TẠP CHÍ KHOA HỌC
TRƯỜNG ĐẠI HỌC SƯ PHẠM TP HỒ CHÍ MINH
Tập 22, Số 3 (2025): 455-466
Website: https://journal.hcmue.edu.vn
ISSN: 2734-9918

HO CHI MINH CITY UNIVERSITY OF EDUCATION
JOURNAL OF SCIENCE
Vol. 22, No. 3 (2025): 455-466
https://doi.org/10.54607/hcmue.js.22.3.4616(2025)

Research Article

POTENTIAL USE OF SPENT TEA LEAVES EXTRACT (*Camellia sinensis* L.) TO PROMOTE EARLY GROWTH OF SALT-STRESSED SEEDLINGS OF BLACK CHERRY TOMATOES (*Solanum lycopersicum* L. var. *cerasiforme*)

Luong Thi Le Tho**, Luong Thi Thu Ngan
Ho Chi Minh University of Education, Vietnam
**Corresponding author: Luong Thi Le Tho –Email: tholtl@hcmue.edu.vn*
Received: November 27, 2024; Revised: March 22, 2025; Accepted: March 24, 2025

ABSTRACT

Salinity stress is a major abiotic factor limiting the productivity of tomato (Solanum lycopersicum L. var. cerasiforme) by impairing seed germination and seedling growth. Spent tea leaf (STL) extract, derived from tea processing residues, contains bioactive compounds such as polyphenols, alkaloids, essential amino acids, fatty acids, and minerals, known to enhance plant stress tolerance. This study investigated the potential of STL extracts from black, green, and oolong teas as seed priming agents to alleviate the adverse effects of salinity stress in black cherry tomato. The seeds were germinated on filter papers containing NaCl solution at different concentrations of 0, 2.5, 5.0, and 7.0 g/L. At 7 g/L NaCl, significant reductions were observed in germination rate, root length, shoot length, and the seed vigor index. To counteract salinity stress effects, seeds were treated with STL extracts derived from black, green, and oolong teas at concentrations of 1%, 2%, and 4%. Among the treatments, seeds primed with 1% oolong STL extract exhibited the most notable improvements across all measured parameters. Under 7.0 g/L NaCl conditions, this treatment produced the highest final germination percentage, average daily germination rate, and Timson index. Additionally, significant enhancements in shoot length, root length, and fresh biomass were observed in seeds treated with oolong STL compared to those subjected to saline conditions without priming.

Keywords: growth; salt stress; seed priming; spent tea leaves; tomato

1. Introduction

The global tea industry generates vast quantities of spent tea leaves (STL) as waste, raising significant environmental concerns. In 2022 alone, approximately 600,000 tons of tea waste were produced, accounting for nearly 10% of the total tea processed worldwide (Debnath et al., 2021). Traditionally, most STL is discarded as organic waste, contributing

Cite this article as: Luong, T. L. T., & Luong, T. T. N. (2025). Potential use of spent tea leaves extract (*Camellia sinensis* L.) to promote early growth of salt-stressed seedlings of black cherry tomatoes (*Solanum lycopersicum* L. var. *cerasiforme*). *Ho Chi Minh City University of Education Journal of Science, 22*(3), 455-466. https://doi.org/10.54607/hcmue.js.22.3.4616(2025)

to landfill accumulation and environmental degradation. This growing waste problem necessitates innovative strategies for reutilization, particularly in agriculture, where bio-based solutions are increasingly sought to enhance crop resilience against abiotic stresses.

One major challenge facing modern agriculture is salinity stress, which severely limits crop productivity, particularly in arid and semi-arid regions. Poor irrigation practices, soil degradation, and climate change have exacerbated soil salinity, impairing essential physiological processes such as seed germination, root development, and biomass accumulation in crops. Tomatoes, among the most widely cultivated and economically important crops, are particularly vulnerable to salinity-induced damage, which disrupts osmotic balance, causes ion toxicity, and suppresses metabolic activities essential for growth (Ahmed et al., 2024).

Recent research has highlighted the potential of STL as an agricultural biostimulant due to its rich composition of bioactive compounds, including polyphenols, flavonoids, and essential minerals (Zuo et al., 2024). These compounds have been shown to enhance plant stress tolerance by improving antioxidant defense mechanisms, boosting chlorophyll synthesis, and promoting nutrient uptake. While traditional seed priming techniques have proven effective in improving tomato germination and growth under stress conditions (Tanou et al., 2012), the potential application of STL extract in mitigating salt stress remains largely unexplored.

This study aims to repurpose STL waste as a sustainable agricultural input, aligning with circular economy principles by transforming the tea industry byproducts into value-added resources. By investigating the efficacy of STL extract in enhancing tomato seedling growth under salt stress, this research not only addresses an urgent environmental challenge but also explores a cost-effective and eco-friendly strategy for improving crop resilience.

2. Materials and methods

2.1. Materials

Black cherry tomato (*Solanum lycopersicum* L. var. *cerasiforme*), supplied by Rang Dong Seeds. For the seeds priming experiment, green tea, black tea, and oolong tea leaves (*Camellia sinensis* L.) provided by DalatFarm were used in the current study.

2.2. Methods

2.2.1. Sodium chloride stress germination tests

Black cherry tomato seeds were surface-sterilized with 1% (v/v) NaOCl solution for five minutes in the laminar flow hood and then rinsed three times with sterile distilled water (Rutkowski et al., 2022). To explore the effect of salt stress on germination traits of the seeds, seeds were spread across Petri dishes (15 cm × 15 cm) with filter paper (Whatman International Ltd.) infiltrated with NaCl solution at concentrations of 0, 2.5, 5.0, 7.0 g/L (S0, S2.5, S5, S7 respectively), and the seeds germinated in distilled water were served as the control. All the seeds were cultured at 25 °C and 50% humidity in the dark. Each treatment was performed in triplicate with 30 seeds per treatment.

2.2.2. Seed priming and stress-inducing agents germination tests

To prepare the spent tea leaf (STL) extracts, fresh tea samples were subjected to an initial extraction by infusion, which is typically intended for consumption. The remaining spent tea leaves were then subjected to a secondary extraction using infusion, following the method described by Gammoudi et al. (2020). Each STL sample weighing 1 g, 2 g, and 4 g was steeped in 100 mL of distilled water at 100 °C for five minutes and filtered through a tea sieve. The resulting extracts were stored at 4 °C in a refrigerator. To evaluate the effects of STL extracts on seed priming, black cherry tomato seeds were divided into ten treatment groups: a control stress group (CS, based on prior test results) and STL extracts derived from black tea (B), green tea (G), and oolong tea (O) at concentrations of 1%, 2%, and 4% (w/v). Seeds were primed in these solutions in darkness at 25 °C for 24 hours and subsequently dried on an ultra-clean bench for 15 minutes (Wang et al., 2018). Before germination, the seeds were surface-sterilized in a laminar flow hood using 1% NaOCl solution for five minutes, followed by three rinses with sterile distilled water. The culture conditions and experimental procedures were consistent with those employed in the sodium chloride stress experiment.

2.2.3. Assessment of germination and growth traits

The number of germinated black tomato seeds, with an extended radicle for at least 1 mm, was recorded every 24 hours. Germination and growth parameters were evaluated at days 7, 14, and 21, following the methodology described by Rofekuggaman et al. (2020). The germination percentage (GP) was calculated using the formula:

Germination Percentage (GP, %) = (Number of germinated seeds/Total number of seeds) × 100

Germination index (%, GI) = (Germination percentage in each treatment)/(Germination percentage in the control)×100

Coefficient of germination (CG) = $(A_1+A_2+ \dots +A_x)/(A_1T_1+A_1T_1+ \dots + A_XT_X)\times100$. Where A = Number of germinated seeds; T = Time corresponding to A; x = Number of days to final count.

Length of radical, and plumule (LRP): After separating radicle and plumule, length was measured in centimeters (cm) with the help of a measuring ruler.

Seedling vigor index (SV) = [Mean of radicle length (cm)+Mean of shoot length (cm)]×100

Fresh mass (FM) = Radicles and plumules were cut, and their fresh weight was determined in milligrams (mg) using a digital electronic balance.

The cumulative germination percentage of each treatment was the sum of the daily germination percentage.

Timson index of germination velocity (Timson index) = $\sum G_i/T = (G_1+G_2+G_3+\ldots\ldots\ldots.+G_n)/T$, where G_1, G_2, G_3, G_i, and G_n are the cumulative germination percentage at the first, second, third, i^{th}, and n^{th} time, respectively, and T is the total germination period.

Mean daily germination (g_i)= Total number of germinated seeds/Total germination periods.

Mean germination time ($\bar{t}$) = $(\Sigma g_i \times t_i)/\Sigma g_i$ where g_i is the daily germination % at time t_i from sowing.

Mean germination rate ($\bar{V}$)= 1/ $\bar{t}$

2.3. Data analysis

The experiment was conducted using a completely randomized design with three replications per treatment group. The data are expressed as the mean ± standard error, and statistical analysis was performed with IBM SPSS Statistical software (IBM Corp., 2023, IBM SPSS Statistics for Windows, Version 29.0.2.0). Duncan tests determined which means differed significantly at a p-value of <0.05, indicating a significant difference.

3. Results and discussion

3.1. Effect of sodium chloride-induced salt stress on germination of black cherry tomato seeds (*Solanum lycopersicum* L. var. *cerasiforme*)

3.1.1. Germination traits

To evaluate the impact of NaCl on the germination ability of black cherry tomato seeds, several parameters were analyzed, including cumulative germination percentage, Timson index, mean daily germination, coefficient of germination, mean germination time, and germination rate index. In the S0, S2.5, and S5 treatments, germination began between days 2 and 7, with final germination rates at day 21 of 100%, 66.67%, and 45.56%, respectively. In contrast, seeds in the S7 treatment germinated more slowly, achieving a significantly lower final germination rate of 12.2%. Statistical analysis using Duncan's test revealed significant differences among treatments in the final germination rate ($p < 0.05$) (Figure 1A). The germination rate index ranged from 3.30 to 127.95, showing a similar pattern of statistical differences (Figure 1F). Further analysis of germination dynamics indicated that mean daily germination varied between 0.58%/day to 4.76%/day, with statistical differences among treatments ($p < 0.05$) (Figure 1C). Additionally, the mean germination time at S7 was 17.67 days, which differed significantly from the S0, S2.5, and S5 treatments ($p < 0.05$) (Figure 1E).

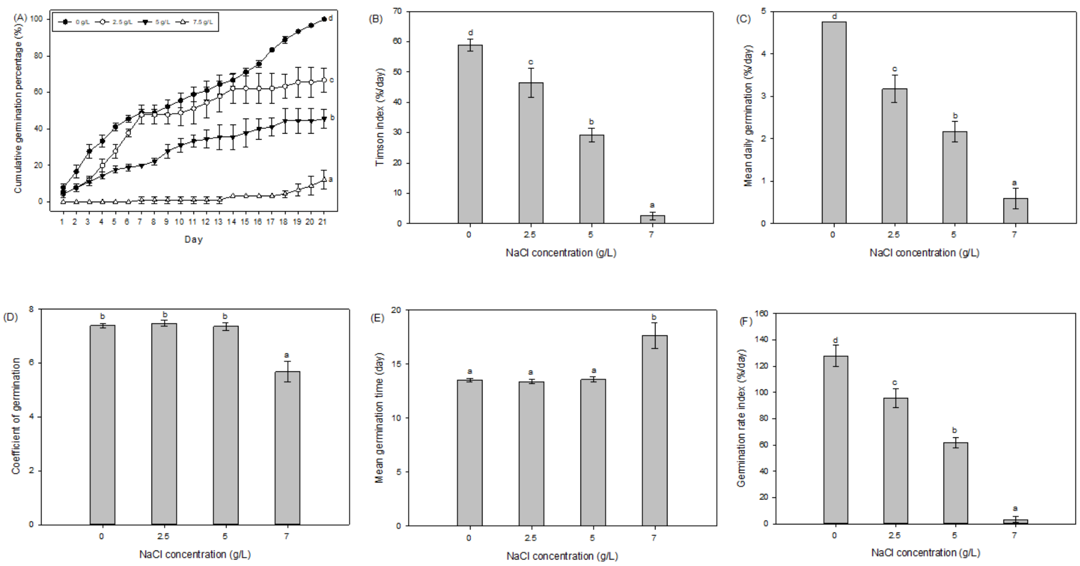

Figure 1. *Germination traits, including germination percentage (A), Timson index (B), mean daily germination (C), coefficient of germination (D), mean germination time (E), and germination rate index (F) of black cherry tomato seed when treated with NaCl. Different letter indicates significant differences between treatments with $p < 0.05$*

Timson index ranged from 2.54 to 58.94 among treatments, showing statistical differences ($p < 0.05$). Meanwhile, no difference was observed among S0, S2.5, and S5 in the coefficient of germination ($p > 0.05$), but S7 had statistical differences among S0, S2.5, and S5 (Figure 1B, D).

3.1.2. Growth traits

Statistical analysis ($p < 0.05$) revealed significant differences between treatments in radical and shoot lengths (Figure 2).

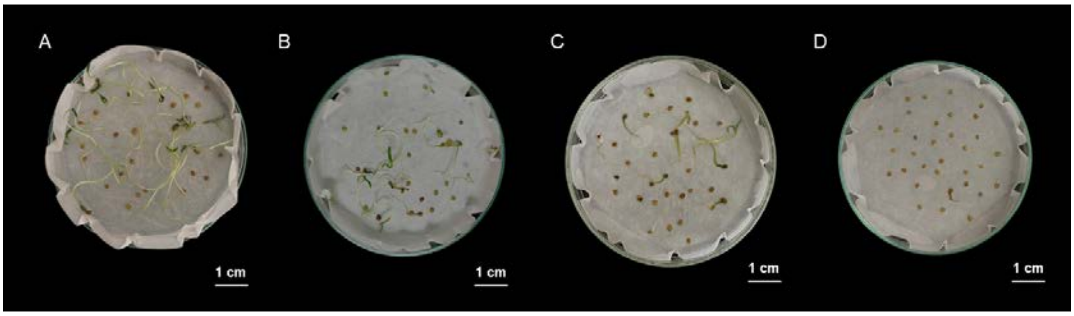

Figure 2. *Black cherry tomato seeds germination at day 21 when treated with 0 g/L (A), 2.5 g/L (B), 5 g/L (C), and 7 g/L (D) NaCl*

Radicle lengths ranged from 1.53 to 5.38 cm, while shoot lengths varied between 0.93 and 3.38 cm, indicating that increasing salt concentrations negatively impacted both parameters (Figure 3A, C). For plumule length, there was no difference between S2.5, S5, and S7 ($p > 0.05$); the highest plumule length in S0 was 3.34 cm (Figure 3B). Shoot length showed a gradual decline with increasing NaCl levels, ranging from approximately 0.5 to 4 cm (Figure 3C). The control treatment exhibited the highest shoot length, while 7 g/L NaCl resulted in complete inhibition of growth. The results of the seed vigor index also recorded differences in treatments ($p < 0.05$), with the highest being 628 in S0 and the lowest being 2.08 in S7 (Figure 3D). However, when salt concentration increased, S5 and S7 recorded significantly lower fresh biomass compared to S0 and S2.5 ($p < 0.05$) (Figure 3E). Overall, increasing NaCl concentrations negatively affected radicle, plumule, and shoot growth, with 7 g/L NaCl showing severe growth inhibition across all parameters.

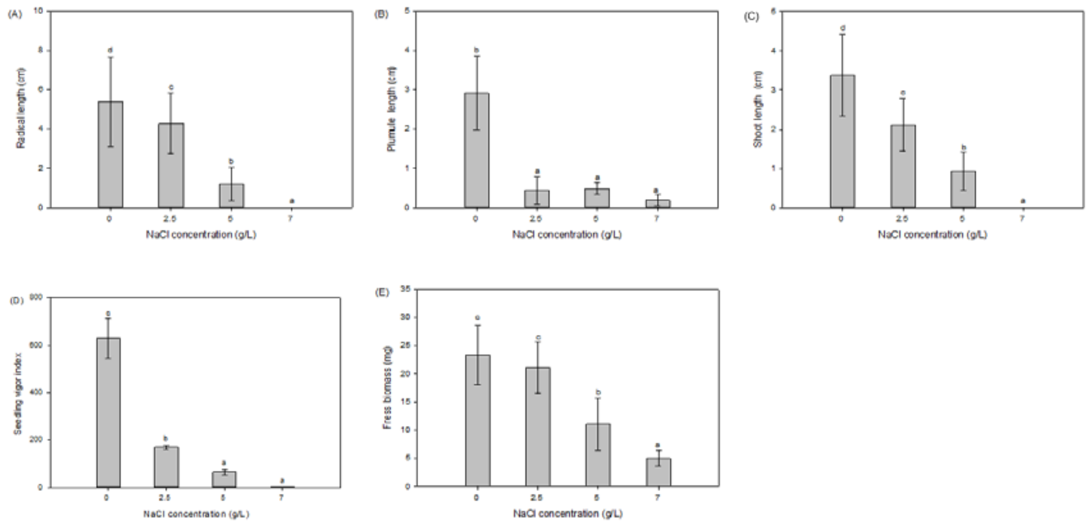

Figure 3. *Radical length (A), plumule length (B), shoot length (C), seedlings vigor index (D), and fresh biomass (E) of black cherry tomato seeds under different NaCl concentrations. Different letter indicates significant differences between treatments with p < 0.05*

3.2. Effect of priming spent tea leaves extracts on germination of black cherry tomato seeds (Solanum lycopersicum L. var. *cerasiforme) under salt stress*

3.2.1. Germination traits

Priming seeds with spent tea leaves extracts improved seed germination compared to CS after 21 days of incubation; the final germination percentage in the STL treatments ranged from 14.44% to 61.11% (Figure 4A). Mean daily germination and germination index had similar results in the Duncan test; CS, G-STL extract at 1%, and B-STL extract at 1% did not show any statistical difference. This indicates that applying higher concentrations of G-STL and B-STL extracts improved seed germination. The results showed that the final germination percentage, mean daily germination, and germination index were highest at O-STL extract at 1%, demonstrating the ability of O-STL to promote seed germination. Meanwhile, mean germination time did not show any difference among treatments ($p > 0.05$) (Figure 4E).

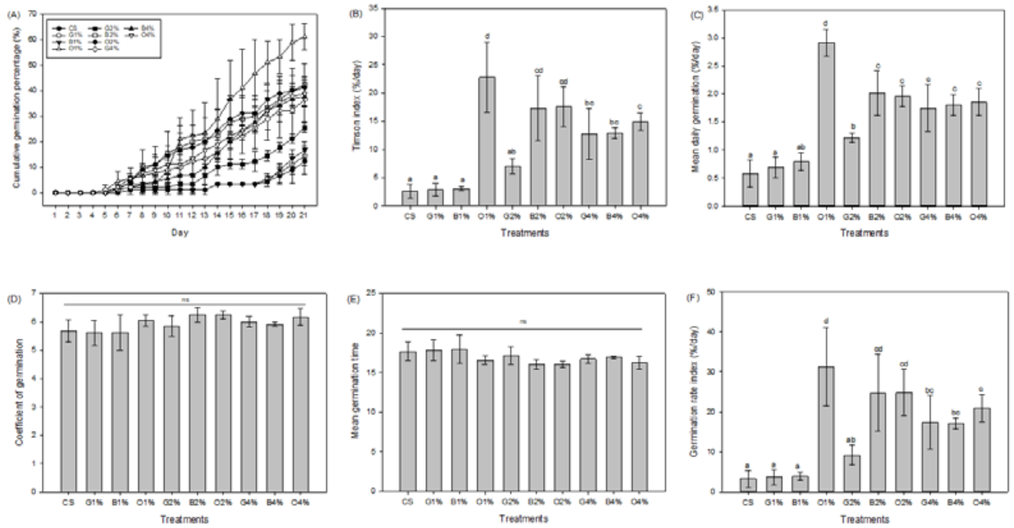

Figure 4. *Germination traits, including germination percentage (A), Timson index (B), mean daily germination (C), coefficient of germination (D), mean germination time (E), and germination rate index (F) of black cherry tomato seed when primed with different spent tea leaves extracts. Different letter indicates significant differences between treatments with $p < 0.05$*

Timson index recorded CS, G-STL extract at 1%, and B-STL extract at 1%, not statistically different ($p > 0.05$). However, in the remaining treatments, there was a difference compared to CS. Notably, the Timson index at O-STL extract at 1% was the highest at 22.8 (Figure 4C). Meanwhile, the coefficient of germination did not record a statistical difference between treatments (Figure 4D).

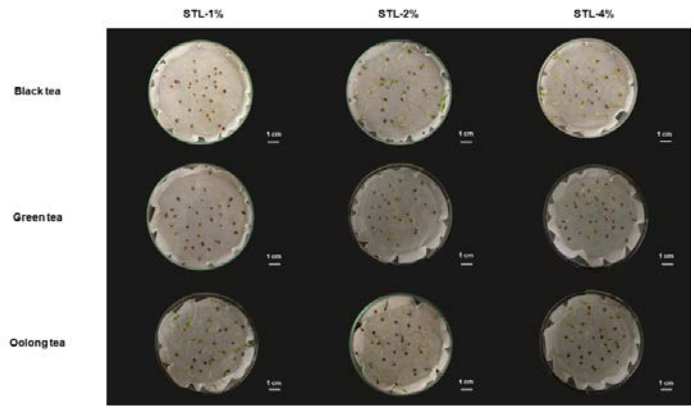

Figure 5. *Black cherry tomato seeds germinated at day 21 when primed with different spent tea leaves extracts*

3.2.2. Growth traits

The study showed that priming seeds with STL extraction for G-STL extract at 1% and B-STL extract at 1% did not affect the promotion of seed growth under saline conditions. G-STL and B-STL extracts promoted growth parameters at concentrations of 2% and 4% (Figure 6). For G-STL extract, the concentration that best affected seed growth was 4%, while for B-STL, it was 2% (Figure 6). When priming seeds, O-STL extract demonstrated the best growth improvement ability at 1%, showing differences from the remaining treatments ($p < 0.05$). Specifically, radical length reached 3.50 cm, plumule length reached 2.60 cm, shoot length reached 4.03 cm, and fresh biomass reached 21.37 mg (Figure 6).

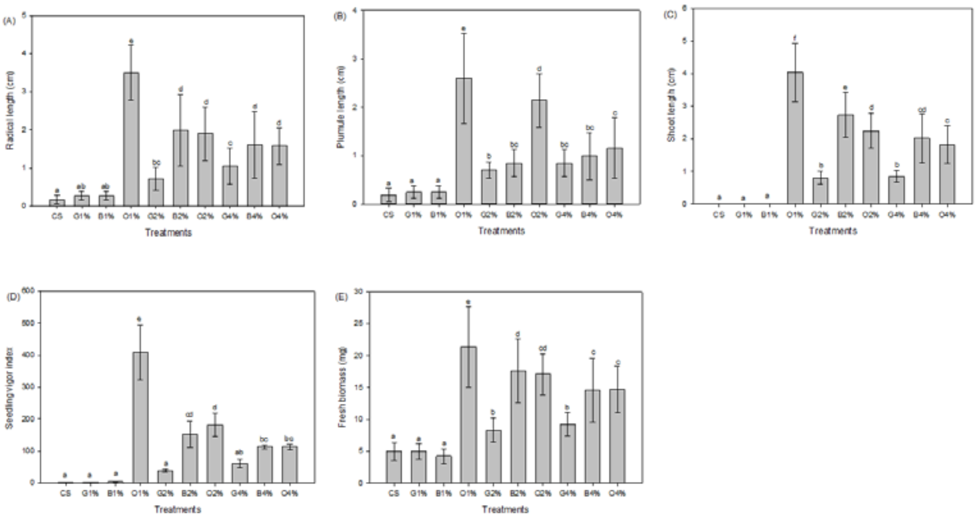

Figure 6. *Radical length (A), plumule length (B), shoot length (C), seedlings vigor index (D), and fresh biomass (E) of black cherry tomato seeds when primed with different concentrations of spent tea leaves extracts. Different letter indicates significant differences between treatments with p < 0.05, and "ns" indicates non-significant*

3.3. Discussion

Salinity stress induces both hyperosmotic and hyperionic conditions, directly impairing plant development and yield traits. High salinity reduces the osmotic potential of the soil solution, disrupting nutrient absorption and negatively affecting plant growth. Critical developmental stages, such as seed germination and seedling growth, are particularly vulnerable to abiotic stresses like salinity. Hyperosmotic stress caused by salt disrupts water uptake in plants, further exacerbating the challenges to early growth stages. Seed germination serves as a predictor of subsequent plant growth and productivity. It typically involves three distinct phases: (1) imbibition, marked by water uptake; (2) metabolic activation, which initiates physiological processes essential for germination; and (3) radicle protrusion through the seed coat. In this study, germination was assessed using cumulative percentage data. The first two phases were temporally indistinct and lacked visible markers, while the third phase was characterized by radicle emergence (Kumar et al., 2021). Our findings revealed that salinity stress significantly affected all germination-related traits and early seedling development, with severity dependent on the salt concentration. Germination potential, as indicated by final germination percentage, decreased under salinity, with higher salt concentrations causing more pronounced delays in sprouting and reductions in germination rates. At low salt levels, dormancy was induced, while high concentrations inhibited sprouting and reduced germination percentages due to excessive salt accumulation around roots and increased water loss via transpiration. Salinity also restricted water absorption, delayed the breakdown of seed storage reserves, and inhibited storage protein synthesis (Ding et al., 2020). These findings align with previous studies documenting the detrimental impacts of salinity on the growth and development of tomato plants, reinforcing the significant role of salinity stress in limiting agricultural productivity (Roșca et al., 2023).

Alongside seed germination, increasing salt levels caused a progressive decline in tissue elongation. This reduction is likely attributed to ion toxicity, restricted nutrient uptake, and water absorption impeded by osmotic stress. Our findings align with prior studies, highlighting root and shoot lengths as reliable indicators of salt tolerance (Aggarwal et al., 2024). Roots play a critical role in water and nutrient uptake, while shoots are responsible for distributing water to aerial tissues. In this study, seedling development was suppressed under all levels of salt stress, consistent with reports attributing these effects to reduced water and nutrient availability, which constrain cell elongation and tissue growth. Seed priming involves exposing seeds to eliciting factors, enhancing their tolerance to future stressors (Tanou et al., 2012). This approach is considered cost-effective as it keeps the plant in a primed state without requiring additional energy expenditure. The mechanisms of seed priming encompass three stages: imbibition, germination, and growth. During imbibition, water absorption activates messenger RNA (mRNA), followed by transcription and translation of proteins that initiate physiological processes critical for germination, including osmolyte regulation. The primary advantage of seed priming lies in optimized water absorption during this stage. In this study, seed priming was conducted using extracts from spent tea leaves (STL), prepared via infusion—a simple and practical technique suitable for large-scale waste utilization at a domestic level. Distilled water was used as the solvent, as it enhances the quality of tea leaf extracts more effectively than tap water (Huang et al., 2012).

The role of priming in mitigating salinity damage was examined across physiological, biochemical, and molecular aspects. Evidence suggests that priming influences key processes such as cell division and elongation, plasma membrane fluidity, and induction of stress-responsive proteins. It also increases the activity of enzymes involved in reserve mobilization, facilitates chromosomal repair, and promotes early DNA replication and repair (Manonmani et al., 2014). Furthermore, priming upregulates numerous germination-related genes, boosts antioxidant enzyme activity and antioxidant compound levels, and reduces malondialdehyde accumulation in seedlings. Additionally, priming promotes K^+ and Ca^{2+} accumulation while decreasing Na^+ and Cl^- levels in seedlings (Tanou et al., 2012). These combined modifications contribute to the concept of "priming memory," enabling faster germination and more vigorous seedlings under subsequent stress exposure. In our study, seed priming with spent tea leaf extract significantly accelerated germination under salt stress. This enhancement can be attributed to correlations between priming-induced nuclear replication and improvements in tomato seed vigor similar to the study conducted in *Capsicum anuum* L. seed (Gammoudi et al., 2021). However, research at the molecular level on tomato is needed to substantiate this theory. STL extracts are rich in flavonoids, phenolic compounds, and antioxidants, and contain essential minerals that are crucial for balanced plant growth and development. The antioxidant properties of polyphenols help mitigate oxidative stress induced by salinity, protecting cellular structures and maintaining metabolic functions (Zuo et al., 2024). Moreover, the essential minerals in STL extract support vital physiological processes that are often disrupted under salinity stress. Comparable improvements in germination speed were observed by Mavi and Atış (2013), who used waste tea extract (30%) for seed priming under 150 mM NaCl stress. They reported a 14% reduction in mean germination time (MGT) compared to unprimed seeds and an increase in the final germination percentage. While direct studies on the application of STL extract in tomatoes under salinity stress are limited, related research provides supportive evidence. The application of these teas led to increased shoot and root dry weight, enhanced chlorophyll content, and improved stem diameter, suggesting a potential role in promoting plant vigor under stress conditions (Ramdani et al., 2013).

4. Conclusion

In conclusion, this study demonstrates that priming black cherry tomato seeds with STL extracts is a promising strategy for enhancing germination and early seedling growth under salt-stress conditions. The findings confirm that increasing NaCl concentrations significantly inhibited seed germination and growth traits, underscoring the sensitivity of black cherry tomato seedlings to saline environments. However, these inhibitory effects were mitigated by biopriming with STL extracts, particularly with the O-STL extract at 1% concentration. This treatment markedly improved the final germination percentage, mean daily germination rate, and growth parameters, including shoot and radicle lengths and fresh biomass. The results suggest that STL extracts, especially those derived from oolong tea, could serve as a cost-effective and sustainable biopriming agent for mitigating abiotic stress in plants. Future research should focus on elucidating the physiological and molecular mechanisms underlying the efficacy of STL extracts. Additionally, their potential application to other crop species affected by salinity warrants further investigation to broaden their utility in stress-resilient agriculture.

- ***Conflict of Interest:*** *Authors have no conflict of interest to declare.*
- ***Acknowledgement:*** *This study was funded by the Science and Technology Budget of Ho Chi Minh City University of Education as part of the student research project for the 2024-2025 academic year.*

REFERENCES

Aggarwal, G., Premnath Edhigalla, Walia, P., Jindal, S., & Sandal, S. S. (2024). A method for screening salt stress tolerance in Indian mustard (*Brassica juncea* L.) Czern & Coss at seedling stage. *Scientific Reports*, *14*(1), Article 63693. https://doi.org/10.1038/s41598-024-63693-6

Ahmed, M., Zoltán Tóth, & Kincső Decsi. (2024). The impact of salinity on crop yields and the confrontational behavior of transcriptional regulators, nanoparticles, and antioxidant defensive mechanisms under stressful conditions: A review. *International Journal of Molecular Sciences*, *25*(5), 2654-2654.

Al-Ashkar, I., Alderfasi, A., Ben Romdhane, W., Seleiman, M. F., El-Said, R. A., & Al-Doss, A. (2020). Morphological and genetic diversity within salt tolerance detection in eighteen wheat genotypes. *Plants*, *9*(3), Article 287.

Anuradha Varier, Vari, A. K., & Dadlani, M. (2010). The subcellular basis of seed priming. *Current Science, 99*(4), 450-456.

Baek, M. W., Lee, J. H., Yeo, C. E., Tae, S. H., Chang, S. M., Choi, H. R., Park, D. S., Tilahun, S., & Jeong, C. S. (2024). Antioxidant profile, amino acids composition, and physicochemical characteristics of cherry tomatoes are associated with their color. *Antioxidants*, *13*(7), Article 785.

Debnath, B., Haldar, D., & Purkait, M. K. (2021). Potential and sustainable utilization of tea waste: A review on present status and future trends. *Journal of Environmental Chemical Engineering*, *9*(5), Article 106179. https://doi.org/10.1016/j.jece.2021.106179

Gammoudi, N., Nagaz, K., & Ferchichi, A. (2020). Potential Use of Spent Coffee Grounds and Spent Tea Leaves Extracts in Priming Treatment to Promote In Vitro Early Growth of Salt-and Drought-Stressed Seedlings of *Capsicum annuum* L. *Waste and Biomass Valorization, 9,* 3341-3353.

Gammoudi, N., Nagaz, K., & Ferchichi, A. (2021). Hydrotime analysis to explore the effect of H*2*O*2*–priming in the relationship between water potential (Ψ) and germination rate of *Capsicum annuum* L. seed under NaCl– and PEG–induced stress. *Plant Physiology and Biochemistry*, *167*, 990-998.

Huang, W.Y., Lin, Y.R., Ho, R.F., Liu, H.Y., & Lin, Y.S. (2013). Effects of water solutions on extracting green tea leaves. *The Scientific World Journal*, *2013*(5), Article 368350.

Kumar, S., Li, G., Yang, J., Huang, X., Ji, Q., Liu, Z., Ke, W., & Hou, H. (2021). Effect of salt stress on growth, physiological parameters, and ionic concentration of water dropwort (*Oenanthe Javanica*) cultivars. *Frontiers in Plant Science*, *12*, Article 660409.

Mavi, K., Atak, M., & Atış, İ. (2013). Effect of organic priming on seedling emergence of pepper under salt stress. *Soil-Water Journal*, *2*(2), 401-408.

Manonmani, V., Junaithal, M. A., & M. Jayanthi. (2014). Halo Priming of Seeds. *Research Journal of Seed Science*, *7*(1), 1-13. https://doi.org/10.3923/rjss.2014.1.13

Nair, K. P. (2020). Tea (*Camellia sinensis* L.) (pp. 333-362). *Springer EBooks*.

Nasrin, S., & Mannan, M. A. (2019). Impact of salinity on seed germination and seedling growth of tomato. *Journal of Bioscience and Agriculture Research*, *21*(1), 1737-1748.

Ramdani, D., Chaudhry, A. S., & Seal, C. J. (2013). Chemical Composition, Plant Secondary Metabolites, and Minerals of Green and Black Teas and the Effect of Different Tea-to-Water Ratios during Their Extraction on the Composition of Their Spent Leaves as Potential Additives for Ruminants. *Journal of Agricultural and Food Chemistry, 61*(20), 4961-4967.

Roșca, M., Mihalache, G., & Stoleru, V. (2023). Tomato responses to salinity stress: From morphological traits to genetic changes. *Frontiers in Plant Science, 14,* Article 1118383. https://doi.org/10.3389/fpls.2023.1118383

Rofekuggaman, Md., Kubra, K., & Mahmood, S. (2020). Effect of Different Salt Concentrations (NaCl) on Seed Germination and Seedling Growth of Tomato cv. BINA Tomato-10. *Asian Plant Research Journal*, *5*(3), 38-44.

Rutkowski, M., Krzemińska-Fiedorowicz, L., Khachatryan, G., Bulski, K., Kołton, A., & Khachatryan, K. (2022). Biodegradable silver nanoparticles gel and its impact on tomato seed germination rate in *in vitro* cultures. *Applied Sciences*, *12*(5), Article 2722.

Singh, J., Sastry, E. V. D., & Singh, V. (2011). Effect of salinity on tomato (Lycopersicon esculentum Mill.) during seed germination stage. *Physiology and Molecular Biology of Plants*, *18*(1), 45-50.

Tanou, G., Fotopoulos, V., & Molassiotis, A. (2012). Priming against environmental challenges and proteomics in plants: Update and agricultural perspectives. *Frontiers in Plant Science*, *3*.

Wang, W., He, A., Peng, S., Huang, J., Cui, K., & Nie, L. (2018). The effect of storage condition and duration on the deterioration of primed rice seeds. *Frontiers in Plant Science*, *9*, Article 172. https://www.google.com/search?q=https://doi.org/10.3389/fpls.2018.00172

Yang, Z., Li, W., Li, D., & Chan, A. S. C. (2023). Evaluation of nutritional compositions, bioactive components, and antioxidant activity of three cherry tomato varieties. *Agronomy*, *13*(3), Article 637.

Zuo, H., Chen, J., Lv, Z., Shao, C., Chen, Z., Zhou, Y., & Shen, C. (2024). Tea-derived polyphenols enhance drought resistance of tea plants (*Camellia Sinensis*) by alleviating jasmonate-isoleucine pathway and flavonoid metabolism flow. *International Journal of Molecular Sciences*, *25*(7), Article 3817.

TIỀM NĂNG SỬ DỤNG BÃ TRÀ (*Camellia sinensis* L.) ĐỂ CẢI THIỆN KHẢ NĂNG NẢY MẦM CỦA HẠT GIỐNG CÀ CHUA BI (*Solanum lycopersicum* L. var. *cerasiforme*) TRONG ĐIỀU KIỆN STRESS BỞI SODIUM CHLORIDE

Lương Thị Lệ Thơ*, Lương Thị Thu Ngân

Trường Đại học Sư phạm Thành phố Hồ Chí Minh, Việt Nam

**Tác giả liên hệ: Lương Thị Lệ Thơ –Email: tholtl@hcmue.edu.vn*

Ngày nhận bài: 27-11-2024; ngày nhận bài sửa: 22-3-2024; ngày duyệt đăng: 24-3-2025

TÓM TẮT

Stress mặn là nhân tố stress phi sinh học cản trở nghiêm trọng sự nảy mầm và phát triển của cây Cà chua (Solanum lycopersicum L. var cersiforme). Chiết xuất từ bã trà (STL) chứa các hợp chất có hoạt tính sinh học cao như polyphenol, alkaloid, amino acid thiết yếu, acid béo và các khoáng chất có tác dụng tăng cường khả năng chống chịu của cây trồng. Nghiên cứu này khảo sát ảnh hưởng của chiết xuất từ bã trà (STL) lên khả năng nảy mầm và sinh trưởng của hạt thông qua phương pháp ngâm hạt giống. Hạt cà chua bi đen được gieo trên giấy thấm có bổ sung dung dịch NaCl ở các nồng độ lần lượt là 0, 2,5, 5,0 và 7,0 g/L. Kết quả cho thấy tỉ lệ nảy mầm, chiều dài rễ mầm, chiều dài thân và chỉ số sức sống hạt giảm đáng kể ở NaCl 7 g/L. Sau đó, hạt giống được xử lí bằng cách ngâm hạt trong chiết xuất STL có nguồn gốc từ trà đen, trà xanh và trà ô long ở nồng độ 1%, 2% và 4% để đánh giá khả năng khả năng nảy mầm và sinh trưởng trong điều kiện NaCl 7 g/L. Đặc biệt, hạt giống được xử lí bằng STL ô long ở mức 1% cho thấy sự cải thiện đáng kể nhất trên tất cả các thông số. Trong nghiệm thức xử lí hạt với STL ô long 1%, tỉ lệ nảy mầm và chỉ số Timson của các hạt đạt mức cao nhất. Đồng thời, chiều dài chồi, chiều dài rễ mầm và sinh khối tươi được cải thiện đáng kể so với các hạt giống đối chứng ở điều kiện bị stress mặn.

Từ khóa: sinh trưởng; stress muối; ngâm hạt, bã trà; cà chua