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Cocopeat Perlite Mixture as an Alternative for Rooted Cuttings Growth Medium of *Impatiens hawkeri x platypetala* in Indonesia

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Abstract

Impatiens hawkeri x platypetala rooted cuttings are typically cultivated using rice husks as a substrate. However, due to the poor water-holding capacity of this medium, *Impatiens* grows slowly in this environment. A viable alternative is the cocopeat perlite mixture which has a better water-holding capacity compared to the rice husk. Currently, there is no sufficient information available regarding the best growth medium to improve the quality of *I. hawkeri x platypetala* rooted cuttings in Indonesia. Therefore, this study aimed to obtain the best medium for quality rooted cuttings *I. hawkeri x platypetala*. The method employed was a randomized complete block design with two factors. The first factor was the *Impatiens* varieties consisting of Impala Agrihorti, Imadata Agrihorti, and Lavender, while the second was the growth medium, comprised of four levels namely rice husk (control), as well as a mixture of cocopeat with 3%, 5% and 8% perlite. The result showed that there was no interaction between varieties and growth medium. The mixture of 3% perlite in cocopeat exhibited better outcomes compared to other treatments. This medium increased the number and length of roots, stem diameter, plant height, leaves thickness, leaves number and survival rate. Therefore, the addition of 3% perlite in cocopeat could replace the rice husk as a rooted cutting growth medium for *I. hawkeri x platypetala*.

Keywords: assimilate partitioning; morphology; soilless culture; survival rate; water-holding capacity

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INTRODUCTION

Impatiens, an ornamental plant with a high economic potential, is well known for absorbing air and soil pollution (W. Liu et al., 2021; Y. Liu et al., 2021), as well as its medicinal and ornamental values (Luo et al., 2021). The preferred cultivar is *Impatiens hawkeri* which has bright, fluorescent and single-colored blossoms, as well as deep dark and single-colored foliage. Indonesia has produced several varieties of *Impatiens*, including the crossing between *I. hawkeri x I. platypetala,* known for their heat-tolerant genotype (Soehendi et al., 2022). Different drought-tolerant varieties have been released including *Impatiens* ‘Impala Agrihorti’ and ‘Imadata Agrihorti’. Both varieties have the potential to be used as landscape plant in lowlands and highlands. Currently, the development and use of *Impatiens* as an ornamental plant, specifically for landscape has a relatively high opportunity with the development of (1) agro-

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tourism, (2) entertainment venues or tourist sites and (3) city parks. To satisfy consumer expectations, high-quality rooted cuttings must be made accessible for optimal plant growth and yield quality. The growth medium, nutrients, tray size, plant age and the timing of transplantation influence the quality of rooted cuttings (Di Benedetto and Pagani, 2012).

Soilless cultures can improve crop output sustainability as well as the efficient use of water and nutrients (Suarez-Caceres et al., 2021). These systems are sustainable agriculture methods for boosting plant productivity and conserving resources (Mourouzidou et al., 2023). Both organic and inorganic substrates including perlite, vermiculite, gravel and rockwool, have great potential to be used as growth medium. Some examples of organic substrates include cocopeat, peat moss and sawdust, among others. Both substrates are intriguing due to their availability and recyclable nature (Masquelier et al., 2022). These substrates serve as a means of transferring microorganisms into the growth medium (Bamdad et al., 2022) and are environmentally friendly (A'saf et al., 2020).

Impatiens 'Impala Agrihorti' and 'Imadata Agrihorti' rooted cuttings have been successfully propagated using rice husk as the growth medium. Rice husks exhibit high total pore spaces, which can contribute to increased root system growth (Permanasari and Susila, 2018). However, *Impatiens* plant requires high humidity during the rooting process, and the use of rice husks results in hampered growth. To enhance the quality of rooted cuttings, particularly in *I. hawkeri x platypetala* variety, alternative growth mediums are needed. Sphagnum peat moss, perlite and vermiculite are growth mediums frequently used in the development of *Impatiens* rooted cuttings (Lojo et al., 2019), as well as cocopeat, perlite and peat mixed medium (2:2:1) for *Impatiens walleriana* (Ghanbari et al., 2019). However, there is limited available information regarding these mediums in Indonesia.

The different growth medium offers quality plant production due to their good water-holding capacity, aeration and nutrient status (Singh et al., 2023), although their effectiveness can be influenced by genotype, environment and production management (Francini and Sebastiani, 2019). In Indonesia and other tropical regions, the cocopeat medium stands out as a widely accessible option (Ayu et al., 2021). It has several advantages including structural and water retention properties, biodegradable in nature, as well as rich in carbon and other nutrients (Bharti et al., 2021). However, its high water-holding capacity can impede water and air exchange, resulting in low aeration and oxygen diffusion for the roots (Awang et al., 2009). This is because cocopeat reduces soil pore size, leading to a drop in total porosity, which lowers oxygen levels and prevents respiration thereby altering the anatomy and morphology of plant (Lojo et al., 2019). To address this, perlite can be added to improve plant growth and viability of the medium (Kazemi et al., 2020). Perlite enhances the physical characteristics of the medium by increasing the total porosity (Ilahi and Ahmad, 2017). Cocopeat and perlite have been identified as appropriate growth medium for certain greenhouse cultures (Ghehsareh et al., 2012). The incorporation of perlite into cocopeat can increase aeration and water retention (Banitalebi et al., 2021). Lojo et al. (2021) employed a perlite mixture of about 20% in a medium for *I. walleriana*. A commercial nursery in Indonesia also used a mixture of cocopeat and 5% perlite as a growth medium for rooted cuttings of several ornamental plant. Therefore, this study aimed to investigate the effects of various rooting medium, including rice husk as a control and a mixture of cocopeat with perlite in varying concentration ranges, on three *I. hawkeri x platypetala* cultivars, namely 'Impala Agrihorti', 'Imadata Agrihorti' and 'Lavender'. The results will provide information on the best growth medium to improve the quality of *Impatiens* rooted cutting varieties.

MATERIALS AND METHOD

Plant material preparation

This study was conducted from September to October 2022 at Bina Usaha Flora Company's greenhouse in West Java, Indonesia, located at 6°43'45"S, 107°4'31"E and 836 m above sea level. Cuttings from the mother plant of *Impatiens,* namely 'Impala Agrihorti', 'Imadata Agrihorti' and 'Lavender' were used as the planting material. The shoot cuttings were measured at the same height of 3 to 4 cm, and root-stimulating agents were applied 5 minutes before planting. Furthermore, rice husk, as well as cocopeat + 3%, 5% and 8% perlite were used as the medium on which the cuttings of the shoots were planted. The cuttings were planted on trays with 200 planting holes in a greenhouse exposed to 60% shade, and irrigate was carried out daily.

Measurement of environment and growth medium properties

Light intensity was measured above the plant canopy using a lux meter, while air temperature and humidity were recorded with a thermohygrometer. The measurements were carried out in the morning (09.00 a.m.), afternoon (12.00 p.m.) and evening (03.00 p.m.) (Shintiavira et al., 2023). Before planting, the pH values for the growth medium were determined by combining 10 g medium with 50 ml water, agitating for 30 minutes and leaving it standing for 24 hours. The electrical conductivity (EC) values were obtained by mixing 40 g medium with 80 ml water, agitating for 15 minutes and leaving for 60 minutes. The mixture was filtered using an EC meter (Hanna H1981–51) before conducting the measurements. The soil moisturizer and temperatures were assessed by a moisturizer meter and a thermometer. The pH and EC values were calculated based on a previous study by Awang et al. (2009).

Study design

A randomized complete block design (RCBD) with two factors was employed in the investigation. The first factor was the *Impatiens* varieties, consisting of 1) Impala Agrihorti, 2) Imadata Agrihorti and 3) Lavender. Meanwhile, the second factor was the growth medium for rooted cuttings, which consisted of 4 levels, namely rice husk (control), cocopeat + 3% perlite, cocopeat + 5% perlite, and cocopeat + 8% perlite. Each of the treatments was replicated three times.

Morphology

The following morphological observations were made: 1) the number of primary root branches, 2) the root length, which referred to the distance between the base of the stem and the tip of the longest root, 3) the stem diameter, measured beneath the node from which the last petiole grew, 4) the plant height, considered as the distance between the apical shoot tip to the base of the stem, 5) the leaves thickness, measured using micrometers three leaves from the top (Huang et al., 2022), 6) survival rate, calculated as the number of growth plant divided by the total number of plant x 100% (Wang et al., 2018). The morphological characteristics were assessed at 14, 21 and 28 days after planting (DAP).

Assimilate partitioning

The organs of the plant, such as leaves, stems and roots, were harvested separately and oven-dried for 96 hours at 80 °C (Lojo et al., 2017). The dried organs were then weighed to determine their total dry weight, root mass ratio (root dry weight divided by the total dry weight), stem mass ratio (stem dry weight divided by the total dry weight) and leaves mass ratio (leaves dry weight divided by the total dry weight). These parameters were measured 28 DAP.

Data analysis

The data were analyzed using analysis of variance (ANOVA) to determine the effect of all treatments. This was followed by the Duncan Multiple Range Test (DMRT) with a of 5%. All data analysis was conducted using the SAS 9.4 program.

RESULTS AND DISCUSSION

Environment

Environmental observations during the rooted cutting plant growth showed that the average temperature, relative humidity, and light intensity were 26.38 °C, 81.17% and 7,388 Lux respectively as shown in Table 1. According to a previous study, the *Impatiens* juvenile requires temperatures in the range of 21.50 to 26.50 °C (Shintiavira et al., 2023). This indicates that the *Impatiens* were provided with optimal conditions in this study for their growth and development.

The cocopeat + 3%, 5% and 8% perlite as well as rice husk had pH values of 5.3, 5.3, 5.8 and 6.5 (Table 2), while the EC values were 2.25, 2.06, 1.08 and 0.81 µS cm^{-1}, respectively. This showed that the higher the perlite concentration, the lower the EC value, as also discovered by Alavi et al. (2020). According to Awang et al. (2009), the initial pH and EC of the growth medium had a direct impact on nutrient

Table 1. Temperature, relative humidity and light intensity during the growth of *Impatiens* cuttings

Variables	Time			Average
	09.00 a.m.	12.00 p.m.	03.00 p.m.	
Temperature (°C)	26.16	28.17	24.83	26.38
Relative humidity (%)	88.50	69.17	85.83	81.17
Light intensity (Lux)	4,500	13,000	4,666	7,388

availability. The cocopeat + 3%, 5% and 8% perlite as well as rice husk had soil moisturizer values of 19.9 to 90%; 17.8 to 80.0%; 15.50 to 80.0% and 10.2 to 50.00%, while the temperature was 22.3, 22.3, 22.5 and 23.5 ºC, respectively. As proven by Dede et al. (2006), the acceptable range for EC and pH of *Impatiens* growth medium was 0.75 to 3.49 µS cm^{-1} and 5.2 to 6.5, respectively. Alam et al. (2020) also stated that the water-retaining capacity of the growth medium was affected by the moisture content. Additionally, Sarkar et al. (2021) reported that cocopeat had a higher moisture content, with better pH and EC compared to the rice husk as a growth medium for lettuce.

Morphology

The good quality of *Impatiens* rooted cutting is determined by the strong stem, branch and root (Lopez and Runkle, 2008). These properties are influenced by genotype, environment and production management (Francini and Sebastiani, 2019). Genetically, different characters were found in each variety. Some genotypes produced different root systems in varying growth mediums, influencing plant growth and development (Kazemi et al., 2020).

Number of roots

There was no interaction observed between varieties and rooted cutting medium in relation to the number of roots (Table 3). *Impatiens* 'Lavender' had the highest number of roots compared to other varieties, from 14 to 28 DAP. The cocopeat mixture with 3 to 8% perlite exhibited a significant increase in the number of roots compared to the rice husk. As the bulk densities of the medium increased, the pore spaces for air were reduced, leading to higher retention of moisture content, greater EC and low oxygen for root growth (Kumarasinghe et al., 2015; Patil et al., 2020). According to Adekiya et al. (2022), cocopeat has a higher porosity than the rice husk, thereby facilitating enhanced root penetration for nutrient absorption and stimulating the growth of more roots.

Root length

There was no interaction between varieties and rooted cutting medium in terms of root length as shown in Table 4. *Impatiens* 'Lavender' had the highest root length compared to the other varieties, from 14 to 28 DAP. The cocopeat mixture containing 3 to 8% perlite increased the number of roots compared to the rice husk, and the most significant growth was observed in the 3% perlite treatment. This medium showed the capacity to effectively anchor the root system, thereby facilitating the absorption of water and nutrients, resulting in the formation of longer roots due to the activity of the lateral meristem (Li et al., 2018). The increase in root width caused by the lateral spread influenced the dry weight (Djaingsastro et al., 2021). The application of

Table 2. EC, pH, soil moisturizer and soil temperature of rooted cutting mediums

Treatments	EC (µS cm^{-1})	pH	Soil moisturizer (%)	Soil temperature (ºC)
Cocopeat + 3% perlite	2.25	5.3	19.9-90.0	22.3
Cocopeat + 5% perlite	2.06	5.3	17.8-80.0	22.3
Cocopeat + 8% perlite	1.08	5.8	15.5-80.0	22.5
Rice husk (control)	0.81	6.5	10.2-50.0	23.5

Table 3. Number of roots for *Impatiens* cuttings in various growth mediums

Treatments	Days after planting		
	14	21	28
Varieties			
Impala Agrihorti	9.43^{a}	13.75^{b}	15.61^{b}
Imadata Agrihorti	9.53^{a}	11.91^{b}	19.01^{a}
Lavender	12.81^{a}	18.11^{a}	21.83^{a}
Rooted cuttings medium			
Cocopeat + 3% perlite	11.55^{a}	15.70^{a}	18.33^{ab}
Cocopeat + 5% perlite	11.77^{a}	16.07^{a}	20.33^{a}
Cocopeat + 8% perlite	11.81^{a}	15.26^{a}	20.81^{a}
Rice husk (control)	9.60^{b}	11.33^{b}	15.78^{b}
CV (%)	18.38	18.61	18.06

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an $\alpha = 0.05$. CV = coefficient variation cocopeat as a growth medium increased vegetative growth in a young persimmon orchard by improving the water and nutrient status of plants (Parra et al., 2022).

Stem diameter

There was no interaction between varieties and rooted cutting medium in terms of stem diameter as shown in Table 5. *Impatiens* 'Imadata Agrihorti' had the largest diameter compared to other varieties at 28 DAP. The cocopeat mixture containing 3 to 8% perlite significantly increased the stem diameter more than the rice husk. The enhanced stem diameter can be attributed to the support provided by root elongation, which contributed to overall shoot growth and stability (Tracy et al., 2013). Under optimal soil water supply, high stem hydraulic conductivity allows quick water transport from stems into leaves to compensate for transpiration water loss and consequently maintain high daily water potential (Zhang and Cao, 2009).

Number of leaves

There was no interaction between varieties and rooted cutting medium in relation to leaves number as shown in Table 6. All Impatiens varieties had nearly the same values and there was no significant difference in the number of leaves at 14 and 28 DAP. The 3 to 8% perlite in cocopeat significantly increased the number of leaves from 14 to 28 DAP, and the most significant result was produced by the 3% perlite treatment. According to Adekiya et al. (2022), cocopeat mediums have higher water retention, contributing to a rise in the number of leaves in tomatoes. The higher number and length of the root improved nutrient uptake and increased stem hydraulic conductivity, facilitating both leaves growth and mesophyll cell expansion (Zhang and Cao, 2009). Djaingsastro et al. (2021) reported that the cocopeat might assist the planting medium in holding the water content for the optimal photosynthetic process

Table 4. Root length of *Impatiens* cuttings in various growth mediums (cm)

Treatments	Days after planting		
	14	21	28
Varieties			
Impala Agrihorti	4.06[b]	5.96[a]	5.86[b]
Imadata Agrihorti	3.76[b]	4.95[b]	5.31[b]
Lavender	4.62[a]	6.70[a]	6.83[a]
Rooted cuttings medium			
Cocopeat + 3% perlite	4.41[a]	6.18[a]	6.42[a]
Cocopeat + 5% perlite	4.49[a]	6.10[a]	6.17[ab]
Cocopeat + 8% perlite	4.29[a]	6.09[a]	6.17[ab]
Rice husk (control)	3.16[b]	5.11[a]	5.25[b]
CV (%)	12.68	17.29	15.88

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an $\alpha = 0.05$. CV = coefficient variation

Table 5. Stem diameter of *Impatiens* cuttings in various rooted cutting mediums (mm)

Treatments	Days after planting		
	14	21	28
Varieties			
Impala Agrihorti	2.30[a]	2.77[a]	2.80[b]
Imadata Agrihorti	2.19[a]	2.66[a]	3.04[a]
Lavender	2.37[a]	2.33[b]	2.80[b]
Rooted cuttings medium			
Cocopeat + 3% perlite	2.31[a]	2.62[a]	3.16[a]
Cocopeat + 5% perlite	2.40[a]	2.64[a]	3.09[a]
Cocopeat + 8% perlite	2.36[a]	2.61[a]	2.82[ab]
Rice husk (Control)	2.12[b]	2.48[a]	2.50[b]
CV (%)	7.19	9.67	11.50

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an $\alpha = 0.05$. CV = coefficient variation and transportation. This, in turn, significantly impacted vegetative growth and productivity, evidenced by the number of leaves.

Plant height

There was no interaction between varieties and rooted cutting medium in relation to plant height as shown in Table 7. *Impatiens* ‘Impala Agrihorti’ had a faster growth rate than ‘Lavender’ and ‘Imadata Agrihorti’ from 14 to 28 DAP. The 3 to 8% perlite in cocopeat significantly increased the plant height compared to the rice husk, and the most significant result was produced by the 3%. Auxin accumulation in the root tip increased growth and allocated more carbohydrates for the elevation of the plant height (Li et al., 2018). According to Sarkar et al. (2021), cocopeat provided ample microclimate conditions in the root region and increased plant height, number of leaves, as well as fresh biomass components compared to rice husk in lettuce.

Leaves thickness

There was no interaction between varieties and rooted cutting medium in terms of leaves thickness as shown in Table 8. *Impatiens* ‘Imadata Agrihorti’ had the highest leaves thickness compared to other varieties. The cocopeat mixture with 3 to 8% perlite increased the leaves thickness and the most significant result was yielded by the 3% perlite. According to Zhang and Cao (2009), leaves with greater thickness often have dense veins and wide vascular bundles to accelerate the diffusion of water and nutrients. This phenomenon underscores the correlation between stem hydraulic conductivity and nutrient use efficiency.

Survival rates

There was no interaction between varieties and rooted cutting medium in relation to the survival rate as illustrated in Table 9. *Impatiens* ‘Lavender’ had the highest survival rate at 14 to 28 DAP compared to other varieties. The 3%, 5% and 8%

Table 6. Number of leaves of *Impatiens* cuttings in various growth mediums

Treatments	Days after planting		
	14	21	28
Varieties			
Impala Agrihorti	5.50[a]	6.00[a]	6.02[a]
Imadata Agrihorti	5.56[a]	5.17[b]	6.19[a]
Lavender	5.68[a]	5.49[ab]	6.61[a]
Rooted cuttings medium			
Cocopeat + 3% perlite	5.66[a]	5.67[a]	6.94[a]
Cocopeat + 5% perlite	5.77[a]	5.62[ab]	6.47[a]
Cocopeat + 8% perlite	5.62[a]	5.41[ab]	6.36[a]
Rice husk (Control)	4.88[b]	5.15[b]	5.33[b]
CV (%)	6.90	8.10	13.45

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an α = 0.05. CV = coefficient variation

Table 7. Plant height of *Impatiens* cuttings in various rooted cutting mediums (cm)

Treatments	Days after planting		
	14	21	28
Varieties			
Impala Agrihorti	4.78[a]	5.28[a]	7.40[a]
Imadata Agrihorti	2.92[c]	3.42[c]	4.98[c]
Lavender	4.20[a]	4.70[b]	6.60[b]
Rooted cuttings medium			
Cocopeat + 3% perlite	4.23[a]	4.73[a]	4.23[a]
Cocopeat + 5% perlite	4.16[a]	4.66[a]	4.16[a]
Cocopeat + 8% perlite	3.98[ab]	4.48[ab]	3.98[ab]
Rice husk (Control)	3.50[b]	4.00[b]	3.50[b]
CV (%)	14.23	12.69	9.58

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an α = 0.05. CV = coefficient variation perlite in cocopeat increased the survival rate by 83.33%, 82.75% and 79.78%, respectively. The production of adventitious roots can increase the survival rate of rooted cuttings (Singh et al., 2015).

Assimilate partitioning

There was no interaction between varieties and rooted cutting medium in terms of the total dry weight as shown in Table 10. The total weight was similar among the varieties, but there were differences in the assimilation distribution to the root, leaves and stem. Pagani et al. (2015) reported that the use of different plant sinks influenced the assimilate partitioning for each plant organ. *Impatiens* 'Impala Agrihorti' showed a better ability for leaves assimilation, presumably due to its larger plant size and broader leaves. *Impatiens* 'Imadata Agrihorti' exhibited more efficient assimilation towards the stem, while 'Lavender' showed a greater root and leaves assimilation due to the strength of the root system. Based on the results, the cocopeat + perlite (3%, 5% and 8%) and rice husk had pH values of 5.3, 5.3, 5.8 and 6.5, respectively. This shows that the higher the pH of the medium, the lower the total dry weight of the plant. According to Massa et al. (2018), high pH (from 5.99 to 7.47) decreased the dry weight of *Impatiens*. Djaingsastro et al. (2021) also stated that higher EC created the best-quality plant, evident from the increased height and root volume, resulting in enhanced fresh and dry weight.

Based on the results, the different growth mediums examined had similar effects in all varieties. This study showed that *Impatiens* cuttings demonstrated a preference for growth medium with higher EC values (2.25 µS cm^{-1}). This was in contrast to the results of Xu et al. (2021) stating that higher EC (> 2.0 dS m^{-1}) inhibited the growth of roots in nasturtium cuttings. The elevated EC values of cocopeat in perlite showcased nutrient availability in the growth medium, potentially impacting the quality of *Impatiens*. According to Kobori et al. (2022),

Table 8. Leaves thickness of *Impatiens* in various rooted cutting mediums (mm)

Treatments	Days after planting		
	14	21	28
Varieties			
Impala Agrihorti	0.20^{b}	0.21^{c}	0.21^{c}
Imadata Agrihorti	0.24^{a}	0.29^{a}	0.29^{a}
Lavender	0.23^{b}	0.24^{b}	0.24^{b}
Rooted cuttings medium			
Cocopeat + 3% perlite	0.24^{a}	0.26^{a}	0.26^{a}
Cocopeat + 5% perlite	0.23^{ab}	0.25^{ab}	0.25^{ab}
Cocopeat + 8% perlite	0.23^{ab}	0.24^{bc}	0.24^{bc}
Rice husk (Control)	0.22^{b}	0.23^{c}	0.23^{c}
CV (%)	8.05	5.33	8.78

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an α = 0.05. CV = coefficient variation

Table 9. The survival rate of *Impatiens* in various rooted cuttings mediums

Treatments	Survival rate (%)
Varieties	
Impala Agrihorti	80.48^{b}
Imadata Agrihorti	77.94^{b}
Lavender	84.18^{a}
Rooted cuttings medium	
Cocopeat + 3% perlite	83.33^{a}
Cocopeat + 5% perlite	82.75^{a}
Cocopeat + 8% perlite	79.78^{ab}
Rice husk (Control)	77.56^{b}
CV (%)	4.74

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an α = 0.05. CV = coefficient variation

Table 10. Assimilate partitioning of *Impatiens* in various rooted cutting mediums at 28 DAP

Treatments	Root dry weight (g)	Stem dry weight (g)	Leaves dry weight (g)	Total dry weight (g)	Root mass ratio	Stem mass ratio	Leaves mass ratio
Varieties							
Impala Agrihorti	0.009^{b}	0.021^{ab}	0.049^{a}	0.080^{a}	0.12^{c}	0.26^{b}	0.53^{a}
Imadata Agrihorti	0.012^{ab}	0.028^{a}	0.049^{a}	0.083^{a}	0.15^{b}	0.32^{a}	0.40^{b}
Lavender	0.01^{a}	0.019^{b}	0.047^{a}	0.080^{a}	0.17^{a}	0.23^{b}	0.51^{a}
Rooted cuttings medium							
C + 3% perlite	0.015^{a}	0.022^{ab}	0.054^{a}	0.094^{a}	0.16^{a}	0.24^{a}	0.53^{a}
C + 5% perlite	0.011^{a}	0.026^{a}	0.045^{ab}	0.081^{a}	0.13^{ab}	0.30^{a}	0.56^{a}
C + 8% perlite	0.014^{a}	0.025^{ab}	0.050^{a}	0.087^{a}	0.15^{ab}	0.28^{a}	0.56^{a}
Rice husk (Control)	0.008^{a}	0.017^{b}	0.037^{b}	0.063^{b}	0.12^{b}	0.27^{a}	0.26^{b}
CV (%)	33.49	35.54	21.13	22.71	20.61	24.07	25.04

Notes: numbers followed by the same letter in the same column show no significant difference based on the DMRT with an α = 0.05. C = cocopeat medium, CV = coefficient variation

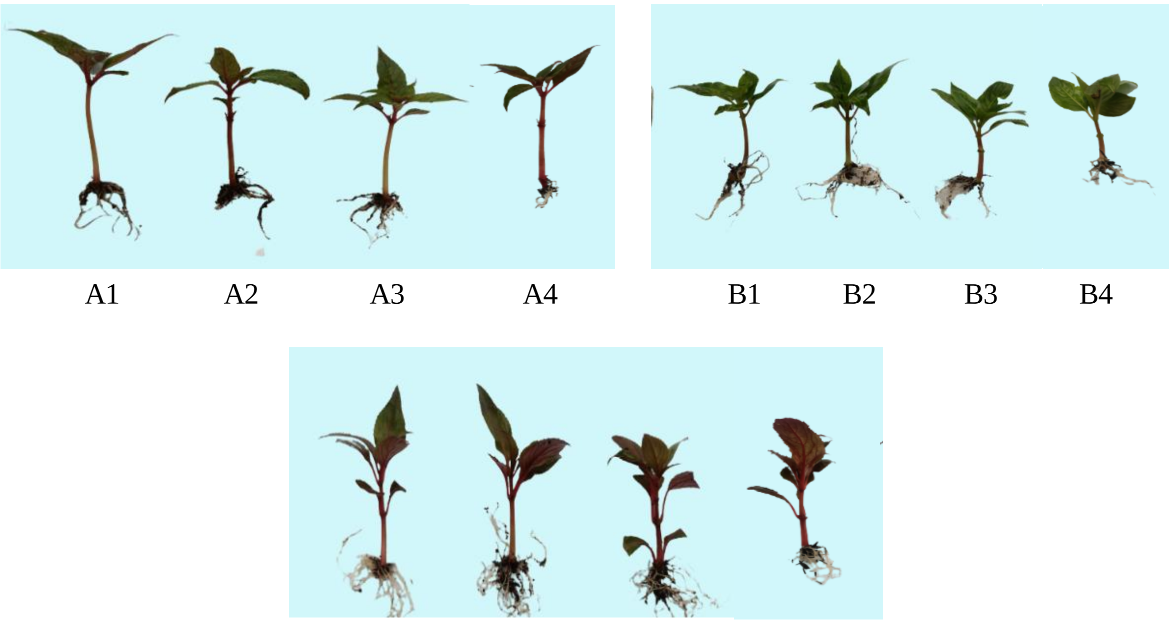

Figure 1. Rooted cuttings of *Impatiens* 'Impala Agrihorti (A), 'Imadata Agrihorti' (B), 'Lavender' (C), and levels of perlite concentration such as 3% (1), 5% (2), 8% (3) and rice husk (4) at 28 DAP

the quality index of *Impatiens* rooted cuttings is indicated by the dry mass, plant height and stem diameter.

The *Impatiens* plant could produce more root dry weights when cultivated in a medium featuring elevated nutrient status combined with higher moisture content (Kazemi et al., 2020). This outcome can be attributed to the significant influence of root growth on nutrient uptake (Singh et al., 2023). Additionally, the allocation of assimilates within the plant further supports the growth in stem diameter and leaves number (Lojo et al., 2019). The increment in stem diameter facilitated nutrient transportation to the leaves (Zhang and Cao, 2009), while the higher number of leaves enhanced photosynthetic activities leading to increased assimilation for further growth (Adekiya et al., 2022). The performance of *Impatiens* rooted cuttings is shown in Figure 1.

CONCLUSIONS

The growth medium of *Impatiens* rooted cuttings composed of 3% perlite in cocopeat exhibited better performance compared to rice husk in all varieties. This medium had lower pH, as well as higher EC and moisture than the others. These features increased the number and length of roots, contributing to the growth of stem diameter, plant height, leaves thickness, leaves number and survival rate. Future studies are recommended to explore plant growth, promoting microorganisms in soilless systems as an alternative for sustainable agriculture growth medium.

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