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Comparative study of growth of money plants (*Epipremnum* ssp.) within aquaponics system and herbaceous stem cutting method

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Abstract

The money plant (*Epipremnum aureum*) is a widely cultivated ornamental species valued for its aesthetic appeal and ease of maintenance. Traditionally propagated through herbaceous stem cutting (HSCM) in water-filled containers, this plant has recently been explored for growth in aquaponics systems (APS), which integrate aquaculture and hydroponics for sustainable cultivation. The present study compared the growth performance of three varieties *E. aureum* Linden & André, and its cultivars *E. aureum* 'Neon', and *E. aureum* 'N Joy' under APS and HSCM over a 56-day period. Growth parameters, including stem length, leaf number, root length, and biomass, were recorded at regular intervals and analysed using independent sample t-tests. Results indicated that plants grown in aquaponics exhibited superior stem elongation, biomass accumulation, and overall vigour compared to HSCM, although differences in leaf number and root length varied among money plants. Biomass gain was consistently greater in APS, underscoring the role of nutrient-rich water derived from fish waste in promoting plant growth. These findings demonstrate that aquaponics provides a more effective cultivation approach for money plants compared to conventional HSCM, with potential applications in sustainable indoor gardening and ornamental plant production.

Keywords: Aquaponics system, money plant, plant growth performance, Indoor plants

Introduction

The cultivation of decorative plants, like the money plant (*Epipremnum aureum*), has surged in popularity owing to its visual charm and simplicity of maintenance. It is a perennial, herbaceous shrub commonly grown as an ornamental plant (Lalitha *et al.* 2010) [6], with *Epipremnum aureum* and *E. pinnatum* being the most commonly cultivated species. Species of *Epipremnum* are frequently grown as ornamental foliage and find extensive use in interior landscaping globally (Chen *et al.* 2005) [3]. Conventionally, these plants are nurtured in soil within pots. It can also be cultivated in water-based systems through a vegetative propagation technique known as herbaceous stem cutting (Parmar *et al.* 2024). [9]

Nevertheless, as interest in sustainable agricultural practices rises, alternative cultivation methods such as aquaponics have captured attention for their ability to enhance plant growth while reducing resource consumption. There are studies concerning the growth of the money plant in aquaponics, as this plant has a remarkable capacity to absorb toxic effluents for its development (Yadav *et al.* 2021) [14] which is important for an aquaponics system. Aquaponics system, which integrates aquaculture with hydroponics, establishes a closed-loop system that supplies plants with nutrient-rich water sourced from fish tanks, and the plant, by absorbing these nutrients, helps maintain a clean aquarium. Many households keep the money plant in bottles indoors to promote its growth.

This research aims to compare the growth performance of varieties of money plant (*E. aureum* 'Linden and Andre', *E. aureum* 'Neon' and *E. aureum* 'NJoy') within an aquaponics system against the herbaceous cutting method, concentrating on essential growth metrics such as stem length, leaf number, root length and biomass.

Materials and Methods

Cuttings of three money plant (*Epipremnum aureum*) varieties 'Linden and Andre', 'Neon',

and 'N Joy' were procured from an agricultural store in Ratnagiri, Maharashtra, India as depicted in Figure 1. The cuttings were kept in beakers filled with tap water for one week to allow root initiation before transplantation. The experiment was conducted for 56 days under two treatments: an aquaponics system (APS) and the herbaceous stem cutting method (HSCM).

The aquaponics system was fabricated following the approach of Pagar *et al.* (2025) ^[13], with nine (3 cutting of each variety) rooted cuttings planted in such a way that plants were spatially separated to avoid vertical and horizontal overlap (Figure 2). The experiment followed a completely randomised design (CRD), with equal numbers of cuttings per variety and replication.

For the HSCM, nine glass beakers of 500 ml capacity were used in replication. (Singh *et al.* 2019) ^[12] (Figure 3). Tap water with pH 7.1 ± 0.2 was used, and water was replenished every 7 days to prevent nutrient depletion and algal growth. In both condition plants were maintained under indoor conditions (24 ± 2 °C), and a 12 h light: 12 h dark photoperiod).

Growth parameters, including stem length, leaf number, root length and biomass were recorded. Stem measurements were taken using a measuring scale (Medina *et al.* 2021) ^[7], while the number of leaves was counted manually (Castro-

Mejía *et al.* 2020) ^[2] at 14-day intervals. The root length was measured using a scale (Medina *et al.*, 2021) ^[7], and the fresh biomass of each plant was measured using a digital balance. Both parameters were recorded at the beginning and at the end of the experiment following the method of Rahman *et al.* (2021) ^[10]. The net gain in each growth parameter was calculated by comparing initial and final values. To ensure fair comparison, each species was evaluated separately, with growth parameters of the same species in the aquaponics system compared against those in the HSCM. Since the three varieties naturally exhibit different growth rates, no direct comparison was made between species. However, all three were planted together in the aquaponics unit, reflecting common household practice where multiple money plant varieties are grown in a single setup.

The collected data for stem length and leaf number were analysed using SPSS version 21. Growth parameters were expressed as mean $\pm$ standard error (SE). Independent sample t-tests were used to compare growth performance between APS and HSCM (Bakiu *et al.* 2017) ^[1]. A 95% confidence interval was used, and statistical significance was set at $p < 0.05$. Absolute gain in the stem length, leaf number, root length and biomass was estimated. Results were graphically represented using bar charts and line graphs with error bars.



Fig 1: The species of plant used for the study.



Fig 2: Aquaponics system plantation



Fig 3: HSCM plantation

Results

Stem Length

The stem length of all three plant varieties was measured, and it was observed that plants grown in the aquaponics system exhibited greater stem elongation compared to those in the HSCM. However, statistical analysis revealed significant difference for *Epipremnum aureum* 'Neon' and between the two systems and no significant difference for the rest of the species. The detailed measurements for each species are provided in Table 1 and illustrated in Figure 4 a.

Leaf Number

Leaf counts were recorded for all replicates (Table 1). No statistically significant difference was observed in leaf numbers among the three species across the two systems. A slight increase in leaf number was recorded for *E. aureum* (Linden & André) and *E. aureum* 'N Joy' in the aquaponics

system, whereas *E. aureum* 'Neon' exhibited a higher gain in leaf number under the aquaponics system (Figure 4 b).

Root Length

Root length was measured at the beginning and end of the experiment as showcased in Table 1. The highest increase in root length was observed in *E. aureum* 'Neon' under the aquaponics system, where the method outperformed the HSCM (Figure 4 c). For the remaining species, root elongation was comparatively higher in the aquaponics system.

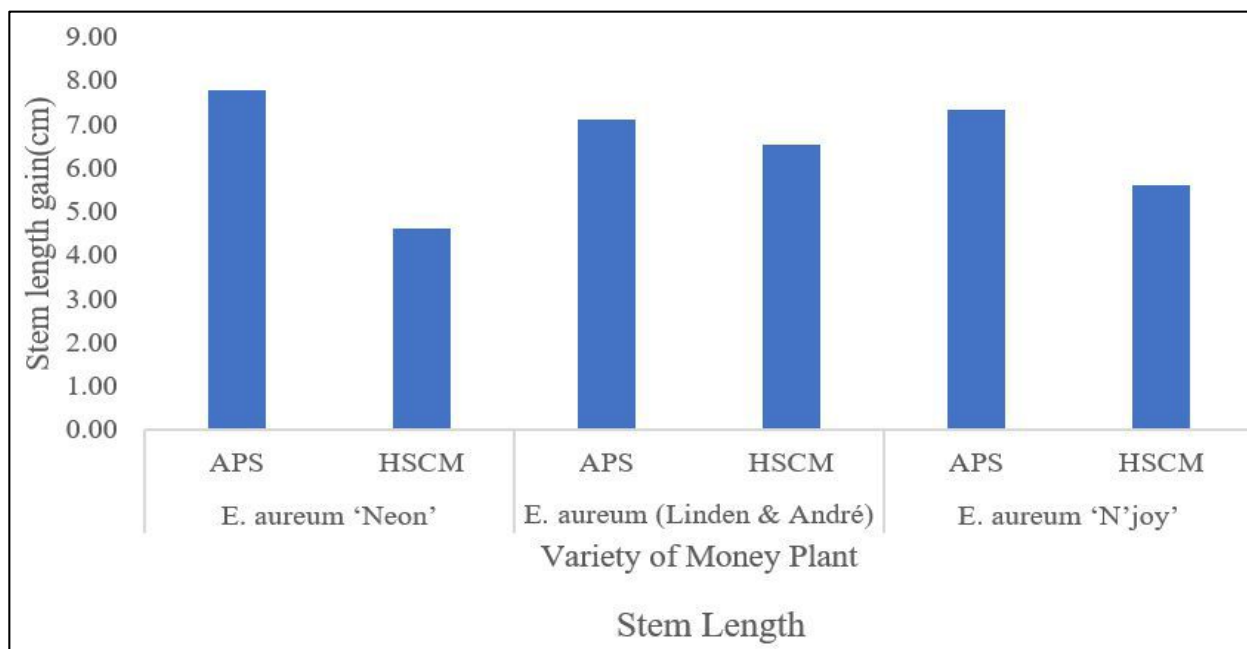
Plant Biomass

The biomass of all three plant varieties was recorded at both the start and the conclusion of the experiment see (Table 1; Figure 4 d). A greater increase in biomass was observed in plants grown under the aquaponics system compared to the HSCM.

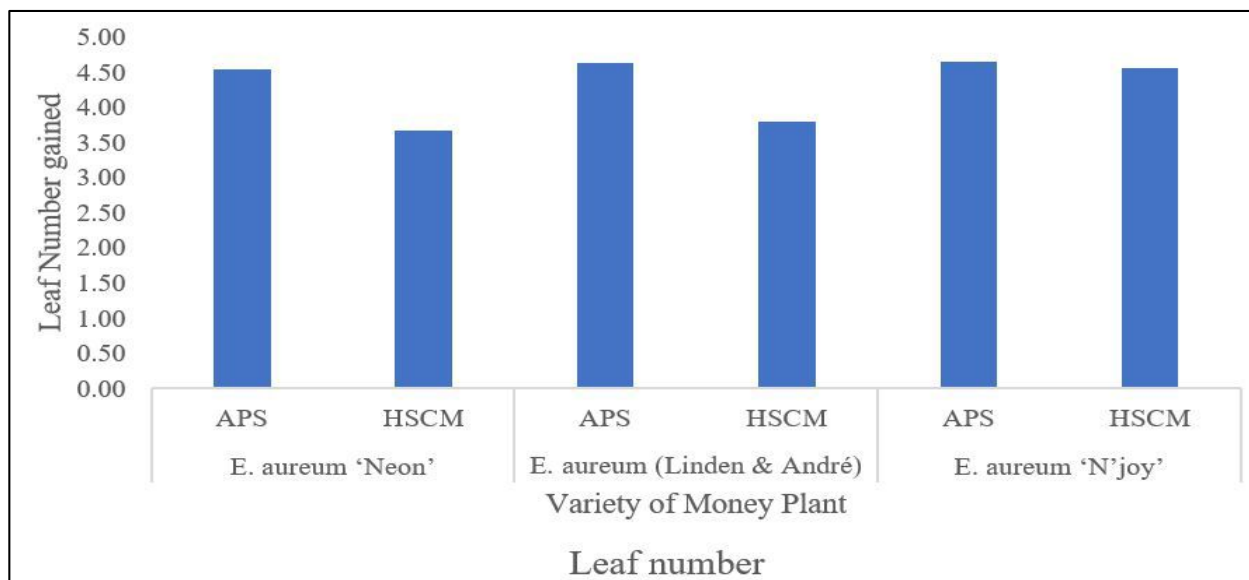
Table 1: Growth parameters for the plant observed during experiment.

Sr. No.	Parameter	<i>E. aureum</i> 'Neon'		<i>E. aureum</i> (Linden & André)		<i>E. aureum</i> 'N'joy'	
		APS	HSCM	APS	HSCM	APS	HSCM
1	Initial Stem length (cm)	6.44±0.52	6.90±0.13	5.37±0.12	5.64±0.71	5.44±0.57	5.93±0.93
	Final Stem length (cm)	14.23±1.46	11.52±0.93	12.46±2.13	12.34±1.87	12.78±2.07	12.55±1.13
	Stem length gain (cm)	7.79±1.02	4.62±0.63	7.09±1.13	6.70±1.13	7.34±1.13	6.62±1.09
2	Initial leaf number	6.78±1.27	7.00±1.61	4.67±0.87	5.33±1.79	7.67±0.68	6.73±1.40
	Final leaf number	11.33±0.89	10.67±0.94	9.30±0.88	9.13±1.19	12.33±0.61	11.3±1.70
	Change in leaf number	4.55±0.84	3.67±0.67	4.63±0.85	3.80±0.21	4.66±0.37	4.57±0.52
3	Initial root length (cm)	7.55±0.61	7.11±0.83	6.22±0.93	6.09±0.74	8.22±1.20	7.53±0.72
	Final root length (cm)	16.63±0.94	14.1±0.56	13.59±1.42	12.3±0.58	15.49±0.77	15.06±0.46
	Gain in root length (cm)	9.08±0.97	6.99±0.63	7.37±1.02	6.21±0.68	7.27±1.11	7.53±0.58
4	Initial biomass of plant (g)	12.2±1.34	11.6±0.89	14.2±1.19	14.5±0.97	12.6±1.07	12.4±1.28
	Final biomass of plant (g)	21.6±0.64	18.1±1.04	28.6±0.80	27.3±1.22	23.3±1.47	22.57±1.56
	Gain in biomass of plant (g)	9.4±0.94	6.5±1.08	14.4±0.91	12.8±1.12	10.7±1.25	10.17±1.14

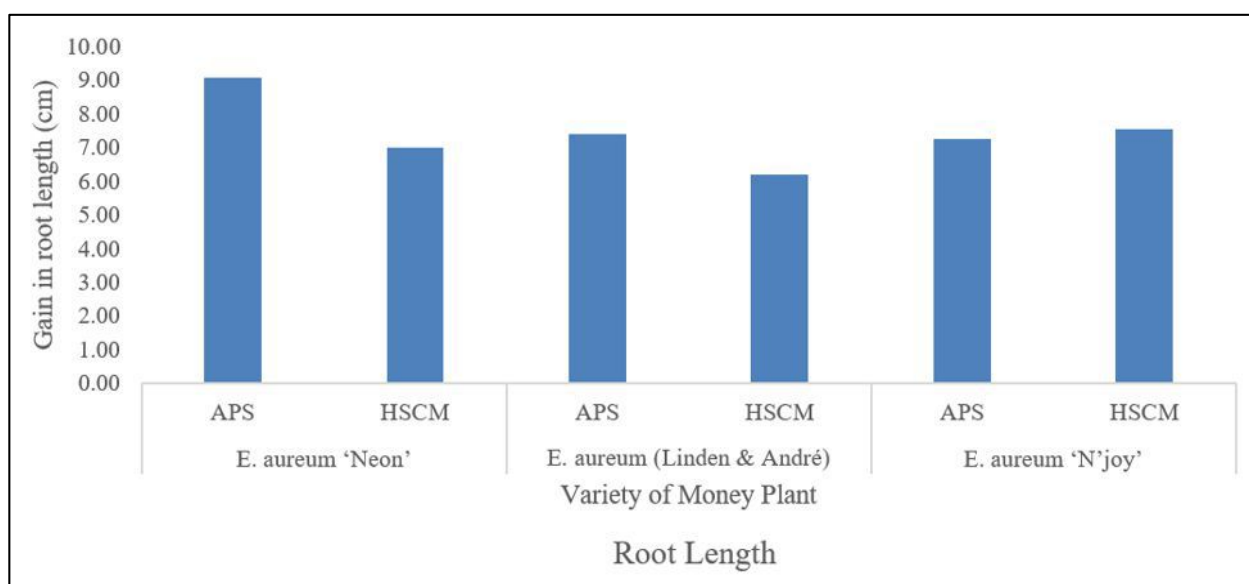
Parameters were expressed as mean±standard error (SE)



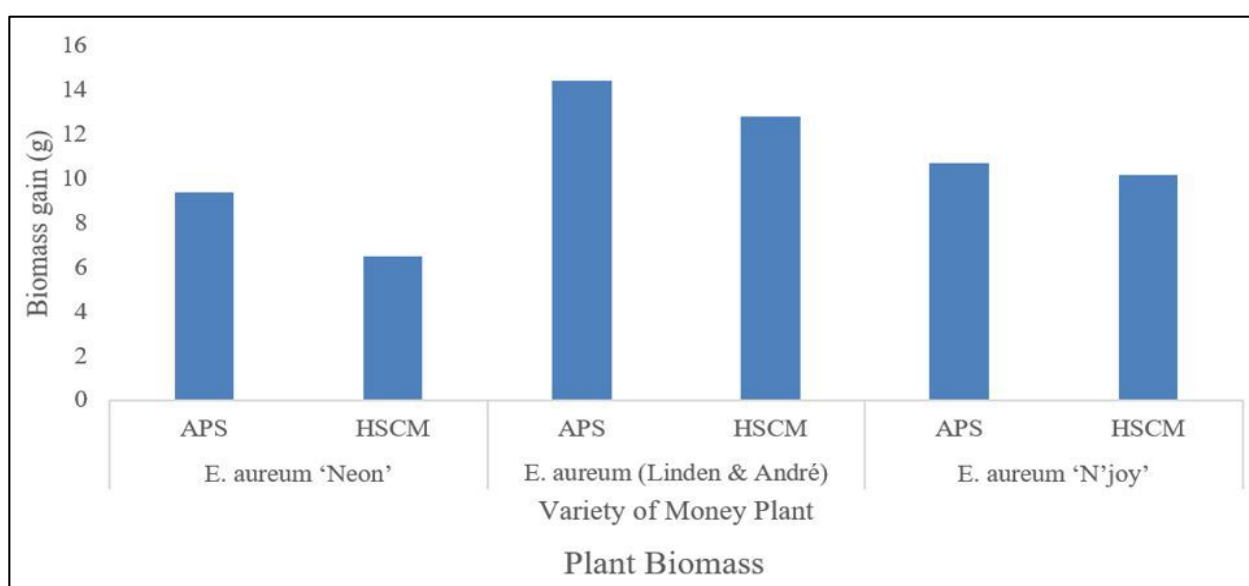
a



b



c



d

Fig 4: The figure represents the variation in each growth parameters for each species.

Discussion

E. aureum are efficient in absorbing nutrients, particularly nitrogen and nitrate, as reported by Kankia *et al.* (2024) [5]. This makes them well-suited for aquaponic systems, which typically have higher ammonia and nitrate loads. In the present study, plants grown in aquaponics exhibited better coloration, vigour, and overall health compared to those grown in HSCM.

Compared to HSCM, stem length rose greater in aquaponics. In contrast to *E. aureum* (Linden & André), which recorded 132.17% and 115.65%, respectively, *E. aureum* 'Neon' demonstrated a 120.96% rise in aquaponics compared to 66.87% in HSCM. These results are in line with those of Rahman *et al.* (2021) [10], who found that aquaponic systems with fish exhibited more stem elongation than those without fish, which is similar to water-only systems. Leaf number also showed higher gains in aquaponics. *E. aureum* 'Neon' exhibited a 67.10% increase compared to 52.42% in HSCM, while *E. aureum* 'N Joy' had 60% in aquaponics against 67% in HSCM. Similarly, *E. aureum* (Linden & André) recorded 99% in aquaponics and 71% in HSCM. Rahman *et al.* (2021) [10] also noted higher leaf proliferation in aquaponics, supporting the present findings. Root growth varied by cultivar. *E. aureum* 'Neon' performed better in aquaponics (120%) than in HSCM (98%), whereas *E. aureum* 'N Joy' and *E. aureum* (Linden & André) showed greater elongation in aquaponics. Overall, root length nearly doubled in both systems. Higher elongation in roots was also observed by Rahman *et al.* (2021) [10] in the aquaponics system. Biomass accumulation was consistently higher in aquaponics in all the species. For example, *E. aureum* (Linden & André) gained 101.4% biomass in aquaponics compared to 88.27% in HSCM, while *E. aureum* 'N Joy' recorded 84% and 82%, respectively. Similar trends were reported by Rahman *et al.* (2021) [10], Mishra *et al.* (2024) [8], and Clarkson & Lane (1991) [4], who found significantly greater biomass production in aquaponics than in water-only systems.

In aquaponics, ammonia is converted into nitrite and then into nitrate, which is subsequently utilized by plants. The enhanced performance of aquaponics can be attributed to nutrient cycling, where fish waste provides ammonia that is converted to nitrate by nitrifying bacteria, serving as an essential nutrient for plants leading to more controlled nitrate levels (Rakocy *et al.* 2006) [11]. In contrast, HSCM relies solely on clean water, which lacks nutrient availability, resulting in reduced growth. The present study thus confirms that aquaponics not only improves nutrient uptake but also promotes microbial associations at the root zone, enhancing overall plant performance.

Conclusion

The study demonstrated that aquaponics provides a more favourable environment for the growth of money plant (*Epipremnum aureum*) varieties compared to the herbaceous stem cutting method. While root growth varied among varieties, aquaponics consistently promoted higher stem elongation, biomass accumulation, and overall plant vigour due to enhanced nutrient availability. These results highlight aquaponics as a sustainable and efficient alternative for cultivating ornamental plants, with potential benefits for household and indoor gardening practices.

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