



Role of Jasmonic acid on microtuberization potential of Potato (*Solanum tuberosum* L.) under in vitro conditions

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Abstract

This study investigated the effects of jasmonic acid (JA) on the in vitro tuberization potential of potato (*Solanum tuberosum* L.). Single-node stem cuttings were cultured on agar-solidified Murashige and Skoog (MS) medium supplemented with different concentrations (0, 0.5, 1.0, and 2.0 μ M) of JA and 80 g/L-1 sucrose. The results showed that JA supplementation improved several plantlet growth parameters, with 1.0 μ M being the most effective concentration, producing the highest number of leaves (19) and a maximum shoot length of 15.13 cm. Moreover, the same treatment resulted in the highest plantlet fresh weight (649.38 mg) and maximum microtuber production (07 microtubers) within 24 days of culture. The study provides a foundation for further optimization of in vitro micropropagation and microtuberization protocols to support the rapid multiplication and commercial production of economically important potato cultivars.

Keywords: Jasmonic acid, potato, plants in vitro establishment, tuberization potential

Solanum tuberosum L. (Potato), belonging to the family Solanaceae, is a main crop for food security in the world (Ahmad et al., 2021). Potato is an important source of increasing vitamin C and protein content and has become a worthy source of earning money for low-income farm household (Navarre et al., 2009). Being one of the world's most important food crops, productivity heavily depends on the efficiency of tuber formation, a complex developmental process influenced by a network of hormonal, genetic, and environmental factors. In vitro propagation techniques are widely used for the rapid multiplication of disease-free planting material, and optimizing microtuberization under controlled conditions has become a crucial area of study for crop improvement (Vishal et al., 2025). Jasmonic acid (JA) production and increased lipoxygenase activity trigger the JA pathway (Singh et

al., 2022). JA is a class of endogenous PGRs widely distributed within the plant kingdom (Ulloa et al., 2002). Microtubers can be obtained and stored for a long time and directly transported to market without transferring to fresh media without acclimation (Pervaiz et al., 2023). JA significantly promoted tuberization in potato more effectively than kinetin, increasing tuber number, weight, and tuberization rate while also reducing rooting ability (Pelacho and Mingo-Castel, 1991). Theobromide stimulates potato microtuber formation and affects plant growth and development (Berg, 1991). In vitro effects of JA show that meristem growth induction medium supplemented with 0.5 – 10 μ M increases the number of meristems in potato, which developed buds without symptoms of senescence (Ravnikar et al., 1992). A number of studies demonstrated that JA was not directly involved in



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potato tuber formation (Jackson, 1999). The application of 0.2-2.0 mg dm⁻³ JA resulted in a significant increase in shoot fresh mass, as well as the number and root length of plantlets (Zhang et al., 2006).

Among various plant hormones, JA appeared as a key signaling molecule required in regulating plant growth, development, and protective mechanisms. Generally known for its role in stress signaling and secondary metabolite production, recent studies suggest that JA may also play a significant role in developmental processes such as tuber formation and initiation. However, the mechanistic understanding of JA's influence on tuberization, particularly under in vitro conditions, remains limited. This study aims to investigate the role of JA in strengthening the tuberization potential of potato during in vitro establishment. Comprehending the hormonal regulation during early stages of tuber development could provide new strategies for quality through hormone-mediated interventions and improving tuber yield in tissue culture systems.

Certified virus-free plantlets of Potato (*Solanum tuberosum* L.) were obtained from previously maintained in vitro cultures as a source of explants in the Plant Developmental and Regenerative Biology Lab. The cultured plantlets were maintained on MS basal medium (Murashige and Skoog, 1962) under in vitro conditions before experimental treatment. Cultured plantlets were used for subculturing on MS medium. Macronutrients (20X) gL⁻¹, Micronutrients (100) gL⁻¹, Vitamins (200X) gL⁻¹, Myo-Inositol (100X) gL⁻¹ & Iron-EDTA (200) gL⁻¹ were prepared as stock solutions for the preparation of MS medium, then stored in brown bottles at 4 °C in the refrigerator.

The following procedures were adopted to sterilize tools, glassware, and medium. Glassware was washed with detergent prior to sterilization in an oven at 180 °C for 2 hours. Medium was poured into Pyrex tubes and capped tightly. Then it was autoclaved at 121 °C and 15 lb inch² pressure for 15 minutes. The laminar air flow cabinet was cleaned and mopped with rectified spirit from the outer as well as inner surfaces. Before inoculation, the blower was kept on for an hour. Tools were sterilized in STERI-350 (Swiss-made) at 250 °C.

Sterilized cultured plants were inoculated onto culture medium in sterile glass test tubes and maintained in a growth chamber at 25 ± 2 °C with a 16/8-hour photoperiod (light/dark). Sub-culturing was carried out every 21 days into fresh medium to assess tuberization potential over successive passages. Then the tubes were incubated at 25 ± 2 °C in complete

darkness. To study the effect of JA on tuberization, three types of media were prepared, each with a different concentration of Jasmonic acid (JA), along with one having a normal concentration (control). For this purpose, the required quantities of macronutrients, micronutrients, myo-inositol, vitamins, and iron-EDTA were finely mixed, then the volume was raised to 1 liter. pH of the medium was maintained at 5.7 to 5.8; after adjusting the pH, agar was added to it. The medium was heated in an oven for a few minutes to dissolve the agar.

This freshly prepared medium was poured into each culture test tube and then labeled accordingly. A stock of JA was prepared in ethanol; the stock solution was filter-sterilized, and macronutrients were prepared with different concentrations of JA as follows: Control 0 µM (T1); 0.5 µM (T2); 1.0 µM (T3); & 2.0 µM (T4) JA. All constituents were sterilized by autoclaving at 120 °C. Each treatment was replicated five times, with each replicate consisting of one explant.

After initial shoot establishment (approximately 2-3 weeks), plantlets were shifted aseptically to fresh medium containing all concentrations of JA. Sub-culturing was carried out every 21 days to provide fresh nutrients, remove senescing tissue, and maintain growth vigor. During each shifting event, individual plantlets were carefully transferred to new culture vessels under sterile conditions in a laminar airflow chamber.

A small segment, containing two nodes of explant, was sliced with the help of a scalpel and inoculated vertically into the medium contained in culture tubes. The data were recorded for initiation, number and size of microtubers, fresh weight and dry weight of tubers, and for the shoot and root length of plants. ANOVA (analysis of variance) was used to analyze the data, and the mean values were compared with DMRT using SPSS v.12

The application of various JA concentrations resulted in significant changes in the number of leaves on potato plantlets (Figure 1a). The highest number of leaves (19) was obtained in MS medium supplemented with 1.0 µM JA, followed by the highest number of leaves (17). T1 produced only 3 leaves, whereas T2 and T4 produced 12 and 8 leaves, respectively, suggesting a differential response to the experimental conditions (Figure 2a - d). The present results agree with those of Dermastia et al. (1994) but have an edge over their results by demonstrating that plantlets grown on JA promoted the number of leaves. The application of JA resulted in a significant increase in

cultured plant development and shoot elongation. Significant variations were observed among JA concentrations, potato in vitro cultivars, and the interaction of JA on shoot length. After 6 weeks of cultivation, the longest shoots (15.13 cm) were obtained, followed by 14.93 cm and 13.50 cm (Figure 1b). Addition of JA resulted in an increase in shoot length compared to the control. This study suggests that JA helps potato plants to grow better in lab conditions. Other researchers reported similar findings, finding that increasing JA levels led to longer, thicker shoots and taller plantlets in a specific growth medium. The results of this study show similarities with those of Ravnkar et al. (1992) and Dermastia et al. (1994).

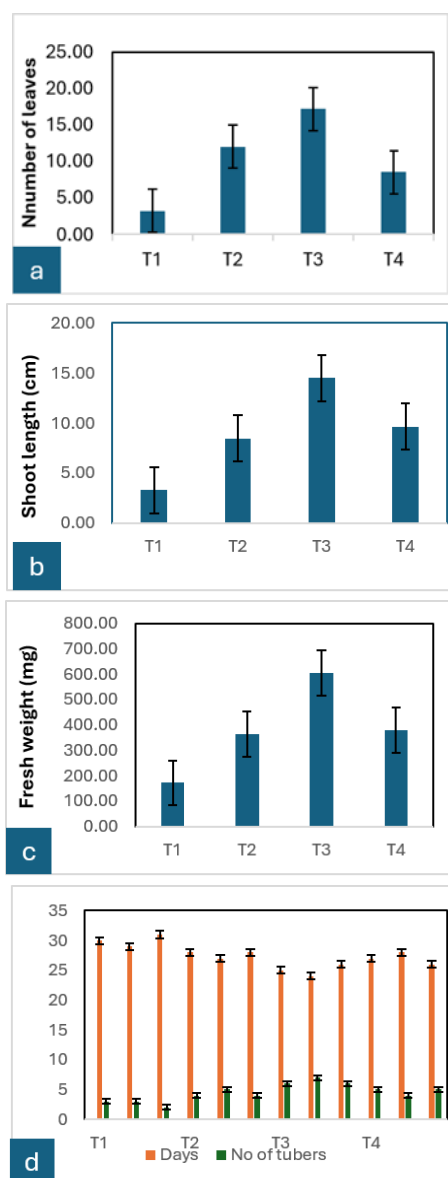


Figure 1. Effect of jasmonic acid (0, 0.5, 1.0, 2.0 μ M) on different parameters of shoot growth and microtuber

production of potato. **a)** Number of leaves. **b)** Shoot length, **c)** Fresh weight (mg), **d)** Number of microtubers.

Significant variations in the FW of plantlets were observed. The maximum fresh weight of plantlets was observed at 649.38 mg, using 1.0 μ M JA in MS medium (Figure 1c). Treatment T3 showed the highest fresh weight (approximately 600 mg) and the highest number of leaves (17). Treatment T1 had the lowest fresh weight, 175 mg and the fewest leaves (3). Our results show even better outcomes than previous studies that found JA increased the overall weight and size of potato plantlets. Another study also noted that JA boosted the fresh weight of potato shoots, but too much JA could actually inhibit the plants from growing. Zhang et al. (2006) also reported that the application of JA significantly increased the shoot fresh mass of potato plantlets.

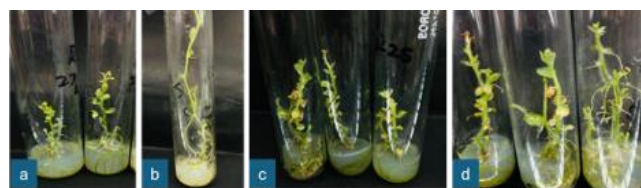


Figure 2 (a - d). Effect of jasmonic acid on the growth and morphology of in vitro cultures of potato on MS medium.

Treatment T1 showed consistent tuber production across its replicates, with counts ranging from 2 to 3 tubers observed at 30, 29, and 31 days for replicates 1, 2, and 3, respectively. Similarly, T2 demonstrated relatively consistent tuber production, yielding 4 tubers after 28 days, 5 tubers after 27 days, and 4 tubers at 28 days for its three replicates (Figure 1d). Treatment T3 exhibited a slightly wider range in tuber counts, with replicates producing 6 tubers at 25 days, 7 tubers at 24 days, and 6 tubers at 26 days. Finally, T4 had tuber counts like T2, with replicates producing 5 tubers at 27 days, 4 tubers at 28 days, and 5 tubers at 26 days.

The present study suggests that JA-supplemented MS medium facilitates efficient micropropagation without callus formation or abnormal shoot growth, with 0.5 and 1.0 μ M showing improved effects. An optimal concentration of 1.0 μ M JA significantly increased all plantlet growth characteristics and is proposed for mass production of healthy stocks.

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Author(s) contribution: M.A. performed the experimental work and wrote the initial draft, and SA& Z.A.S. conceived the idea, supervised the experimental work, and proofread the final draft.

Conflict of interest: The authors declare no conflict of interest.

Data availability: All data supporting the findings of this study are available within the paper. We do not have any research data outside the submitted manuscript file.

Declarations

Consent for publication: Not applicable.

Competing interests: The authors declare no competing interests.

References

- Ahmadu, T., Abdullahi, A., & Ahmad, K. (2021). The role of crop protection in sustainable potato (*Solanum tuberosum* L.) production to alleviate global starvation problem: An overview. IntechOpen.
- Berg, V.D. and Ewing, E.E. (1991). Jasmonates and their role in plant growth & development with special reference to the control of potato tuberization: a review. *American Potato Journal*, 68: 781-794.
- Jackson, S.D. (1999). Multiple signaling pathways control tuber induction in potato. *Plant Physiology*, 119: 1-8.
- Murashige, T., Skoog, F. (1962). A revised medium for rapid growth and bioassay with tobacco tissue cultures. *Physiologia Plantarum*, 15: 473-497.
- Navarre, D.A., Goyer, A., & Shakya, R. (2009). Nutritional value of potatoes: vitamin, phytonutrient, and mineral content. In: *Advances in potato chemistry and technology* (pp. 395-424). Academic Press.
- Pelacho, A.M. and Mingo-Castel, A.M. (1991). Jasmonic acids induce tuberization of potato stolon cultured *in vitro*. *Plant Physiology*, 97: 1253-1255.
- Pervaiz, A., Sajid, Z. A., Yousaf, S., Aftab, F. (2023). Microtuberization potential of jasmonic acid, kinetin and putrescine in potato (*Solanum tuberosum* L.). *American Journal of Potato Research*, 100(2), 184-191.
- Ravnikar, M., Vilhar, B., Gogala, N. (1992). Stimulatory effects of Jasmonic acid on potato stem node & protoplast culture. *Plant Growth Regulation*, 11: 29-33.
- Singh, P., Arif, Y., Miszczuk, E., Bajguz, A., & Hayat, S. (2022). Specific roles of lipoxygenases in development and responses to stress in plants. *Plants*, 11(7), 979.
- Ulloa, R.M., Raices, M., MacIntosh, G.C., Maldonado, S, Tellez-Inon, M.T. (2002). Jasmonic acid affects plant morphology & calcium-dependent protein kinase expression and activity in *Solanum tuberosum*. *Physiologia Plantarum*, 115: 417-427.
- Vishal, Mali, S., Dutta, M., Choudhary, A., & Zinta, G. (2025). Potato microtuberization: its regulation and applications. *Critical Reviews in Biotechnology*, 45(7), 1454-1477.
- Zhang, Z.J., Mao, B.Z., Li, H.Z., Zhou, W.J., Takeuchi, Y., Yoneyama, K. (2006). Effect of salinity on Physiological characteristics, yield & quality of physiological potato. - *Acta Physiologia Plantarum*, 27: 481-489.

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