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RESEARCH ARTICLE

Effect of several kinds of potting media on tuberous yield and quality of eddoe taro plants (*Colocasia esculenta* L.) in various potting substrates

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Abstract

Eddoe taro (*Colocasia esculenta* (L.) Schott var. *antiquorum*) is a valuable tuber crop widely cultivated for its starchy corms and cormels, which serve as a rich source of carbohydrates and essential nutrients. However, the optimization of potting media for eddoe taro cultivation in controlled environments has not been fully explored. This study evaluated the effects of five potting substrates on the growth, tuber yield and quality of eddoe taro under nethouse conditions. A completely randomized design was employed with five treatments: Loamy soil (Tre 1), loamy soil + coconut coir (1:1) (Tre 2), loamy soil + TMX mixed soil (1:1) (Tre 3), loamy soil + coconut coir + TMX mixed soil (1:1:1) (Tre 4) and loamy soil + mixed coconut coir (rice husk: rice husk ash: coconut coir, 1:1:5) + TMX mixed soil (1:1:1) (Tre 5). Each treatment consisted of 15 replicates (one plant per pot). Growth parameters such as plant height, leaf number and leaf size were significantly improved in treatments containing TMX mixed soil (Tre 3, 4 and 5) compared to treatments without TMX (Tre 1 and 2). Tre 4 yielded the highest total cormels (37 per plant), marketable tubers (20.5 per plant), corm yield (0.95 kg/m^2), cormel yield (8.81 kg/m^2) and marketable yield (8.29 kg/m^2). Additionally, this treatment produced tubers with superior quality characteristics, including 15.4 % dry matter content and 27.9 mg/g fresh weight of total sugar. These findings demonstrate that loamy soil combined with coconut coir and TMX mixed soil (1:1:1) serves as an optimal substrate for eddoe taro cultivation in pots under controlled environments, offering practical solutions for urban and small-scale farming systems.

Keywords: eddoe taro; potting substrate; tuber quality; tuber yield; vegetative growth

Introduction

Taro (*Colocasia esculenta* (L.) Schott) is a vital staple food and cash crop cultivated widely in tropical and subtropical regions (1). With an estimated annual production of over 10 million tons globally, taro plays a crucial role in ensuring food security and providing nutrition, particularly in resource limited regions (2, 3). Among its varieties, eddoe taro (*C. esculenta* var. *antiquorum*) is highly valued for its starchy corms and cormels, which are rich in carbohydrates, essential minerals and dietary fiber (4). In Vietnam, taro is the fourth most significant tuber crop after potatoes, sweet potatoes and cassava, covering an annual cultivation area of approximately 15000 hectares. Eddoe taro is particularly notable for its adaptability to poor soils and dry climates, making it a preferred crop in countries such as Vietnam, China and Japan (5). Besides its nutritional value, various parts of the taro plant are used in traditional medicine and it is cultivated as a cash crop due to its economic importance (6, 7). Traditional taro cultivation typically requires open field conditions with high light intensity for maximum yield (8). However, taro is also shade tolerant, allowing reasonable yields to be achieved in shaded or semi-controlled environments, such as nethouses (9). With the rapid development of urban farming, growing taro in pots is increasingly recognized as a practical solution for households with limited space (10 - 12). Potting substrates composition directly influences plant growth by modifying soil physical and chemical properties, including porosity, water retention and nutrient supply (13, 14). Despite the critical role of potting media in crop productivity, limited research has explored its impact on the growth, yield and quality of taro cultivated under nethouse conditions.

Research on eddoe taro has mainly focused on traditional field cultivation, leaving a gap in knowledge regarding its response to different potting substrates in controlled environments. Identifying optimal potting substrates could provide a pathway for improving taro cultivation in urban and small-scale agricultural systems, contributing to sustainable farming practices. Previous studies have shown that adding organic materials such as coconut coir and biochar to substrates can enhance plant growth by increasing soil porosity, cation exchange capacity and water holding capacity (15, 16). This study aims to evaluate the effects of different potting media on the vegetative growth, yield and quality of eddoe taro grown under nethouse conditions. By identifying the most suitable substrate composition, the research seeks to offer practical recommendations for optimizing taro cultivation in urban and semi-controlled environments, thereby addressing a critical need in sustainable agriculture.

Materials and Methods

Experimental site and location

The experiment was conducted in 2023 at a nethouse located at the College of Agriculture, Can Tho University, Vietnam. Environmental parameters, including air temperature, humidity and light intensity, were monitored weekly using a thermo-hygrometer and lux meter (Lux-meter 4NA315, Tokyo Photo-Electric Co., Ltd). The average air temperature ranged from 29.8 °C to 33.0 °C, relative humidity varied between 62.2 % and 74.7 % and light intensity ranged from 14.9 to 27.9 kilolux conditions deemed suitable for eddoe taro growth in controlled environments.

Plant materials

Eddoe taro (*Colocasia esculenta* (L.) Schott var. *antiquorum*) plantlets were propagated through tissue culture from side suckers of mature corms. Healthy plantlets with uniform height and at least two fully developed leaves were selected for the experiment. Before transplanting, the plantlets were acclimatized in a controlled environment for 45 days to ensure proper root establishment (Fig. 1). The taro corms were characterized by their small, oval to round shape, dark brown rough skin and white flesh. These plantlets were then transplanted into black plastic pots (32 cm top diameter × 25 cm bottom diameter × 27.5 cm height) filled with the respective potting media treatments.

Experimental design

The experiment was conducted using a completely randomized design to evaluate the effects of different potting media on the growth, yield and quality of eddoe taro (*Colocasia esculenta* var. antiquorum). Five treatments, representing different potting substrate compositions, were included: Loamy soil (control) (Tre 1), Loamy soil + coconut coir (1:1) (Tre 2), Loamy soil + TMX mixed soil (1:1) (Tre 3), Loamy soil + coconut coir + TMX mixed soil (1:1:1) (Tre 4) and Loamy soil + mixed coconut coir (rice husk: rice husk ash: coconut coir in a 1:1:5 ratio) + TMX mixed soil (1:1:1) (Tre 5). Each treatment had 15 replicates, with one plant per pot, resulting in 75 experimental units in total. Black plastic pots measuring 32 cm in top diameter, 25 cm in bottom diameter and 27.5 cm in height were used for the study. Each pot was filled with the assigned potting medium.

Fig. 1. (A) The eddoe plantlets. (B) The edible tubers (corms).

Substrate preparation

The potting substrates were prepared using loamy soil, coconut coir, TMX mixed soil and additional organic materials (OM), including rice husk and rice husk ash, mixed in specified ratios. Five treatments were established (Table 1).

Cultivation and fertilization practices

Healthy eddoe taro plantlets, propagated through tissue culture and acclimatized for 45 days, were transplanted into the pots. Each plantlet was inspected to ensure uniformity in size and health before planting. Fertilization was applied uniformly across all treatments using urea (46 % N), DAP (18-46-0), NPK (20-20-15) and KCl. Fertilizers were applied seven times during the growing season: (1) at planting (0.1 g DAP per pot), (2) at 15 days after planting (DAP) with 0.3 g Urea, 0.2 g DAP and 0.2 g NPK, (3) at 25 DAP with 0.3 g Urea, 0.3 g NPK and 0.1 g KCl, (4) at 35 DAP with 0.15 g Urea, 0.4 g NPK and 0.12 g KCl, (5) at 50 DAP with 0.5 g NPK and 0.3 g KCl, (6) at 70 DAP with 0.5 g NPK and 0.4 g KCl and (7) at 90 DAP with 0.5 g NPK and 0.4 g KCl. Plants were watered daily to maintain adequate soil moisture levels and systemic pesticides or fungicides were applied three times during the experiment to control pests and diseases.

Data collection

Vegetative growth parameters were measured at 30, 60, 90 and 120 days after planting (DAP) to assess the effects of potting media on plant performance. These parameters included plant height, number of mature leaves, leaf length, leaf breadth and relative chlorophyll content of the leaves. Plant height was measured from the soil surface to the tip of the tallest leaf, while the number of mature leaves per plant was counted. Leaf length was measured from the base of the leaf to the apex and leaf breadth was recorded at the widest point. Relative chlorophyll content was assessed using a SPAD-502 chlorophyll meter to provide insights into photosynthetic efficiency during vegetative growth (Fig. 2).

Yield parameters were recorded at harvest (140 DAP), when plants showed signs of senescence, including yellowing leaves and a decline in plant height. Harvested tubers were analyzed for corm weight (g) and corm breadth (measured horizontally at the middle of the corm). The total number and weight of cormels per plant were recorded. Marketable yield was determined by identifying cormels with a diameter greater than 2 cm and recording their total weight. These measurements provided a comprehensive evaluation of the yield potential of the taro plants under different potting media treatments.

Tuber quality traits, including dry matter, total sugar and starch content, were assessed after harvest to evaluate the nutritional and market value of the tubers. Corm samples were

Table 1. Experimental treatments

Treatment	Substrate properties
Tre 1	pH (4.71), N_{Total} 0.185 %, P_{Total} 0.2 %, K_{Total} 1.09 %, Ca 0.135 %, OM 2.89 %.
Tre 2	pH (4.32), N_{Total} 0.093 %, P_{Total} 0.101 %, K_{Total} 1.26 %, Ca 0.121 % OM 6.03 %
Tre 3	pH (6.36), N_{Total} 0.294 %, P_{Total} 0.209 K_{Total} 1.23 %, Ca 0.491 %, OM 10.1 %
Tre 4	pH (5.85), N_{Total} 0.197 %, P_{Total} 0.119 %, K_{Total} 1.29 %, Ca 0.264 %, OM 7.68 %
Tre 5	pH (5.85), N_{Total} 0.146 %, P_{Total} 0.171 %, K_{Total} 1.09 %, Ca 0.275 %, OM 6.51 %.

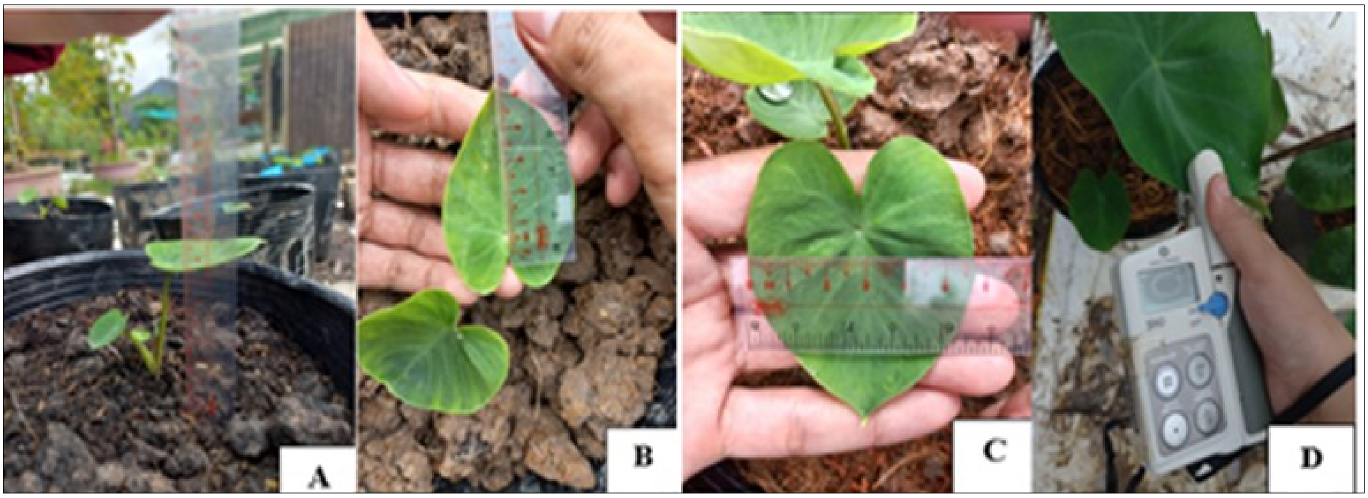

Fig. 2. Description on the ways to measure the growth parameters (A: plant height; B: leaf length; C: leaf breadth; D: recorded Spad value)

washed, finely cut and dried in a hot air oven at 105 °C until a constant weight was achieved, enabling the calculation of dry matter content. Total sugar and starch contents were determined using the established colorimetric methods (17, 18). These methods ensured accurate and reliable measurements, reflecting the effects of potting media on the nutritional composition and quality of taro tubers

Data processing and analyses

The collected data were analyzed statistically to assess the effects of the potting media on the growth, yield and quality of eddoe taro. Statistical tests, including analysis of variance (ANOVA), were conducted using SPSS software to identify significant differences among treatments. Duncan's multiple range test was used to compare treatment means when significant effects were observed ($p < 0.05$). Regression analysis was performed where necessary to explore relationships between growth parameters and media properties.

Measured variables, including mortality rates (counted and calculated the percentage of plants that were dead during the experiment if any) and yield, were expressed as mean values with standard deviations. Percentage data, such as mortality or composition values, were arcsine-transformed prior to analysis to ensure normality of variance. Results were presented in tables and figures to highlight significant trends and treatment effects on plant growth and performance.

Results

Effect of potting substrates on vegetative growth and relative chlorophyll content

Plant height and number of leaves increased significantly with Tre 3, 4 and 5 compared to the treament of Loamy soil (control), Loamy soil combined with coconut coir (1:1) (Table 2). At 30 DAP, no significant differences were observed due to the early growth stage and limited nutrient uptake. By 60 DAP, plants in treatments 3 and 4 (68.7 cm and 68.6 cm, respectively) were significantly taller than those in treatment 1 (58.2 cm). This trend continued through 90 and 120 DAP, where treatments with TMX mixed soil consistently outperformed others, achieving plant heights exceeding 70 cm. The number of leaves followed a similar trend. No significant differences were observed at 30, 60, or 90 DAP. At 120 DAP, leaf quantity of treatment 3, 4 and 5 were significantly taller than those of treatment 1 and 2.

The results from Table 3 indicate that significant differences in leaf size were observed among treatments, particularly at 90 and 120 DAP. Treatments with TMX mixed soil (3-5) consistently produced longer (> 26 cm) leaves than those of the control and treatment 2. Similarly, treatments with TMX mixed soil (3-5) consistently produced broader (> 24 cm) leaves than the control and treatment 2. Meanwhile treatment 2 did not show significant differences in leaf width when compared to the control.

The SPAD value, an indicator of chlorophyll content, varied significantly across treatments, particularly at 60 and 90 DAP (Table 4). Treatment 1 maintained the highest SPAD values at 60 DAP. Treatment 1 and 2 did not show any significant

Table 2. The effect of potting substrates on plant height and number of leaves of eddoe taro plant at various stages

Treatments	Plant height (cm)				Number of leaves (leaf)			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
Tre 1	25.8	58.2^{c}	53.0^{c}	55.7^{b}	4.3	5.1	5.4	2.5^{b}
Tre 2	26.1	66.5^{ab}	63.2^{b}	65.5^{b}	4.7	5.8	5.3	2.1^{b}
Tre 3	26.6	68.7^{a}	70.2^{a}	71.3^{a}	4.4	5.7	5.5	3.3^{a}
Tre 4	24.9	68.6^{a}	71.2^{a}	73.8^{a}	4.6	5.7	5.4	3.2^{a}
Tre 5	22.1	60.9^{bc}	71.4^{a}	72.1^{a}	4.1	5.5	5.3	2.9^{a}
Sig.	ns	**	**	**	ns	ns	ns	**
CV (%)	19.7	14.9	13.8	14.1	22.1	9.5	11.8	12.4

Values are means of 15 replications. Different lowercase letters in the same column indicate significant differences at $P < 0.01$ (**); and ns is no significant difference. DAP is day after planting.

Table 3. The effect of potting substrate on the leaf size of eddoe taro plants at various stages

Treatments	Leaf length (cm)				Leaf width (cm)			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
Tre 1	13.3	20.7^{b}	21.9^{c}	22.1^{b}	11.6	21.1^{b}	20.0^{b}	20.7^{b}
Tre 2	12.2	24.2^{a}	23.6^{bc}	22.9^{b}	11.4	23.6^{a}	21.8^{ab}	21.1^{ab}
Tre 3	12.1	24.4^{a}	25.5^{ab}	26.3^{a}	11.0	24.1^{a}	22.8^{a}	24.5^{a}
Tre 4	11.9	25.4^{a}	26.0^{a}	26.8^{a}	11.1	24.9^{a}	23.2^{a}	24.8^{a}
Tre 5	10.7	24.1^{a}	24.9^{ab}	26.7^{a}	9.8	23.5^{a}	22.5^{a}	24.3^{a}
Sig.	ns	**	**	**	ns	**	**	**
CV (%)	24.2	10.7	11.8	11.8	22.1	9.5	11.8	12.4

Values are means of 15 replications. Different lowercase letters in the same column indicate significant differences at $P < 0.01$ (**); and ns is no significant difference. DAP is day after planting.

Table 4. Effect of several kinds of potting substrates on the SPAD value

Treatments	Days after planting			
	30	60	90	120
Tre 1	47.8	57.6^{a}	58.0^{a}	44.9
Tre 2	44.4	51.3^{b}	55.7^{a}	47.2
Tre 3	43.6	48.9^{b}	54.4^{a}	48.8
Tre 4	43.6	52.3^{b}	53.1^{ab}	40.1
Tre 5	44.8	50.6^{b}	48.7^{b}	42.8
Sig.	ns	**	*	ns
CV (%)	10.6	11.5	13.3	19.3

Values are means of 15 replications. Different lowercase letters in the same column indicate significant differences at P < 0.01 (**), P<0.05 (*); and ns is no significant difference.

differences when compared to treatments 3 and 4 at 90 days after (58.0, 55.7 and 54.4, 53.1, respectively) suggest efficient nitrogen utilization during vegetative growth, as nitrogen is essential for chlorophyll synthesis and photosynthetic activity. At 120 DAP, SPAD values dropped across all treatments, consistent with senescence and resource allocation to storage organs.

Effect of potting substrates on the number and weight of corms/plant

Fig. 3 shows that Tre 4 recorded the highest corm weight (0.55kg/plant), number of corms per plant (20.5), representing a 69.9 % increase in corm weight and a 39.6 % increase in number of corms per plant compared to the control (Tre 1). Tre 3 and 5 also performed well, producing corm weights/plant of 0.48 kg and 0.44 kg, respectively. Tre 1 showed the lowest corm weight (0.33 kg) per plant significantly in comparison to the other treatments.

Effect of potting substrates on the quality of corm

Dry matter content, an indicator of the concentration of solids in corm, was highest in Tre 4 (15.4 %), followed by Tre 3 and 5, with 14.6 % and 13.9 %, respectively. In contrast, Tre 1 and 2 produced significantly lower dry matter contents of 9.9 % and 11.3 %, respectively (Fig. 4).

Tre 4 also recorded the highest total sugar content (27.9 mg/g fresh weight), which was significantly higher than all other treatments. Tre 3 and 5 followed with sugar contents of 21.4 mg/g and 21.7 mg/g, respectively. In contrast, Tre 1 and 2 also had lower sugar contents than the others, below 20 mg/g (Fig. 4).

Starch content, the primary storage carbohydrate in taro, was also significantly higher in treatments containing TMX mixed soil (Tre 3-5). Tre 3, 4 and 5 achieved starch contents of 180.9 mg/g, 180.7 mg/g and 161.7 mg/g fresh weight, respectively, compared to 129.8 mg/g in the control (Tre 1) and 118.6 mg/g in Tre 2.

Discussion

The increased plant height in the Tre 3, 4 and 5 reflects better nitrogen availability, critical for cell elongation and chlorophyll synthesis (14). Furthermore, TMX-enriched media provided superior physical properties, such as improved aeration and water retention, supporting robust vegetative growth (19, 20). Overall, the development of the leaves shows an increasing trend in accordance with the growth process of taro plants. Although there were no significant differences in the data observed at 30,

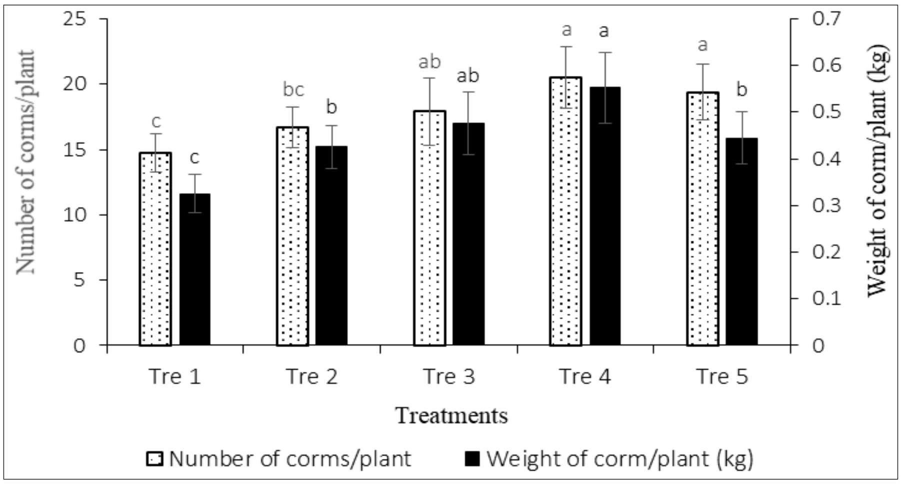

Fig. 3. Number of corms and weight of corm/plant at different potting substrates.

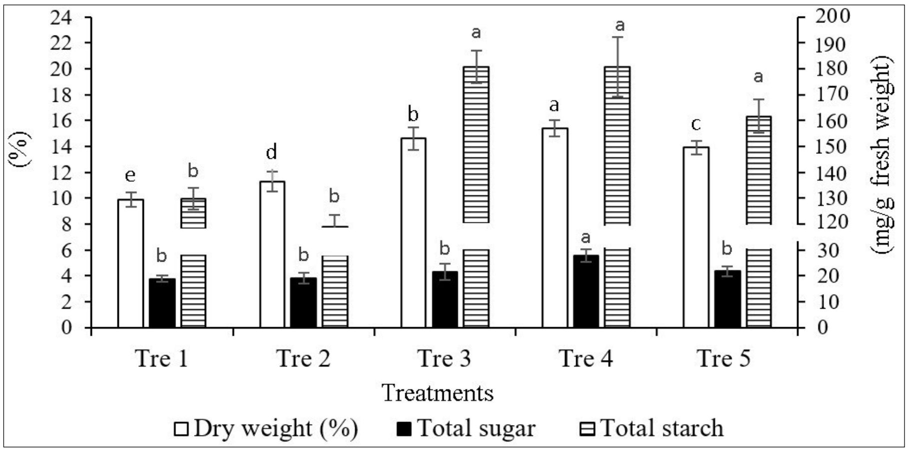

Fig. 4. Dry weight of corm, total sugar and total starch in corm on various potting substrates.

60, or 90 DAP, Tre 3, 4 and 5 were significantly taller than those in treatment 1 and 2 at 120 DAP, while Tre 1 and 2 recorded the lowest (Table 2). During the experiment time, there was no mortality rate for the plants; however, leaf senescence was more pronounced in Tre 1 and 2 due to nutrient limitations. These findings align with early works who reported that nutrient-rich substrates promote sustained vegetative growth and delayed senescence (21).

The superior performance of TMX-enriched media is attributed to enhanced soil aeration, water retention and nutrient availability. TMX mixed soil improved root oxygenation and supported microbial activity, facilitating the mineralization of nutrients such as nitrogen and phosphorus, which are crucial for leaf elongation and expansion (14, 22). Coconut coir, present in Tre 4 and 5, likely contributed to higher water-holding capacity and reduced bulk density, optimizing moisture availability for sustained leaf growth. Larger leaves improve photosynthetic capacity, supporting carbohydrate production for tuber development. In contrast, Tre 1 and 2 had acidic pH (4.32-4.71) (Table 1), which likely reduced phosphorus and magnesium availability, limiting leaf size (Table 3). Poor root aeration in these treatments may have further restricted nutrient uptake. These results highlight the importance of substrates that balance nutrient supply, pH and physical properties to maximize leaf growth and overall plant performance (23).

By 90 DAP, SPAD values declined in Tre 4 and 5 (Table 4), reflecting nutrient redistribution from chlorophyll synthesis to tuber formation. Higher SPAD values during key growth stages in Tre 3, 4 and 5 correlated with superior weight of corm (Fig. 3 and 4). Tre 4 achieved the highest corm weight (63.3 g) outperforming Tre 1 and 2. TMX mixed soil likely improved soil aeration, water retention and nutrient availability, enhancing root and tuber development (19, 24). Organic amendments in TMX mixed soil also enhanced photosynthetic efficiency by supporting relative chlorophyll content, which supplied carbohydrates for tuber growth (25, 26). These results highlight the importance of nutrient-rich, well-aerated substrates for improving taro productivity and suggest that SPAD values could serve as a reliable indicator for crop performance in similar systems.

The results clearly show that corm weight, number of corm per plant, sugar content and starch content were significantly influenced by the composition of the potting substrate (Fig. 3 and 4). Treatments enriched with TMX mixed soil (3, 4 and 5) consistently outperformed the control (Loamy soil) and Tre 2 (loamy soil + coconut coir). The superior weight of corm in Tre 3, 4 and 5 can be attributed to the enhanced properties of TMX mixed soil. The higher pH (5.85-6.36) (Table 1) improved nutrient solubility, particularly for phosphorus and calcium, which are critical for corm development (27). The increased organic matter (6.51 % - 10.1 %) likely supported microbial activity, facilitating nutrient cycling and root health (28-30). Organic components, such as coconut coir in Tre 4 and 5 (Table 1), further enhanced water-holding capacity and reduced soil compaction, improving aeration and root-zone conditions. These findings align with studies showing that organic amendments improve root development by increasing pore space and oxygen availability (16, 31). Furthermore, TMX mixed soil's high nutrient exchange capacity provided sustained nutrient release, which is particularly beneficial for tuberous crops like taro with prolonged growth periods (21).

The highest corm weight in Tre 4 (Fig. 4), corm weight is critical factors influencing taro marketability. This aligns with findings from previous works who demonstrated that organic substrates significantly enhance yield and quality in tuberous crops (32). The higher weight of corm achieved in Tre 3, 4 and 5 present a practical and economically viable solution for farmers, especially in controlled environments such as potting substrates. However, future studies are needed to assess TMX mixed soil's cost-effectiveness and long-term impact on soil health in diverse growing conditions. Higher dry matter content is associated with improved storage and processing qualities, making the tubers more desirable for commercial purposes (21).

The superior performance of treatments enriched with TMX mixed soil can be attributed to improved nutrient availability, particularly nitrogen and potassium, which are crucial for carbohydrate metabolism and dry matter accumulation (27). Additionally, the higher organic matter content in these treatments likely enhanced microbial activity, facilitating nutrient mineralization and uptake, thus promoting greater synthesis of structural and storage carbohydrates (29).

The high sugar content in treatments with TMX mixed soil may reflect improved soil aeration and water-holding capacity, which supported sustained photosynthetic efficiency during tuber development. Enhanced sugar accumulation has been previously linked to organic substrates that promote root health and steady nutrient supply (21). Moreover, the optimal pH (5.85-6.36) in TMX-enriched media likely facilitated the uptake of essential nutrients such as magnesium and phosphorus, which play critical roles in sugar metabolism and transport (14). Nutrient-rich substrates enhance starch biosynthesis in taro by supporting vigorous vegetative growth and efficient nutrient translocation to the storage organs. Additionally, potassium, which was likely more available in TMX mixed soil, plays a pivotal role in enzyme activation and starch synthesis (28).

Conclusion

This study highlights the significant impact of potting media composition on the growth, yield and quality of taro. Treatments enriched with TMX mixed soil (3, 4 and 5) demonstrated superior performance across all parameters compared to the control (100 % loamy soil) and the loamy soil + coconut coir treatment.

The enhanced chemical properties of TMX mixed soil, including higher pH, organic matter and nutrient content, supported improved plant growth by promoting nutrient availability, root development and vegetative vigor.

In this experiment, treatment 4 (loamy soil + coconut coir + TMX mixed soil) producing the best results in some yield parameters, including corm weight, cormel number and marketable roots as well as the tuber quality contents with higher values of dry matter, sugar and starch content.

This suggests that substrates combining organic and inorganic components optimize soil aeration, water retention and nutrient cycling, thereby supporting tuber formation. The findings underscore the potential of TMX mixed soil as a sustainable and effective substrate for improving taro productivity and quality, particularly in controlled environments. Future studies should assess its long-term effects on soil health, scalability in field conditions and cost-effectiveness for large-scale production systems.

Authors' contributions

PTPT and TLT conceived the project. PTPT, TLT and LVT designed experiments. LTHY, LNHG, LQP and PTPT carried out experiments. LTHY, LVT and PTPT analyzed data and prepared figures and tables. TLT, LVT and PTPT wrote the manuscript. LTHY, LVT, PTPT and TLT revised the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: The authors have no conflicts of interest to declare.

Ethical issues: None

References

1. Rashmi DR, Raghu N, Gopenath TS, Palanisamy P, Pugazhandhi B, Murugesan K, et al. Taro (*Colocasia esculenta*): An overview. Journal of Medicinal Plants Studies. 2018;6(4):156-61.
2. Singla D, Singh A, Dhull SB, Kumar P, Malik T, Kumar P. Taro starch: Isolation, morphology, modification and novel applications concern - A review. International Journal of Biological Macromolecules. 2020;163:1283-90. https://doi.org/10.1016/j.ijbiomac.2020.07.093
3. Ferdaus MJ, Chukwu-Munsen E, Foguel A, da Silva RC. Taro roots: An underexploited root crop. Nutrients. 2023;15:3337. https://doi.org/10.3390/nu15153337
4. Wang Z, Sun Y, Huang X, Li F, Liu Y, Zhu H, et al. Genetic diversity and population structure of eddoe taro in China using genome-wide SNP markers. PeerJ. 2020;8:e10485. https://doi.org/10.7717/peerj.10485
5. Tuwo M, Tambaru E. The growing of taro *Colocasia esculenta* (L.) Schott var. antiquorum plantlet in several media during acclimatization stage. IOP Conference Series: Earth and Environmental Science. 2021. https://doi.org/10.1088/1755-1315/807/3/032023
6. Mikami T, Tsutsui S. Taro [*Colocasia esculenta* (L.) Schott] production in Japan: Present state, problems and prospects. Acta Agriculturae Slovenica. 2019;114:183-9. https://doi.org/10.14720/aas.2019.114.2.4
7. Paul S, Rahman MH, Tamanna M, Halder D, Kobir MS, Munshi MH, et al. Comparative analysis of weed management techniques in taro (*Colocasia esculenta* (L.) Schott). Plant Science Today. 2025;12(1):1-11. https://doi.org/10.14719/pst.4750
8. Ochiai T, Nguyen VX, Tahara M, Yoshino H. Geographical differentiation of Asian taro, *Colocasia esculenta* (L.) Schott, detected by RAPD and isozyme analyses. Euphytica. 2001;122:219-34. https://doi.org/10.1023/A:1012967922502
9. Onwueme IC, Johnston M. Influence of shade on stomatal density, leaf size and other leaf characteristics in the major tropical root crops, tannia, sweet potato, yam, cassava and taro. Experimental Agriculture. 2008;36(4):509-16. https://doi.org/10.1017/S0014479700001071
10. Bhattarai K, Adhikari AP. Promoting urban farming for creating sustainable cities in Nepal. Urban Science. 2023;7:54. https://doi.org/10.3390/urbansci7020054
11. Matthews PJ. On the trail of taro: An exploration of natural and cultural history. Senri Ethnological Studies. 2014;88.
12. Sambo C. The future is behind us: Raising indigenous knowledge through multifunctional urban agricultural practices in Honolulu, HI. 2021.
13. Agarwal P, Saha S, Hariprasad P. Agro-industrial residues as potting media: Physicochemical and biological characters and their influence on plant growth. Biomass Conversion and Biorefinery. 2023;13:9601-24. https://doi.org/10.1007/s13399-021-01998-6
14. Rahmawati I, Sulistyaningsih E, Purwantoro A. The growth and flowering of potted chrysanthemum (*Chrysanthemum morifolium* Ramat) on types of organic media and watering frequent. Ilmu Pertanian (Agricultural Science). 2019;4:59-64. https://doi.org/10.22146/ipas.42163
15. Caron J, Price J, Rochefort L. Physical properties of organic soil: Adapting mineral soil concepts to horticultural growing media and histosol characterization. Vadose Zone Journal. 2015;14:1-14. https://doi.org/10.2136/vzj2014.10.0146
16. Singh M, Kukal MS, Irmak S, Jhala AJ. Water use characteristics of weeds: A global review, best practices and future directions. Frontiers in Plant Science. 2022;12:794090. https://doi.org/10.3389/fpls.2021.794090
17. DuBois M, Gilles KA, Hamilton JK, Rebers PT, Smith F. Colorimetric method for determination of sugars and related substances. Analytical Chemistry. 1956;28:350-6. https://doi.org/10.1021/ac60111a017
18. Coombs J, Hind G, Leegood R, Tieszen L, Vonshak A. Analytical techniques. In: Techniques in Bioproductivity and Photosynthesis. Elsevier. 1985;219-28. https://doi.org/10.1016/B978-0-08-031999-5.50027-3
19. Laxminarayana K, Mishra S, Soumya S. Good agricultural practices in tropical root and tuber crops. In: Tropical Roots and Tubers: Production, Processing and Technology. 2016;183-224. https://doi.org/10.1002/9781118992739.ch4
20. Wilkinson S, Welch RM, Mayland H, Grunes D. Magnesium in plants: Uptake, distribution, function and utilization by man and animals. Isotopes in Environmental and Health Studies. 1990;39(4):373-9.
21. Saikia J, Mahajan S, Nath DJ, Borah P. Influence of integrated nutrient management on growth, yield, quality and economics of edible taro (*Colocasia esculenta* (L.) Schott). Journal of Root Crops. 2010;36:194-203.
22. Kalita N, Dutta S, Das KN, Kurmi K, Patgiri DK. Impact of different land uses on soil organic carbon stock in Karbi Anglong district of Assam, India. Journal of Soil and Water Conservation. 2023;22:15-22. https://doi.org/10.5958/2455-7145.2023.00003.6
23. Sakamoto M, Suzuki T. Effect of pot volume on the growth of sweetpotato cultivated in the new hydroponic system. Sustainable Agriculture Research. 2018;7:137-45. https://doi.org/10.5539/sar.v7n1p137
24. Abuarab ME, El-Mogy MM, Hassan AM, Abdeldaym EA, Abdelkader NH, El-Sawy MB. The effects of root aeration and different soil conditioners on the nutritional values, yield and water productivity of potato in clay loam soil. Agronomy. 2019;9:418. https://doi.org/10.3390/agronomy9080418
25. Ierna A, Distefano M. Crop nutrition and soil fertility management in organic potato production systems. Horticulturae. 2024;10(8):886. https://doi.org/10.3390/horticulturae10080886
26. Man-Hong Y, Lei Z, Sheng-Tao X, McLaughlin NB, Jing-Hui L. Effect of water soluble humic acid applied to potato foliage on plant growth, photosynthesis characteristics and fresh tuber yield under different water deficits. Scientific Reports. 2020;10:7854. https://doi.org/10.1038/s41598-020-63925-5
27. Havlin J, Heiniger R. Soil fertility management for better crop production. Agronomy. 2020;10(9):1349. https://doi.org/10.3390/

agronomy10091349

28. Fageria N. Role of soil organic matter in maintaining sustainability of cropping systems. Communications in Soil Science and Plant Analysis. 2012;43:2063-113. https://doi.org/10.1080/00103624.2012.697234
29. Hoffland E, Kuyper TW, Comans RN, Creamer RE. Eco-functionality of organic matter in soils. Plant and Soil. 2020;455:1-22. https://doi.org/10.1007/s11104-020-04651-9
30. Reeve JR, Hoagland LA, Villalba JJ, Carr PM, Atucha A, Cambardella C, et al. Organic farming, soil health and food quality: Considering possible links. Advances in Agronomy. 2016;137:319-67. https://doi.org/10.1016/bs.agron.2015.12.003
31. Saputra AA, Utami SNH, Purwanto BH. Effect of biochar and rice irrigation methods on methane gas emissions. IOP Conference Series: Earth and Environmental Science. 2022. https://doi.org/10.1088/1755-1315/1005/1/012009
32. Machado D, Sarmiento L, Gonzalez-Prieto S. The use of organic substrates with contrasting C/N ratio in the regulation of nitrogen use efficiency and losses in a potato agroecosystem. Nutrient Cycling in Agroecosystems. 2010;88:411-27. https://doi.org/10.1007/s10705-010-9366-4

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