



Success Of Water Henna Stem Cuttings (*Impatiens Hawkeri* Bull) Which Are Given Ecoenzymes At Different Concentration Levels And Soaking Times

Fauzan Gunawan Suhairi, Farida Iriani*, Aghnia Rahmawati1,
Universitas Insan Cendikia Mandiri, Bandung City, West Java, Indonesia
Corresponding Author Email: farida.iriani52@gmail.com

Abstract:

Background. Water henna is a widely cultivated ornamental plant, but its success rate from stem cuttings remains relatively low because root formation often fails. One effort to increase the success of water henna cuttings is applying ecoenzymes.

Aims. This study aims to examine the influence of ecoenzymes at several concentrations and soaking times on the growth of water henna stem cuttings. The research was carried out in Pasir Muncang Village, Cicangkang Girang, Sindangkerta District, West Bandung Regency, from July to August 2025.

Methods. The experimental design used was a factorial Group Random Design (RAK) with 12 treatment combinations and 3 replicates, namely A = 0 mL^{L-1} (3 hours), B = 0 mL^{L-1} (6 hours), C = 0 mL^{L-1} (9 hours), D = 5 mL^{L-1} (3 hours), E = 5 mL^{L-1} (6 hours), F = 5 mL^{L-1} (9 hours), G = 10 mL^{L-1} (3 hours), H = 10 mL^{L-1} (6 hours), I = 10 mL^{L-1} (9 hours), J = 15 mL^{L-1} (3 hours), K = 15 mL^{L-1} (6 hours), and L = 15 mL^{L-1} (9 hours).

Result. The results showed that a 10 mL L⁻¹ ecoenzyme concentration and a 6-hour soaking time had the best effect on the number of shoots, number of leaves, root length, number of roots, and fresh weight of the root of the water henna stem cuttings. The longer the soaking time (9 hours) and the higher the ecoenzyme concentration, the less effective the treatment was. The combination of 10 mL L⁻¹ treatment with a soaking time of 6 hours was the optimal treatment dose to spur the formation and growth of the vegetative organs of water henna cuttings.

Conclusion. The results of this study provide practical implications for ornamental plant cultivators to utilize ecoenzymes as an effective, efficient, and environmentally friendly organic waste-based growth promoter for sustainable agricultural systems.

Keywords: *Ecoenzyme, Concentration, Soaking duration, Water henna, Stem cuttings.*



© 2025 The Author(s). This article is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source.

INTRODUCTION

Current research increasingly recognizes ecoenzymes as organic biostimulants that can enhance nutrient mobilization and root formation, although their effectiveness varies by composition, concentration, plant species, and application method.

Ornamental plants are cultivated mainly to increase the aesthetic value of the environment through the shape of the leaves, flowers, colors, and crowns (Marjannah & Saputri, 2019). One ornamental plant with strong development potential is water henna (*Impatiens hawkeri* Bull). This plant is known for its bright and varied flower colors, such as pink, bright red, white, orange, and purple. Water henna can be cultivated in the field or in pots and is often used to beautify the yard (Dan et al., 2010). In addition to its aesthetic value, water henna is also used in religious traditions, for example as a flower sown during pilgrimage, worship by Hindus, and as part of certain religious and belief offerings and ceremonies (Sitawati et al., 2022).

In cultivation, plant propagation is an important stage for producing new individuals. Water henna plants can be propagated generatively or vegetatively. One type of vegetative propagation is cuttings, which involves using parts of the stem, branches, roots, or leaves to grow into new plants (Mariana, 2017). One characteristic of successful propagation through cuttings is successful root formation, followed by the growth of new shoots (Hartmann & Kester, 2014). The application of growth regulators, both natural and synthetic, is one effort to increase success (Simatupang et al., 2018). The main obstacle to water-henna cuttings is that they often undergo stem decay before the roots have time to grow, often due to high medium humidity or the presence of pathogenic fungi such as *Pythium* and *Rhizoctonia* (Purnamasari & Wulandari, 2020; Sari et al., 2022). Therefore, efforts are needed to use natural organic matter to suppress decay and stimulate root formation; one example is using ecoenzymes.

Ecoenzymes are products of fermented domestic organic residues such as fruit peels, vegetable waste, with the addition of brown sugar (molasses) and water containing organic acids (e.g. acetic acid and lactic acid), macro nutrients and micronutrients, small amounts of alcohol compounds and fermented bioactive compounds that are able to produce enzymes from the activity of microorganisms, so that they can act as growth promoters (Rustanta et al., 2022; Zuhro et al., 2023). Practice of using ecoenzymes in plant cultivation in the field: farmers often use ecoenzymes as liquid fertilizers by watering the root zone or spraying the leaves. However, to date, consistent results on the effect of ecoenzymes on increasing plant growth and yield have not been obtained. This is suspected to be due to the non-standardized nutrient content in ecoenzymes, which depends on the type of organic matter used as the nutrient source. Therefore, the concentration of ecoenzyme solutions used for several types of commodities needs to be researched. In addition, the duration of absorption of ecoenzyme

solutions applied to plant materials also needs to be researched, considering that each commodity has a different ability to absorb the given solutes.

Although ecoenzymes have increasingly been investigated as environmentally friendly biostimulants in crop production, previous studies have mainly focused on their application as liquid fertilizer through soil drenching or foliar spraying. Research examining ecoenzymes as a pre-planting soaking treatment for vegetative propagation remains limited, particularly in *Impatiens hawkeri*. Moreover, previous findings on ecoenzyme effectiveness have been inconsistent because their chemical composition varies according to the fermentation substrate, while the response of cutting materials also depends on both solution concentration and exposure duration. Consequently, the optimum interaction between ecoenzyme concentration and soaking duration for improving root and shoot establishment of water henna stem cuttings has not yet been clearly established. This knowledge gap provides the rationale for simultaneously evaluating these two factors in the present study. This formulation closely follows the article's rationale that ecoenzyme effects have been inconsistent, that concentrations need commodity-specific investigation, and that the absorption period also requires investigation because different plant materials have different capacities to absorb applied solutes.

This study aims to examine the application of ecoenzymes in several levels of concentration and soaking time in the ecoenzyme solution to the success of water hen stem cuttings.

LITERATURE REVIEW

New Guinea water henna (*Impatiens hawkeri* Bull) is native to Papua New Guinea and the Solomon Islands and grows optimally in a sheltered environment with high humidity (Luo et al., 2022). Vegetative propagation through stem cuttings can be distinguished into woody stem types that are dormant, semi-woody stems that are not dormant, soft-woody stems (succulent), and herbaceous types that do not contain wood (Hartmann & Kester's, 2014). Water henna plants have herbaceous stems. The success of herbaceous stem cuttings generally takes a shorter time than woody stem cuttings. To shorten the success time of cuttings, it is better to stimulate them with stimulating compounds so that, during the initial process of root formation, sufficient nutrient and water absorption can occur optimally (Jacobsen et al., 2021). Ecoenzymes are not the main type of organic fertilizer rich in macronutrients, so their main function is not to provide plant nutrients. Therefore, many

researchers consider that ecoenzymes are more appropriately referred to as biostimulants, bioactivators, or liquid biological enhancers. The organic acid content in ecoenzymes can trigger the dissolution of bound nutrients and produce compounds that promote root formation (Handayani, 2024; He et al., 2025). Hartmann & Kester reported that the results of the study on herbal stem cuttings through the application of auxin compounds of IBA and NAA types starting from 500-1250 ppm are the best concentration range. They added that the soaking time of cuttings in auxin solutions also affects the acceleration of root formation. Some researchers report that the treatment of soaking cuttings in a solution of synthetic growth regulators or organic substances such as ecoenzymes with the right duration and concentration has a significant effect on the rate of bud initiation and growth of the root system (Sitawati et al., 2022; Supriyadi et al., 2020; Purwandhari et al., 2024). The length of immersion of cutting material in a stimulation solution for each commodity differs because the absorption ability of the solution by the surface of the cutting material depends on the type and maturity of the cutting material, as well as the environmental factors at which the treatment is administered, especially temperature, sunlight intensity, soil moisture, and microspace humidity (Hartmann & Kester, 2014).

METHODS

The research has been carried out in Pasir Muncang Village, RT 03, RW 16, Cicangkang Girang Village, Sindangkerta District, West Bandung Regency (altitude of 750 meters above sea level) from July to August 2025. The method used is a field experiment with a factorial Group Random Design (RAK), consisting of two factors and three replicates. The first factor is the concentration of ecoenzymes, given a symbol (E) with five levels of concentration, namely E1 (0 mL L⁻¹), E2 (5 mL L⁻¹), E3 (10 mL L⁻¹), and E4 (15 mL L⁻¹). The second factor is the length of soaking of the cutting material in the ecoenzyme solution, given the symbol (P) with three levels, namely P1 (3 hours), P2 (6 hours), and P3 (9 hours). Twelve treatment combinations were obtained with a total of 36 experimental units and a total population of 108 cuttings

The water-henna stem cuttings were selected according to the standard for herbaceous materials: 12 cm long and with 2 segments. The base of the cuttings was cut at an angle to expand the surface area available to absorb the solution; the base was soaked to a depth of 5 cm, according to the treatment combination. After the soaking period, the cuttings were planted in a mixture of soil and wet husks at a 1:2 ratio in a polybag measuring 10x10 cm.

Maintenance included watering 4 times a week and weeding manually. The response variables observed included the number of shoots, number of leaves, length of primary roots, number of primary roots, and fresh weight of roots at 21 days after planting (HST). In addition, environmental factors were observed, namely plant pest organisms (OPT), temperature, humidity, and laboratory analysis of soil and ecoenzymes. Data based on Factorial Random Design were analyzed with SPSS version 21 and followed by the Duncan Multiple Distance Test (DMRT) at a 95% confidence level.

DISCUSSION

The results of observations of the microenvironment of the study site showed that the average daily temperature at the research site was 23 °C, soil moisture was 80.59%, and the air humidity was 63-67%, which is an ideal condition for the vegetative growth of *Impatiens hawkeri* (Thuy et al., 2024). Chemical analysis of the planting medium showed N 18%, P 25%, K 63%, and pH 5.3, while ecoenzymes had a pH of 3.5 with C-organic 2.58%, N 0.20%, P 0.00%, and K 0.22%. Table 1 presents the growth response of water henna cuttings to the measured variables under different ecoenzyme concentrations and soaking durations.

Table 1. Effect of Ecoenzyme Administration and Soaking Duration on Henna Cut Response Variables

Water at 21 HST

Code	Treatment	Number of Buds (strands)	Number of Leaves (strands)	Root Length (cm)	Number of Roots (strand)	Fresh Weight Roots (g)
A	E1P1 0 mLL-1 3 hours	3.4 a	3.7 to	2.1 A	15 to	0.32 to
B	E1P2 0 mLL-1 6 hours	3.4 a	3.7 to	2.5 b	17 b	0.38 b
C	E1P3 0 mLL-1 9 hours	3.4 a	3.7 to	2.8 c	18 b	0.42 c
D	E2P1 5 mLL-1 3 hours	4.2 b	4.5 b	3.0 d	20 c	0.48 d
E	E2P2 5 mLL-1 6 hours	4.5 BC	4.9 BC	3.4 e	23 Ef	0.55 f
F	E2P3 5 mLL-1 9 hours	5.1 d	5.4 of	3.7 f	24 fg	0.59 g
G	E3P1 10 mLL-1 3 hours	5.4 d	5.7 e	4.2 h	11 p.m.	0.75 i

H	E3P2 10 mL-1 6 hours	6.3 e	6.6 f	5.4 i	32 in	1.02 j
I	E3P3 10 mL-1 9 hours	5.2 s	5.5 e	4.0 g	25 gh	0.70 h
J	E4P1 15 mL-1 3 hours	4.6 c	5.0 cd	3.4 e	22 of	0.52 e
K	E4P2 15 mL-1, 6 hours	4.5 BC	4.9 BC	3.4 e	21 cd	0.50 of
L	E4P3 15 mL-1 9 hours	4.5 BC	4.9 BC	3.5 e	23 Ef	0.56 f

Remarks: Numbers followed by the same letter in the same column are no different according to the 5% DMRT Test.

Based on factorial RAK analysis and 5% DMRT test, treatment H, which is a combination of treatment at a concentration of 10 ^{mLL-1} with a soaking time of 6 hours, consistently produced the best average growth for all observed response variables, namely the number of shoots 6.3 leaves; Number of leaves 6.6 leaves; Primary root length 5.4 cm; Number of primary roots 32 strands; and Fresh weight of the root 1.02 g. Compared with the treatment without ecoenzyme application (0 mL L-1) at any soaking duration, the effect of adding ecoenzymes to the soaking solution appears positive. Thus, the performance of enzymes in the applied ecoenzymes is active as an activator to synthesize substances or stimulating compounds in the process of root growth and cuttings of herbaceous plants. It is suspected that the nitrogen (0.20%) and potassium (0.22%) content in ecoenzymes provides nutrients that contribute to cuttings, and that organic carbon (2.58%) can help improve the physical properties of the soil. Ecoenzymes made from organic waste generally have pure enzymes that can stimulate cell and tissue division, thus forming adventitious roots and encouraging the emergence of new vegetative shoots (Lingga & Marsono, 2013; Marschner, 2012). Although the ecoenzymes used in this study do not contain laboratory P elements, organic acids such as acetic acid can help dissolve bound phosphorus in the soil medium, making P available for absorption by the root system (Ia et al., 2025). In addition, the process of making the ecoenzymes used in this study also adds agricultural EM4, so it is suspected to add various types of microorganisms that can act as soil improvers. Based on Table 1. It appears that the soaking time of 6 hours is the optimal contact time for the water henna cutting material tissue to absorb the active substances in the soaking solution (Arifin et al., 2020). In contrast, soaking times longer than 6 hours appear to reduce the absorption effect across all measured response variables. It is suspected that the soaking time of 9 hours with

an ecoenzyme concentration of more than 10 mL⁻¹ causes the water henna cuttings to absorb excess linaurite, so that the absorbed substance or compound has exceeded the tolerance threshold; this can cause an antagonistic chemical reaction to the process of cell division and elongation, it is proven that a measurable response variable is worse than the combination of H treatments.

The novelty of this study lies in the simultaneous optimization of ecoenzyme concentration and pre-planting soaking duration for propagating *Impatiens hawkeri* stem cuttings. Unlike previous studies that primarily examined ecoenzymes as fertilizers or evaluated concentration effects independently, this study demonstrates a concentration–duration interaction and establishes 10 mL L⁻¹ ecoenzyme with a 6-hour soaking period as an optimum treatment for promoting both root and shoot development. Furthermore, the study identifies a potential upper treatment threshold, showing that prolonged soaking and higher ecoenzyme exposure do not necessarily enhance cutting performance and may instead suppress vegetative growth. This novelty is supported by the experiment's factorial design and the observation that the 10 mL L⁻¹ × 6-hour treatment consistently produced the best response across all measured variables, whereas longer soaking and excessive exposure reduced treatment effectiveness.

CONCLUSION

The administration of ecoenzymes in a combination of different concentration treatments and soaking lengths had a positive effect on the success of propagating water henna (*Impatiens hawkeri* Bull) stem cuttings. The combination treatment of 10 mL L⁻¹ ecoenzyme concentration and a soaking duration of 6 hours informed the best success for the observed response variables, namely the number of shoots, the number of leaves, the length of primary roots, the number of primary roots, and the fresh weight of the roots of the water henna cuttings.

Implications

The results of this study have significant practical and theoretical implications for floriculture. In practical terms, the use of 10 mL L⁻¹ ecoenzymes with a soaking time of 6 hours can be a cost-efficient solution to replace synthetic growth regulators that are relatively expensive, reduce the risk of root rot, and be able to increase the growth resistance of water

henna seedlings through optimal root formation (average root count of 32 strands). This application also supports eco-friendly cultivation (*green floriculture*) by using organic waste. Theoretically, this study informs the role of eco-stimulants rich in organic acids and potential microorganisms in improving soil, especially in root zones. In this case, ecoenzymes are more important for their auxin-like function than as an organic fertilizer; a safe concentration threshold is 10 mL L⁻¹ to prevent growth inhibition from the media's acidity.

Sincerely:

We express gratitude to farmers in Pasir Muncang Village, RT 03, RW 16, Cicangkang Girang Village, Sindangkerta District, West Bandung Regency, who lent land for this research.

BIBLIOGRAPHY

- Arifin, S., Sepriani, Y., & Dalimunthe, B. A. (2020). Effect of ZPT soaking time on the success of orange cuttings. *Journal of Agrotechnology*, 1(1), 38–44.
- Butar-Butar, F. (2024). Effect of Kepok Banana Peel Liquid Organic Fertilizer Dosage on the Growth of Rose Plants. *JIGA: Journal Innovation in Green Agriculture*, 1(1), 22–34.
- Dan, Y., Baxter, A., Zhang, S., Pantazis, C. J., & Veilleux, R. E. (2010). Development of efficient plant regeneration and transformation system for impatiens using *Agrobacterium tumefaciens*. *BMC Plant Biology*, 10, 165.
- Handayani, F. T. (2024). Optimization of the Use of Eco-Enzyme and NPK Fertilizer in New Guinea Water Henna Plants (*Impatiens hawkeri* Bull.). *Journal of Crop Production*, 12(11), 526–533.
- Hartmann, D.G., & Kester. (2014). *Plant Propagation; Principles and Practices*. Pearson Educational Limited. P 361–427.
- Ia, R., Nfa, H., & Ada, H. (2025). Effect of eco-enzyme application on soil nutrient and plant productivity of green mustard-peanut in inceptisol. *Journal of Soil Science*, 24(2), 196–205.
- Jacobsen, A. G. R., Jervis, G., Xu, J., Topping, J. F., & Lindsey, K. (2021). Root growth responses to mechanical impedance are regulated by a network of ROS, ethylene and auxin signaling in *Arabidopsis*. *New Phytologist*, 231(1), 225–242.
- Lingga, P., & Marsono. (2013). *Instructions for the Use of Fertilizers*. Jakarta: Penestocka Self-Help.
- Luo, X., Zhang, L., & Wang, Y. (2022). Habitat characteristics and physiological traits of *Impatiens hawkeri*. *Journal of Horticultural Research*, 15(3), 112–120.
- Mariana, M. (2017). Effect of planting media on the growth of patchouli stem cuttings (*Pogostemon cablin* Benth). *Journal of Agricultural Extension*, 11(1), 1–8.
- Marjannah, M., & Saputri, I. (2019). The Utilization of Ornamental Plants as Traditional Medicine. *Jeumpa Journal*, 6(1), 210–214.
- Marschner, H. (2012). *Mineral Nutrition of Higher Plants*. London: Academic Press.
- McConnell, J. (1996). Two Tropical Plants as Plant Materials for Teaching Seed Germination. *HortScience*, 31(4), 650a-650.

- Purnamasari, L., & Wulandari, F. (2020). Utilization of Ecoenzymes in Increasing Plant Growth. *Journal of Agroecotechnology*, 8(1), 35–42.
- Purwandhari, A. N., Susilowati, Y. E., & Laeshita, P. L. (2024). Effect of Rootone-F concentration and soaking duration on vine cuttings growth. *Equator Journal of Agricultural Science*, 13(3), 969–975.
- Rustanta, A., Jaya, A. S., & Graciella, M. (2022). Community Empowerment through Eco-Enzyme Cultivation in South Bekasi. *JMM (Journal of Independent Society)*, 6(4), 3360–3368.
- Sari, A. D., Rahayu, S., & Nugroho, E. (2022). The Effect of Planting Media Type and Growth Regulator on the Success of Miana Plant Cuttings. *Journal of Tropical Horticulture*, 5(2), 89–97.
- Sitawati, A.-a., D. M., & Damaiyanti, D. R. R. (2022). Effect of eco-enzyme concentration and pot diameter differences on the growth and flowering of water henna plants. *Proceedings of the PERHORTI National Seminar*, 2022, 19–20.
- Supriyadi, T., Soemarah, T., Suprapti, E., & Budiyo, A. (2020). Effect of concentration and soaking time of pepper cuttings in a solution of growth regulators. *Agrineca Scientific Journal*, 20(2), 158–169.
- Thuy, L. T., Lan, N. T. H., Giang, T. T., & Hong, N. D. A. (2024). Study on the effect of hydroponic nutrient solutions on the growth and development of impatiens plant. *Bulgarian Journal of Agricultural Science*, 30(4), 615–620.
- Zuhro, F., Hasanah, H. U., & Maharani, L. (2023). Analysis of the Quality of Ecoenzymes and Their Effect on the Growth of Mustard Greens. *BIOEDUCATION: Journal of Biology and Its Learning*, 21(3), 276–281