroalimentaria y Pesquera. Anuario estadístico de la producción agrícola. Consultado en <https://nube.agricultura.gob.mx/agroprograma/>

- Araméndiz-Tatis, H., Cardona-Ayala, C., & Correa-Álvarez, E. (2013). Efecto de diferentes sustratos en la calidad de plántulas de berenjena (*Solanum melongena* L.). *Revista Colombiana de Ciencias Hortícolas*, 7(1), 55-61. <https://doi.org/10.17584/rcch.2013v7i1.2035>
- Valero-Valero, N. O. V., Martínez, K. A. C., & Gómez, J. A. G. (2023). Efecto bioestimulante de una chalcona sintética sobre frijol guajiro (*Vigna unguiculata* L. Walp). *Biotecnología en el Sector Agropecuario y Agroindustrial*, 21(2), 62-74. <https://doi.org/10.18684/rbsaa.v21.n2.2023.2153>
- Liu, J., Lian, H., Dou, J., Li, J., Zhu, G., Wang, J. & Li, M. (2025). Physiological impact of *Trichoderma viride* agents on the quality and production of melon that is grown on soils continuously cropped to melon. *Frontiers in Sustainable Food Systems*, 9, 1513324.
- Andrade-Hoyos, P., Rivera-Jiménez, M. N., Landero-Valenzuela, N., Silva-Rojas, H. V., Martínez-Salgado, S. J., & Romero-Arenas, O. (2023). Beneficios ecológicos y biológicos del hongo cosmopolita *Trichoderma* spp. en la agricultura: una perspectiva en el campo mexicano. *Revista Argentina de Microbiología*, 55(4), 366-377. <https://doi.org/10.1016/j.ram.2023.06.005>
- Mahmoodian, S., Kowsari, M., Motallebi, M., Zamani, M., & Jahromi, Z. M. (2022). Effect of Improved *Trichoderma harzianum* on Growth and Resistance Promotion in Bean Plant. *Brazilian Archives Of Biology And Technology*, 65. <https://doi.org/10.1590/1678-4324-2022210671>
- Calin, M., Raut, I., Arsene, M. L., Capra, L., Gurban, A. M., Doni, M., & Jecu, L. (2019). Applications of fungal strains with keratin-degrading and plant growth promoting characteristics. *Agronomy*, 9(9), 543. <https://doi.org/10.3390/agronomy9090543>
- Guzmán-Guzmán, P., Etesami, H., & Santoyo, G. (2025). *Trichoderma*: a multifunctional agent in plant health and microbiome interactions. *BMC microbiology*, 25(1), 434. <https://doi.org/10.1186/s12866-025-04158-2>
- Shapiro, S. S. & Wilk, M. B. (1985). An analysis of variance test for normality (complete samples). *Biometrika*, 52, 591-611.
- Quesada, G. y C. Méndez. 2005. Evaluación de sustratos para almácigos de hortalizas. *Agronomía Mesoamericana*, 16(2): 171-183.
- Hidayat, A. T., Aminah, A., & Ralle, A. (2024). Respon pertumbuhan dan produksi tanaman semangka (*Citrullus vulgaris*) terhadap pemberian *Trichoderma harzianum* dan pupuk npk mutiara. *AGrotekMAS Jurnal Indonesia: Jurnal Ilmu Pertanian*, 4(3), 337-346. <https://doi.org/10.33096/agrotekmas.v4i3.403>
- Waheed, H., Khan, M., Khan, H., Javaid, M., Rahman, F., & Aslam, M. (2020). Enhancement of some key physiological, morphological and biochemical traits of watermelon induced by *Trichoderma harzianum* fungi. *Semina-ciencias Agrarias*, 41, 2047-2060. <https://doi.org/10.5433/1679-0359.2020v41n5supl1p2047>
- Metwally, R. A., & Al-Amri, S. M. (2020). Individual and interactive role of *Trichoderma viride* and arbuscular mycorrhizal fungi on growth and pigment content of onion plants. *Letters in applied microbiology*, 70(2), 79-86. DOI:10.1111/lam.132
- Tambe, A. & Bhosale, A. (2020). Bioefficacy of *T. harzianum* culture extract on crop productivity of watermelon. *International Journal of Researches in Biosciences and Agriculture Technology*, 8(3): 218-224. <https://doi.org/10.29369/ijrbat.2020.03.i.0038>
- TariqJaveed, M., Farooq, T., Al-Hazmi, A. S., Hussain, M. D., & Rehman, A. U. (2021). Role of *Trichoderma* as a biocontrol agent (BCA) of phytoparasitic nematodes and plant growth inducer. *Journal of Invertebrate Pathology*, 183, 107626. <https://doi.org/10.1016/j.jip.2021.107626>
- Muñoz-López, K. M. y Monge-Pérez, J. E. (2024). Efecto de *Trichoderma harzianum* sobre esquejes de tacaco (*Sechium tacaco*). *Revista de I+D Tecnológico*, 20(2): 1-9. <https://doi.org/10.33412/jid.v20.2.4073>
- Harman, G.E., Howell, C.R., Viterbo, A., Chet, I., Lorito, M. (2004). *Trichoderma* species- opportunistic, avirulent plant symbionts. *Nature Reviews Microbiology*, 2, 43-56. <https://doi.org/10.1038/nrmicro797>
- López-Bucio, J., Pelagio-Flores, R., & Herrera-Estrella, A. (2015). *Trichoderma* as biostimulant: exploiting the multilevel properties of a plant beneficial fungus. *Scientia Horticulturae*, 196, 109-123. <https://doi.org/10.1016/j.scienta.2015.08.043>
- Montalvão, S., E. Marques, J. B. Silva, J. P. Silva, and S. Mello. 2020. *Trichoderma* activity in seed germination, promoting seedling growth and rhizocompetence in tomato plants. *The Journal of Agricultural Science* 172(10), 252-262. <https://doi.org/10.5539/jas.v12n10p252>
- Vazallo, S.N., Ramírez, L.T., Carranza, L.T., García, B.Z. and Bernilla, B.S. (2013) Efecto de la inoculación de *Rhizobium etli* y *Trichoderma viride* sobre el crecimiento aéreo y radicular de *Capsicum annum* var. longum. *Revista REBIOLEST*, 1, 11-21.