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Evaluation of potting media for optimized the root and shoot growth of *Zamioculcas zamiifolia*

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ABSTRACT

An experiment on the effect of different potting mixtures on the growth of Zamioculcas zamiifolia was conducted at ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat, India, to evaluate the impact of various potting mixtures on the growth and quality of the ZZ plant. The experiment was laid out with seven treatments i.e.T_1 (Sand + Vermicompost @ 2:1 v/v), T_2 (Sand + Bio-compost @ 2:1 v/v), T_3 (Sand + FYM @ 2:1 v/v), T_4 (Cocopeat + Vermicompost @ 2:1 v/v), T_5 (Cocopeat + Bio-compost @ 2:1 v/v), T_6 (Cocopeat + FYM @ 2:1 v/v), T_7 (Control Soil) with three replication. At 180 days, plants in the control treatment (T_7) achieved maximum incremental plant height (13.07 cm) and internodal length (4.40 cm). However, the potting mixture Sand + FYM (2:1 v/v) excelled in most growth parameters. Plants grown in Sand + FYM (2:1 v/v) exhibited the highest number of leaves (5.75), number of leaflets on the longest leaf (16.92), fresh stem weight (379.94 g), and dry stem weight (48.94 g). Root measurements in T_3 were also notable, with fresh weight (164.18 g), dry weight (11.16 g), longest root length (23.25 cm), root diameter (6.62mm), and root count (12.00). Additionally, sand + FYM (2:1 v/v) yielded the largest tuber circumference (19.30 cm), total plant leaf area (871.24 cm^2), net assimilation rate (1.046×10^{-5} g m^{-2} day^{-1}), and relative growth rate (1.33×10^{-2} g g^{-1} day^{-1}). This treatment also showed the lowest root-shoot ratio (0.22) and highest visual quality score (4.83), indicating its effectiveness for robust plant growth.

Keywords: *FYM, Sand, Net assimilation rate, Potting mixture, Plant growth, Relative growth rate, Root growth, visual quality score, ZZ plant, Zamioculcas zamiifolia.*

Introduction

Zamioculcas zamiifolia, commonly known as the ZZ plant, is an aroid noted for its unique pinnate leaves and resilience, native to eastern Africa. It belongs to the Araceae family and can propagate asexually through methods such as rhizome division, leaflet cutting, and petiole cutting. When propagated *via* leaflet cuttings, individual leaflets or halved larger leaflets are placed in a rooting medium with the basal end down to stimulate growth [5]. This stemless, perennial species with its thick rhizomes and glossy foliage, has become increasingly popular for indoor decoration due to its ability to tolerate low light and drought, as well as its resistance to pests and diseases [7,4].

Selecting an appropriate potting medium is crucial for the optimal growth of indoor plants like *Zamioculcas zamiifolia*. Traditional soil is often avoided in indoor cultivation due to its weight, compaction issues, drainage limitations, and potential for disease [19]. Consequently, soilless alternatives such as vermicompost, sand, cocopeat, and bio-compost are commonly used, as they offer enhanced physical and chemical properties. Vermicompost, for instance, is rich in nutrients and supports water retention, pathogen resistance, and plant hormone activity [11]. Sand improves aeration and drainage, and cocopeat a byproduct of the coir industry provides high water retention and pore space, making it an eco-friendly substitute for peat [24]. Bio-compost, derived from agricultural and livestock by-products, improves soil structure, aeration, and microbial composition [14,6]. Farmyard manure (FYM) further enhances soil health and supports flowering [13].

Different potting media in combination help to improve physico-chemical properties of growing media, ultimately helping to encourage the growth of indoor plants. Hence, this investigation was carried out to determine the optimal medium for parameters such as plant height, leaf count, biomass, and root development, contributing to better growth and ornamental quality of *Zamioculcas zamiifolia*.

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Materials and Methods

The present investigation was conducted in shade conditions under 50% Black shade net during September 2023 to March 2024 at the Advanced Training Centre of Soilless System for Production of Various Crops, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, using a Completely Randomized Design (CRD) to evaluate the effect of different potting mixture effect on the growth of *Zamioculcas zamiifolia.* The plants were grown under consistent conditions, with uniform light, water, and nutrient levels to ensure environmental factors remained standardized. The experiment involved a series of treatment combinations, outlined in the details below, *viz.,* cocopeat, bio-compost, FYM, and sand were prepared as per the treatments and filled in pots having a size of 6.5 L. All the morphological parameters were measured at the start of the experiment, at 60 days, 120 days, and at the end of the experiment, *i.e.,* 180 days. Whereas, the physiological parameters *i.e.*, net assimilation rate and relative growth rate, were calculated at 120 and 180 days.

The incremental plant height from base to tip, internodal length and longest root length were measured with meter scale, number of leaves, number of leaflets on longest leaf and number of roots per plant were counted manually, total plant leaf area was measured using *Biovis* digital leaf area meter, fresh weight of stem and root weight were measured using weighing balance, plants were dried using the hot air oven at 65°C ± 1, tuber circumference using the measuring tape, longest root diameter measured using digital *vernier calliper,* Net Assimilation Rate (g m^{-2} day^{-1}) was computed with the help of formula.

$$NAR = \frac{W - W1}{t2 - t1} \times \frac{logeA2 - logeA1}{A2 - A1}$$

Where W_1 is the dry weight of the plant at time t_1, $W_2$is the dry weight of the plant at time t_2, A_1 is total leaf area of plant at time t_1, A_2 is total leaf area of the plant at time t_2, t_1= initial days, $t_2$is final days.

Relative growth rate (RGR) was computed with the help of the following formula.

$$RGR = \frac{lnW2 - lnW_1}{t_2 - t_1}$$

Where W_1 is the dry weight of the plant at time t_1, W_2 is the dry weight of the plant at time t_2, $t_1$is the initial days and $t_2$is the final days. Root to-shoot ratio was calculated using the formula.

$$Root\ to\ shoot\ ratio\ = \frac{\text{Dry weight of root}}{\text{Dry weight of shoot}}$$

Treatment details

Sl. No.	Treatment	Treatment combinations
1.	T_1	Sand+Vermicompost(2:1v/v)
2.	T_2	Sand + Bio-compost (2:1 v/v)
3.	T_3	Sand + FYM (2:1 v/v)
4.	T_4	Cocopeat+Vermicompost(2:1v/v)
5.	T_5	Cocopeat + Bio-compost (2:1 v/v)
6.	T_6	Cocopeat + FYM (2:1 v/v)
7.	T_7	Soil(Control)

Results and discussion

Shoot Characteristics

Incremental plant height(cm)

As presented in Table 1 and Fig.1, plant height was significantly influenced by different potting mixtures. The maximum plant height was recorded in T_7 (Soil) (11.42 cm, 12.04 cm and 13.07 cm) at 60, 120, and 180 days, respectively. Minimum plant height was recorded in T_5 (Cocopeat + Bio-compost 2:1 v/v) (5.33 cm, 7.03 cm, and 7.59 cm) at 60, 120, and 180 days.

Internodal Length (cm)

As presented in Table 1, plants grown inT_7 (Soil) potting mixture resulted in maximum internodal length (1.82 cm, 2.91 cm and 4.40 cm) at 60, 120, and 180 days after planting. While minimum internodal length (0.64 cm, 1.38 cm and 2.28 cm) was obtained in T_5(Cocopeat + Bio-compost 2:1 v/v) at 60, 120 and 180 days after planting, respectively.

ZZ Plants grown in T_7 (Soil) recorded maximum incremental plant height (cm) and internodal length (cm). This is probably due to the fact that the better structure and texture of the soil, a sufficient amount of organic matter in the soil, which increases water and nutrient holding capacity, free from pests and pathogens.

Number of leaves per plant

As presented in Table 1, plants grown in T_3(Sand + FYM 2:1 v/v) potting mixture resulted in the maximum total number of leaves per plant (1.71, 2.02, and 2.40) at 60, 120, and 180 days after planting. While the minimum total number of leaves per plant (1.00, 1.08, and 1.63) was obtained inT_7 (Soil) at 60, 120 and 180 days after planting, respectively.

Number of leaflets per leaf

As presented in Table 1, the number of leaflets per leaf was significantly influenced by different potting mixtures. The maximum number of leaflets per leaf was recorded in T_3(Sand + FYM 2:1 v/v) (14.83, 16.67, and 16.92) at 60, 120, and 180 days, respectively. Whereas, the minimum plant height was recorded in T_7 (Soil) (9.33, 11.83, and 12.08) at 60, 120, and 180 days, respectively.

Total plant leaf area

As presented in Table 1, the maximum total leaf area of the plant was recorded from plants grown in T_3(Sand + FYM 2:1 v/v) (301.47 cm^2, 512.49 cm^2 and 871.24 cm^2) at 60,120, and 180 days after planting. Whereas, minimum leaf area was observed in T_7(Soil) (129.07 cm^2, 219.41 cm^2 and 376.34 cm^2) at 60, 120, and 180 days, respectively.

Number of leaves per plant and number of leaflets on longest leaf area mainly attributed to the fact that, incorporation of FYM had lower down clay content and compactness of potting media, also better nutrient availability, which enhanced photosynthetic activity leading to higher production of significantly more functional leaves [18]. More leaves might be due to aeration made available by Sand [10]. The better water holding capacity, low bulk density, nearly neutral pH, and normal EC values of media might also contribute to improving the ability to supply ample quantities of nutrients to plants [17] for plant growth in the media containing Sand and FYM. Similar results were reported in Oroxylum indicum [20], Aglaonema [21], litchi [3] and Khirni [18].

Fresh and Dry Weight of Stem and Root

Fresh weight of stem (g)

As presented in Table 2, fresh weight of the stem was significantly influenced by the different growing media. Among different growing media, T_3 (Sand + FYM 2:1 v/v) produced the maximum fresh weight of stem (78.67 g, 192.00 g, and 379.94 g) at 60, 120 and 180 days, respectively. While the minimum dry weight of shoot was observed in T_7 (Soil) (28.76 g, 55.58 g and 83.13 g) at 60, 120 and 180 days, respectively.

Dry weight of stem (g)

As presented in the Table 2, the maximum dry weight of stem was recorded from the plants grown in T_3(Sand + FYM 2:1 v/v) (5.35 g, 21.58 g and 48.94 g) at 60, 120 and 180 days after planting. While the minimum dry weight of shoot was observed in T_7(Soil) (1.79 g, 6.25 g and 10.71 g) at 60, 120 and 180 days, respectively.

Fresh weight of roots (g)

As presented in Table 2, the highest value of fresh weight of root (37.72 g, 80.75 g and 164.18 g) was recorded in T_3 (Sand + FYM 2:1 v/v) at 60,120 and 180 days after planting. Whereas, the lowest fresh weight of root was observed in T_7 (Soil) (30.82g, 60.79 g, and 85.22 g) at 60, 120 and 180 days, respectively.

Dry weight of roots (g)

As presented in the Table 2, plants grown under T_3(Sand + FYM 2:1 v/v) was resulted in significantly maximum dry weight of root (2.52 g, 5.49 g and 11.16 g) at 60, 120 and 180 days after planting. While the minimum dry weight of root (1.98g, 3.78 g and 5.30 g) was found in T_7 (Soil) at 60, 120 and 180 days after planting.

Plants grown in Sand + FYM 2:1 v/v (T_3) performed better in the fresh weight of stem, dry weight of stem, fresh weight of root, and dry weight of root at 60, 120, and 180 days after planting in comparison to all other growing media. This might be due to better physical and chemical properties of the growing medium containing FYM which improved the lower bulk density, higher moisture holding capacity, aeration, slow and continuous better nutrient availability [1] and soil porosity improved by addition of sand leading to better root penetration and development of secondary roots leading to significantly increased the fresh weight of shoot and root [18]. Similar results were reported in *Mangifera indica* [9] and *Crassula ovata*, *Pachyphytum hookeri*, *Senecio rowleyanus*, *Sedum rubrotinctum* and *Crassula capitella* [15].

Root parameters

Longest root length (cm)

As presented in the Table 3, the maximum longest root length (21.61 cm, 22.25 cm, 23.25 cm) was recorded with T_3(Sand + FYM 2:1 v/v) at 60, 120 and 180 days, respectively. While the minimum longest root length (16.20 cm, 16.61 cm, 17.58 cm) was noted in potting media T_7 (Soil) at 60, 120, and 180 days, respectively.

Number of Roots Per Plant

As presented in Table 3 and Fig.2, the maximum number of roots per plant (11.17, 11.67, 12.00) was found with the growing media T_3(Sand + FYM 2:1 v/v) at 60, 120 and 180 days, respectively. However, the minimum number of roots per plant (7.67, 7.83, 8.17) were obtained with T_7(Soil) at 60, 120 and 180 days after planting.

Longest Root Diameter (mm)

As presented in Table 3 and Fig.3, among different growing media, maximum root diameter (6.43 mm, 6.43 mm and 6.62 mm) was found in T_3(Sand + FYM 2:1 v/v) at 60, 120 and 180 days after planting. While the minimum root diameter (7.67 mm, 7.83 mm and 8.17 mm) was reported in T_7(Soil) at 60, 120 and 180 days after planting.

Tuber circumference (cm)

As presented in the Table 3, the maximum tuber circumference (18.05 cm, 18.72 cm, 19.30 cm) was recorded with T_3(Sand + FYM 2:1 v/v) at 60, 120 and 180 days, respectively. While, minimum longest root length (12.68 cm, 13.22 cm, 14.84 cm) was noted in potting media T_7(Soil) at 60, 120 and 180 days, respectively.

Growing media *i.e.*, T_3 (Sand + FYM @ 2:1 v/v) excelled all other treatments with respect to longest root length, number of roots per plant, longest root diameter and tuber circumference. This might be subjected to better physical and chemical properties of the potting medium containing FYM which improved the better ion exchange, water retention and enhanced microbial activity, leading to better nutrient availability, higher soil porosity due to the granular structure of soil and aeration, leading to better root penetration [18]. Moreover, an increase in a good number of leaves coupled with a conducive root environment would led to proper nutrient uptake in the substrates, which may result in greater accumulation of food matter, leading to an increase in root and tuber characteristics [12]. The results are in uniformity with the earlier findings of other plants such as *Codieum variegatum* [1], *Mangifera indica* [9], chrysanthemum cv. Haldighati [16], *Crassula ovata*, *Pachyphytum hookeri*, *Senecio rowleyanus*, *Sedum rubrotinctum,* and *Crassula capitella* [15], and sweet orange (cv. Sathgudi) [8].

Physiological parameters

Net Assimilation Rate ($g\,m^{-2}\,day^{-1}$)

As presented in the table 4, net assimilation rate (NAR) was significantly influenced due to different growing media. During 120 and 180 days after planting, among various potting media, (Sand + FYM 2:1 v/v) T_3 was resulted in the maximum net assimilation rate (1.03×10^{-5} g m^{-2} day^{-1}and1.04×10^{-5} g m^{-2} day^{-1}). While, minimum net assimilation rate (0.78×10^{-5} g m^{-2} day^{-1}and0.44×10^{-5} g m^{-2} day^{-1}) was observed in (Soil) T_7 at 120 and 180 days after planting.

(Sand + FYM 2:1 v/v) T_3 likely excelled due to better nutrient availability, moisture retention, aeration, and drainage, facilitating optimal root growth and nutrient uptake. These findings align with the other crop capsicum [22].

Relative Growth Rate ($g\,g^{-1}\,day^{-1}$)

As presented in Table 4, during 120 and 180 days after planting, maximum relative growth rate (2.05×10^{-2} g g^{-1} day^{-1}and1.33×10^{-2} g g^{-1} day^{-1}) was recorded in (Sand + FYM 2:1 v/v) T_3. While a minimum relative growth rate (1.63×10^{-2} g g^{-1} day^{-1} and 0.78×10^{-2} g g^{-1} day^{-1}) was observed in the (Soil) T_7.

Relative growth rate (RGR) serves as a key indicator of how different growing media affect the growth of *Zamioculcas zamiifolia*. (Sand + FYM 2:1 v/v) T_3 superior performance is attributed to its favorable media composition, which improves textural and structural properties, enhances nutrient availability, and boosts plant growth, as noted by [8]

Root-to-Shoot Ratio

As presented in the Table 4 and Fig.4, among different potting media, the minimum root shoot ratio (0.47, 0.25 and 0.23) was recorded in T_3(Sand + FYM 2:1 v/v) at 60, 120 and 180 days after planting. While the maximum root shoot ratio (1.127 and 0.520) was noticed in T_5(Cocopeat + Bio-compost 2:1 v/v) at 60 and 180 days after planting and at 120 days after planting the maximum root to shoot ratio (0.617) was noticed in T_7(Soil).

The lowest root-to-shoot ratio in T_3 (Sand + FYM @ 2:1 v/v) is attributed to increased root length and growth, likely due to improved root surface area facilitating better nutrient uptake, water absorption, and aeration. These findings align with [3] in their work on root development and similar studies in acid lime [23] and papaya [2].

Visual Quality

As presented in the Table 5, during 60, 120 and 180 days after planting better visual appearance (4.50, 4.83 and 4.83) was recorded in (Sand + FYM 2:1 v/v) T_3. While minimum appearance score (2.67, 2.83 and 3.33) was observed in the (Soil) T_7 at 60, 120, and 180 days.

Table 1: Effect of different potting media on growth characteristics on Zamioculcas zamiifolia

Shoot characteristics															
	Incremental plant height(cm)			Internodal length(cm)			Number of leaves			Number of leaflets on longest leaf			Total leaf area		
Treatments	60 days	120 days	180 days	60 days	120 days	180 days	60 days	120 days	180 days	60 days	120 days	180 days	60 days	120 days	180 days
T1	8.30	9.36	10.38	1.25	1.95	2.90	1.32	1.63	2.12	13.83	15.92	16.00	177.64	301.97	513.38
T2	7.03	8.54	9.55	0.72	1.52	2.40	1.04	1.35	1.91	11.08	13.20	13.58	147.77	251.21	427.06
T3	10.42	11.25	12.41	1.65	2.68	3.50	1.71	2.02	2.40	14.83	16.67	16.92	301.47	512.49	871.24
T4	7.92	8.78	9.80	0.94	1.84	2.74	1.29	1.61	1.98	11.42	14.08	14.50	169.99	288.97	491.26
T5	5.33	7.03	7.59	0.64	1.38	2.28	1.00	1.19	1.73	10.67	12.67	12.75	135.09	229.66	390.42
T6	10.01	11.06	12.35	1.57	2.44	3.25	1.58	1.78	2.22	14.00	16.42	16.75	271.87	462.17	785.69
T7	11.42	12.04	13.07	1.82	2.91	4.40	1.00	1.08	1.63	9.33	11.83	12.08	129.07	219.41	376.34
SEm ±	0.27	0.25	0.26	0.03	0.06	0.08	0.05	0.06	0.07	0.34	0.37	0.37	12.9	7.41	4.74
CD at 5 %	0.81	0.76	0.78	0.10	0.18	0.23	0.16	0.18	0.22	1.03	1.12	1.13	39.28	22.49	14.39
CV %	5.36	4.48	4.14	4.61	4.76	4.28	7.15	6.80	6.23	4.85	4.46	4.42	4.31	3.97	4.07

Table 2: Effect of different potting media on fresh and dry biomass of Zamioculcaszamiifolia

Fresh and Dry Weight of Shoot and Root												
	Fresh weight of stem (g)			Fresh weight of root (g)			Dry weight of stem (g)			Dry weight of root (g)		
Treatments	60 days	120 days	180 days	60 days	120 days	180 days	60 days	120 days	180 days	60 days	120 days	180 days
T1	65.58	105.77	185.44	33.80	77.33	141.15	4.19	11.89	23.89	2.16	4.95	9.02
T2	30.91	69.58	109.56	33.81	64.36	107.85	1.92	7.82	14.11	2.11	4.02	6.72
T3	78.67	192.00	379.94	37.72	80.75	164.18	5.35	21.58	48.94	2.52	5.49	11.16
T4	60.18	98.89	161.41	34.20	72.00	123.84	3.74	11.11	20.79	2.14	4.47	7.70
T5	28.99	61.06	87.31	32.66	62.50	93.70	1.81	6.86	11.25	2.03	3.89	5.83
T6	72.02	172.53	315.86	33.42	73.05	136.85	5.17	19.39	40.68	2.40	5.25	9.84
T7	28.76	55.58	83.13	30.82	60.79	85.22	1.79	6.25	10.71	1.98	3.78	5.30
Sem±	2.20	4.15	4.91	1.14	2.08	5.63	0.09	0.47	0.63	0.066	0.11	0.29
CD at 5 %	6.68	12.59	14.90	3.46	6.32	17.09	0.26	1.42	1.92	0.20	0.33	0.88
CV %	7.31	6.66	4.50	5.85	5.14	8.01	4.36	6.66	4.50	5.18	4.19	6.31

Table 3: Effect of different potting media on root parameters of Zamioculcas zamiifolia

Physiological parameters							
	Relative Growth Rate (× 10^{-2} g g^{-1} day^{-1})		Net Assimilation Rate (× 10^{-5} gm^{-2} day^{-1})		Root Shoot Ratio		
Treatments	120 days	180 days	120 days	180 days	60 days	120 days	180 days
T_1	1.62	1.11	0.95	0.86	0.52	0.42	0.38
T_2	1.79	0.94	0.86	0.58	1.10	0.51	0.48
T_3	2.05	1.33	1.03	1.04	0.47	0.25	0.23
T_4	1.62	1.00	0.92	0.72	0.57	0.40	0.37
T_5	1.71	0.80	0.83	0.44	1.13	0.57	0.52
T_6	1.96	1.19	1.02	0.91	0.46	0.27	0.24
T_7	1.63	0.78	0.78	0.44	1.10	0.62	0.50
SEm ±	0.49	0.024	3.58	2.47	0.02	0.03	0.02
CD at 5 %	0.148	0.071	10.86	7.50	0.86	0.09	0.06
CV %	4.77	3.99	6.76	5.97	6.39	12.19	9.22

Table 4: Influence of different potting media on physiological parameters of Zamioculcas zamiifolia

Root parameters												
	Tuber circumference (cm)			Longest root length(cm)			Number of roots per plant			Longest root diameter (mm)		
Treatments	60 days	120 days	180 days	60 days	120 days	180 days	60 days	120 days	180 days	60 days	120 days	180 days
T_1	17.07	17.97	18.62	21.01	21.55	21.88	10.67	11.17	11.67	6.08	6.29	6.50
T_2	15.97	17.65	18.54	19.55	20.80	21.60	10.50	11.04	11.50	5.95	6.10	6.35
T_3	18.05	18.72	19.30	21.61	22.25	23.25	11.17	11.67	12.00	6.26	6.43	6.62
T_4	13.09	14.83	15.84	17.67	17.98	18.91	8.00	8.33	9.00	5.06	5.22	5.54
T_5	14.33	15.07	15.91	17.96	19.37	20.02	8.33	8.67	9.33	5.08	5.34	5.68
T_6	15.78	16.09	16.42	18.04	20.47	20.84	9.17	9.33	9.67	5.32	5.44	5.76
T_7	12.68	13.22	14.84	16.20	16.61	17.58	7.67	7.83	8.17	4.95	5.16	5.45
SEm ±	0.46	0.41	0.52	0.46	0.39	0.56	0.26	0.24	0.27	0.14	0.16	0.18
CD at 5 %	1.38	1.25	1.57	1.41	1.17	1.70	0.79	0.72	0.83	0.42	0.47	0.54
CV %	5.17	4.39	5.26	4.27	3.37	4.72	4.81	4.25	4.67	4.37	4.71	5.19

Table 5: Effectofdifferentpottingmixturesonvisualqualityof Zamioculcaszamiifolia

Treatments	60 Days	120 Days	180 Days
T_1	3.83	4.00	4.33
T_2	3.33	3.67	3.83
T_3	4.50	4.83	4.83
T_4	3.83	4.00	3.83
T_5	3.33	3.50	3.83
T_6	4.33	4.50	4.00
T_7	2.67	2.83	3.33

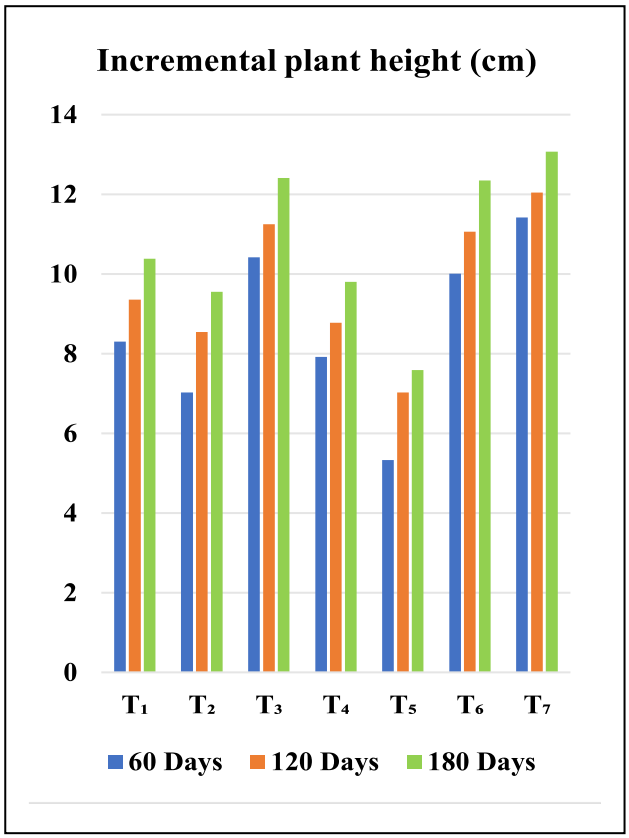

Figure 1: Effect of different potting media on incremental plant height (cm)

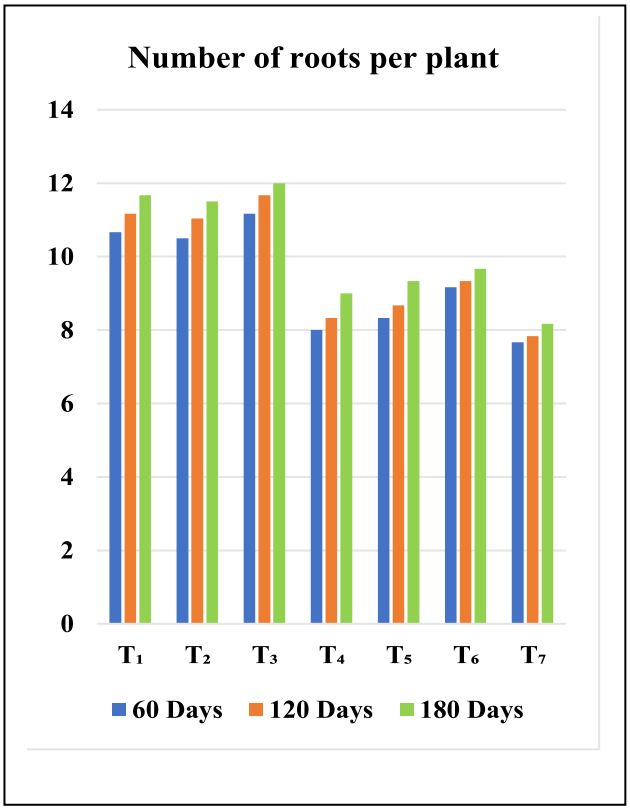

Figure 2: Effect of different potting media on number of roots per plant

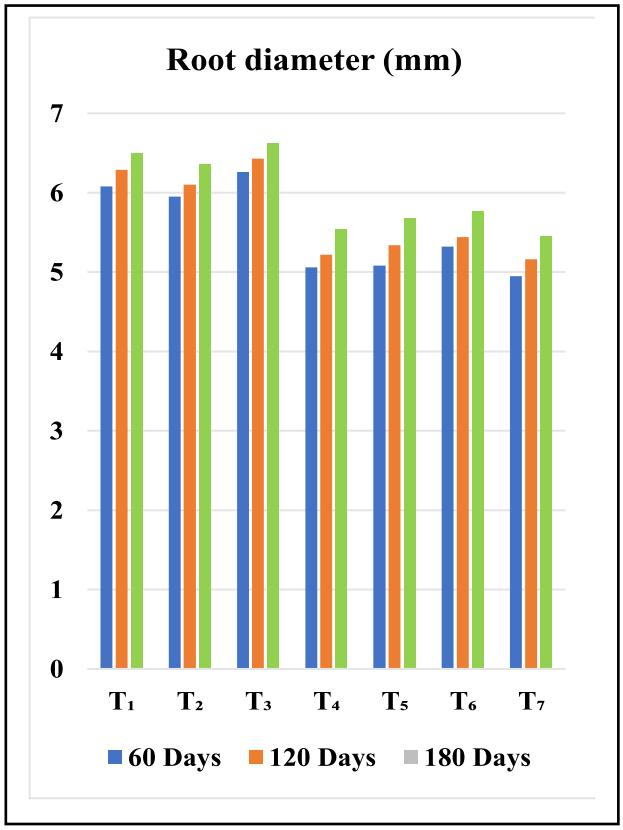

Figure 3: Effect of different potting media on root diameter (mm)

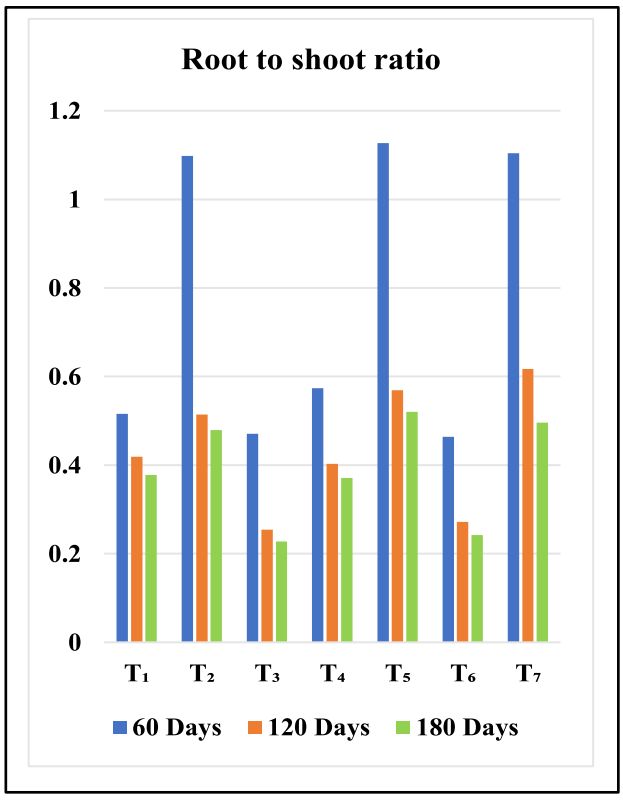

Figure 4: Effect of different potting media on root to shoot ratio

Conclusion

From the results of the present study, it can be concluded that potting mixture Sand + FYM @ 2:1 v/v was found better for growth in terms of number of shoots, number of leaves, number of leaflets, plant biomass, and overall visual quality of *Zamioculcas zamiifolia.*

Future scope of study

Future research can focus on evaluating the best-performing potting mixtures under different environmental conditions and seasons to validate their consistency and adaptability. Long-term studies assessing the influence of these mixtures on overall plant health, foliage quality and aesthetic value will help in standardizing media recommendations for commercial production of *Zamioculcas zamiifolia*. Expanding the study to include other ornamental foliage species may help determine the wider applicability of the media combinations. Furthermore, assessing the economic feasibility, ease of media preparation and sustainability aspects will support practical adoption by nurseries and growers. Integrating FYM & other organic amendments or biofertilizers with selected potting media can also be explored to further enhance plant vigor, reduce input costs and promote eco-friendly cultivation practices.

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