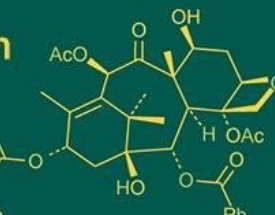


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(1): 1208-1216
www.biochemjournal.com
Received: 02-11-2025
Accepted: 04-12-2025

Palupunuri Vidyasree
Postgraduate Student, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Wanaparthy District, Telangana, India

Dr. Veenajoshi
Associate Professor of Horticulture, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Wanaparthy District, Telangana, India

Dr. N Seenivasan
Professor of Horticulture, College of Horticulture, Mulugu, Sri Konda Laxman Telangana State Horticultural University, Siddipet District, Telangana, India

Dr. P Gouthami
Assistant Professor of Crop Physiology, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Wanaparthy District, Telangana, India

Dr. G Sathish
Assistant Professor of Agricultural Statistics, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Wanaparthy District, Telangana, India

Corresponding Author:
Palupunuri Vidyasree
Postgraduate Student, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Wanaparthy District, Telangana, India

Optimization of foliar Nano urea and media composition for improved growth in ornamental philodendron

Palupunuri Vidyasree, Veenajoshi, N Seenivasan, P Gouthami and G Sathish

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i1So.7238>

Abstract

The present investigation, “Optimization of Foliar Nano Urea and Media Composition for Improved Growth in Ornamental Philodendron”, was carried out at the College of Horticulture, Mojerla, SKLTSHU, during December 2021 to May 2022. The experiment was laid out in a factorial randomized block design (FRBD) with two factors. The first factor included six levels of nano urea: N0: No spray, N1: Conventional urea 2 g L⁻¹, N2: Nano urea 0.5 ml L⁻¹, N3: Nano urea 1 ml L⁻¹, N4: Nano urea 1.5 ml L⁻¹, and N5: Nano urea 2 ml L⁻¹. The second factor consisted of four levels of potting media composition: M1: Red Earth, M2: Red Earth + Cocopeat (1:1), M3: Red Earth + Cocopeat + FYM (1:1:1), and M4: Red Earth + Cocopeat + FYM (2:1:1). Growth parameters including plant height, number of leaves, leaf length, leaf width, and leaf area were recorded at 65, 95, and 125 days after planting (DAP). Significant variations were observed among nano urea levels and media compositions, with the highest growth recorded in the N5M3 treatment combination, registering 46.29 cm plant height, 62.13 leaves per plant, and 213.49 cm² leaf area at 125 DAP. The enhanced growth is attributed to increased nitrogen availability, stimulation of auxin synthesis, improved enzymatic activity, and efficient translocation of photosynthates, which promoted cell division, elongation, and leaf expansion. Cocopeat-based media improved water retention, aeration, and nutrient availability, while FYM contributed essential nutrients and organic carbon, enhancing overall plant growth. Interaction effects between nano urea levels and media composition were statistically significant for all growth parameters. The study concludes that foliar application of nano urea at 2 ml L⁻¹ combined with Red Earth + Cocopeat + FYM (1:1:1) potting media is optimal for maximizing vegetative growth and ornamental quality of *Philodendron scandens*.

Keywords: Philodendron scandens, nano urea, potting media, foliar application

Introduction

Philodendron (*Philodendron scandens*), commonly known as Heart Leaf Philodendron, is one of the most popular ornamental foliage plants worldwide, valued for its lush green leaves, aesthetic appeal, and adaptability to indoor and landscape cultivation. Foliage quality, plant height, leaf size, and overall vegetative vigor are key parameters determining the commercial value of Philodendron, making efficient nutrient management crucial for sustainable production.

Nitrogen (N) is an essential macronutrient that plays a central role in plant growth, as it is a key component of amino acids, proteins, nucleic acids, and chlorophyll. Nitrogen availability directly influences cell division, elongation, and differentiation, which are critical for vegetative growth and photosynthetic efficiency (Mahmoud *et al.*, 2020) [8]. Conventional nitrogen fertilizers, such as urea, are widely used; however, their low use efficiency, leaching losses, and environmental impact necessitate the exploration of alternative nitrogen sources. Nano-fertilizers, particularly nano urea, have emerged as a promising approach to improve nutrient use efficiency due to their ultra-small particle size (20–50 nm), high surface area, and enhanced solubility. These properties enable nano urea particles to penetrate leaf surfaces effectively, stimulate enzymatic activity, and promote physiological processes such as auxin production and carbohydrate mobilization, ultimately enhancing vegetative growth and plant quality (Sharma *et al.*, 2022; Sai Kumar *et al.*, 2022) [13, 12]. In addition to nutrient

management, the composition of potting media significantly affects plant growth by influencing aeration, water retention, nutrient availability, and microbial activity. Components such as cocopeat provide high water-holding capacity and porosity, while farmyard manure enriches the media with organic matter and essential nutrients, promoting root development and overall plant vigor (Abad *et al.*, 2002; Nair and Bharathi, 2015) ^[1, 10]. Considering the potential of nano urea and optimized media, the present study was designed to evaluate the effect of different levels of nano urea and potting media compositions on the growth and development of *Philodendron*. The study aimed to determine the optimal combination of foliar-applied nano urea and media composition to maximize vegetative growth and improve foliage quality in potted *Philodendron* plants.

Materials and Methods

The investigation was carried out during the Rabi season of 2021 at the Post Graduate Research Block, College of Horticulture, Mojerla. The experimental material consisted of heart-leaf philodendron (*Philodendron scandens* L.), an ornamental foliage plant belonging to the family Araceae. Uniform and healthy mid-stem cuttings measuring approximately 15 cm in length with four nodes were used for planting. The experiment was laid out in a Factorial Randomized Block Design (FRBD) comprising two factors, twenty-four treatment combinations, and three replications. Each replication consisted of ten plants, grown individually in polybags of 10 × 12 inches. The first factor included six nitrogen treatments, namely control (no spray), conventional urea @ 2 g L⁻¹, and nano urea applied as foliar spray at 0.5, 1.0, 1.5 and 2.0 ml L⁻¹. The second factor consisted of four potting media combinations, viz., red earth alone; red earth + cocopeat (1:1); red earth + cocopeat + farmyard manure (1:1:1); and red earth + cocopeat + farmyard manure (2:1:1). Potting media were prepared by thoroughly mixing red earth, cocopeat, and well-decomposed farmyard manure in the prescribed proportions. Polybags were filled with the respective media and placed in sunken beds (10 cm depth) to facilitate moisture conservation and protection from extreme temperature fluctuations. Stem cuttings were initially treated with a fungicidal solution containing carbendazim and mancozeb for ten minutes, followed by dipping in IBA at 1000 ppm for fifteen minutes. Treated cuttings were planted in polybags, ensuring that two nodes remained below and two nodes above the surface of the media. Light irrigation was provided immediately after planting.

Preparation and application of nutrient solutions

Nano urea solutions of 0.05, 0.10, 0.15, and 0.20 per cent were prepared by diluting 0.5, 1.0, 1.5, and 2.0 ml of nano urea, respectively, in one litre of distilled water. A 0.2 per cent conventional urea solution was prepared by dissolving 2 g of urea in one litre of water. The first foliar spray was applied at 35 days after planting, followed by subsequent sprays at 15-day intervals for a period of three months. In total, six foliar applications were carried out during the experiment.

Plants were irrigated once every two days during December to February, while irrigation was provided on alternate days during March to May. Intercultural operations such as regular weeding and periodic loosening of the growing media were performed to maintain optimum growth conditions throughout the experimental period.

Results and discussion

Vegetative growth of *Philodendron scandens*, including plant height, number of leaves, leaf length, leaf width, and leaf area, was significantly influenced by nano urea levels, potting media composition, and their interaction across all observation stages (65, 95, and 125 DAP), except for leaf length, which showed non-significant variation. These growth parameters are critical indicators of plant vigour and aesthetic quality, particularly for ornamental foliage plants, as they directly influence photosynthetic capacity, resource allocation, and overall canopy development.

Plant Height (cm)

Plant height exhibited significant variation in response to nano urea application and potting media (Tables 1a, 1b; Fig. 1a,b,c). At 65 DAP, the tallest plants were observed under N₅ (2 ml L⁻¹ nano urea; 24.23 cm), followed by N₄ (1.5 ml L⁻¹; 21.91 cm), whereas the control (N₀) recorded the shortest height (18.24 cm). Among media, M₃ (Red Earth + Cocopeat + FYM, 1:1:1) produced maximum height (24.18 cm), while M₁ (Red Earth alone) was the least effective (17.85 cm). The interaction effect of nano urea and media was significant, with T₂₃ (N₅M₃) yielding the tallest plants (28.32 cm) and T₁ (N₀M₁) the shortest (15.91 cm). This trend persisted at 95 DAP and 125 DAP, where N₅ consistently enhanced height (31.64 and 38.98 cm, respectively), and the N₅M₃ combination produced the maximum height (37.39 and 46.29 cm).

The enhanced plant height can be mechanistically explained by the superior foliar absorption and mobility of nano urea. The extremely small particle size (<50 nm) allows nano nitrogen to penetrate stomatal pores efficiently, improving nitrogen assimilation and amino acid synthesis, including tryptophan a precursor of indole-3-acetic acid (IAA), the principal auxin responsible for cell elongation and apical dominance (Sharma *et al.*, 2022; Sai Kumar *et al.*, 2022) ^[13, 12]. Additionally, nano urea provides sustained nutrient release, stimulating enzymatic activity, photosynthate translocation, and vegetative growth. Potting media also played a significant role. The combination of cocopeat and FYM in M₃ enhanced water retention, aeration, and nutrient availability, promoting root proliferation and nutrient uptake. The fibrous nature of cocopeat improved soil porosity and reduced bulk density, supporting optimal plant metabolic activity and vegetative elongation (Awang *et al.*, 2009; Nair and Bharathi, 2015) ^[5, 10]. These results align with El-Shawa *et al.* (2022) ^[7] in *Philodendron* and Abdel-Salam (2018) ^[3] in lettuce, where nano urea significantly increased plant height.

Number of Leaves per Plant

Leaf number is directly associated with photosynthetic efficiency and ornamental value. Leaf number exhibited significant variation in response to nano urea application and potting media (Tables 2a, 2b; Fig. 2a,b,c). At 65 DAP, N₅ produced the highest number of leaves (12.63), followed by N₄ (10.63), while N₀ recorded the lowest (7.34). Media effect was significant, with M₃ supporting the maximum leaves (11.84) and M₁ the least (7.82). The interaction T₂₃ (N₅M₃) yielded 17.17 leaves at 65 DAP, increasing to 62.13 leaves at 125 DAP, demonstrating cumulative growth benefits of optimized nutrient-media combinations.

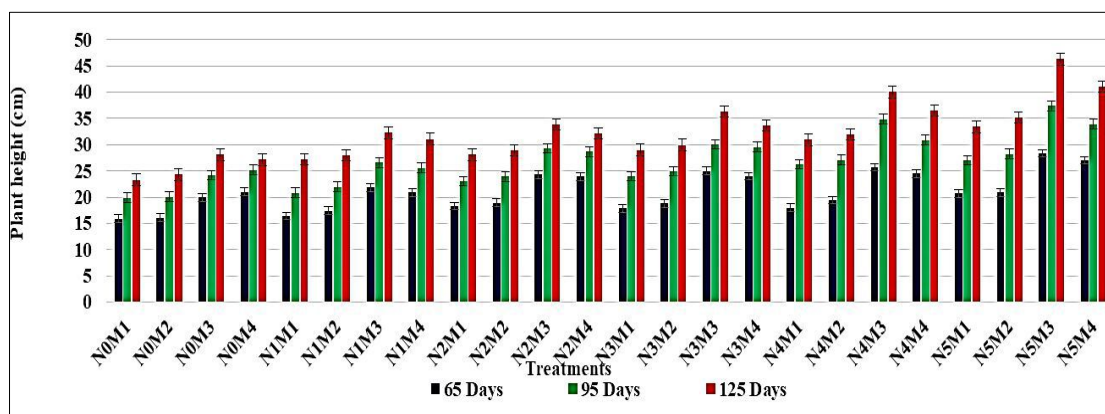
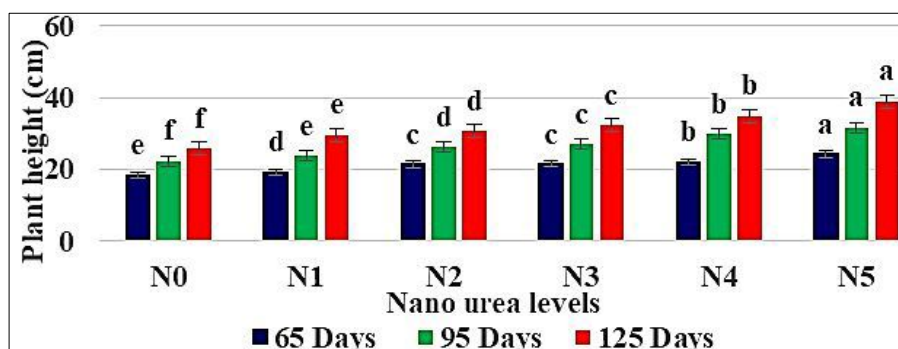
Table 1a: Effect of nano urea levels and composition of potting media on plant height (cm) at 65 and 95 days after planting in *Philodendron scandens*

Media Composition	Nano Urea Levels													
	65 Days After Planting							95 Days After Planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	15.91	16.38	18.31	17.88	17.98	20.67	17.85 ^d	19.90	20.81	23.02	23.97	26.27	27.02	23.50 ^d
M ₂	16.11	17.41	18.92	18.81	19.45	20.91	18.60 ^c	20.08	21.94	23.92	24.94	27.07	28.22	24.36 ^c
M ₃	19.93	21.82	24.29	25.00	25.71	28.32	24.18 ^a	24.18	26.56	29.29	30.04	34.84	37.39	30.38 ^a
M ₄	21.03	20.91	23.92	24.01	24.47	27.02	24.04 ^b	25.14	25.53	28.65	29.52	30.86	33.93	28.94 ^b
Mean	18.24 ^e	19.13 ^d	21.36 ^c	21.42 ^c	21.90 ^b	24.23 ^a		22.33 ^f	23.71 ^e	26.22 ^d	27.12 ^c	29.76 ^b	31.64 ^a	
	S.E.M			C.D. 5%				S.E.M			C.D. 5%			
N	0.05			0.15				0.05			0.15			
M	0.04			0.12				0.04			0.12			
N*M	0.11			0.30				0.10			0.30			

Table 1b: Effect of nano urea levels and composition of potting media on plant height (cm) at 125 days after planting in *Philodendron scandens*

Media Composition	Nano Urea Levels						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	23.27	27.21	28.09	28.98	30.93	33.38	28.64 ^d
M ₂	24.29	28.00	28.94	29.91	31.94	35.18	29.71 ^c
M ₃	28.06	32.25	33.79	36.31	40.04	46.29	36.12 ^a
M ₄	27.15	31.07	32.15	33.63	36.50	41.04	33.59 ^b
Mean	25.69 ^f	29.63 ^e	30.74 ^d	32.21 ^c	34.86 ^b	38.98 ^a	
	S.E.M			C.D. 5%			
N	0.04			0.12			
M	0.06			0.10			
N*M	0.09			0.25			

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

**Fig 1a:** Interaction effect of nano urea levels and composition of potting media on plant height (cm) in *Philodendron scandens***Fig 1b:** Effect of nano urea levels on plant height (cm)

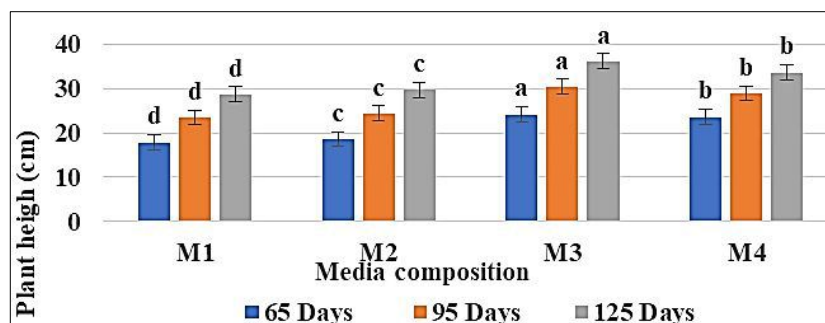


Fig 1c: Effect of composition of potting media on plant

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

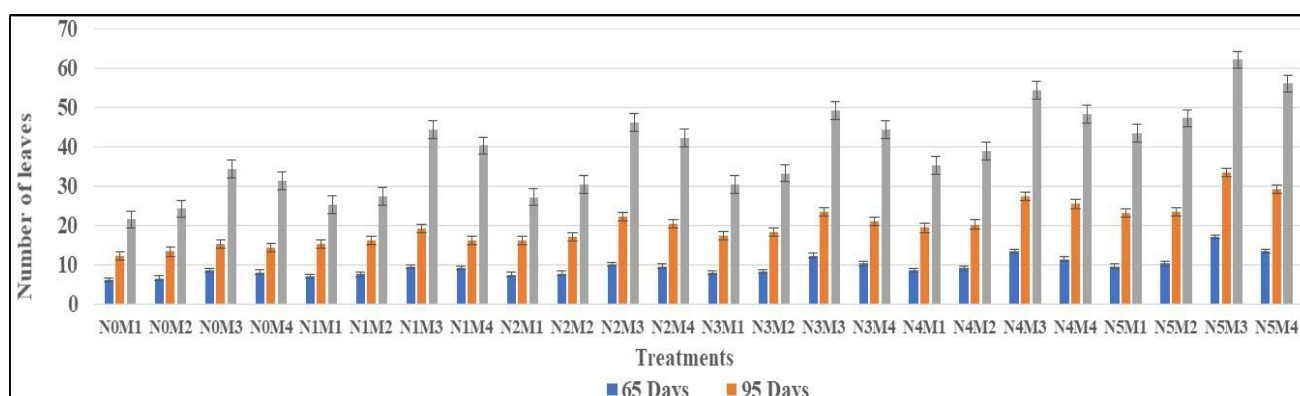
Table 2a: Effect of nano urea levels and composition of potting media on number of leaves at 65 and 95 days after planting in *Philodendron scandens*

Media composition	Nano urea levels													
	65 Days after planting							95 Days after planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	6.17	7.10	7.53	7.93	8.57	9.63	7.82 ^d	12.23	15.13	16.07	17.37	19.37	23.10	17.21 ^d
M ₂	6.57	7.57	7.80	8.23	9.10	10.27	8.26 ^c	13.30	16.30	17.20	18.43	20.27	23.43	18.16 ^c
M ₃	8.53	9.47	10.17	12.37	13.37	17.17	11.84 ^a	15.33	19.23	22.27	23.40	27.37	33.40	23.50 ^a
M ₄	8.10	9.17	9.60	10.30	11.47	13.43	10.34 ^b	14.23	16.13	20.30	21.17	25.43	29.10	21.06 ^b
MEAN	7.34 ^f	8.33 ^e	8.78 ^d	9.71 ^c	10.63 ^b	12.63 ^a		13.78 ^f	16.70 ^e	18.96 ^d	20.09 ^c	23.11 ^b	27.26 ^a	
	S.E.M			C.D. 5%				S.E.M			C.D. 5%			
N	0.05			0.13				0.07			0.21			
M	0.04			0.11				0.06			0.17			
N*M	0.09			0.27				0.15			0.41			

Table 2b: Effect of nano urea levels and composition of potting media on number of leaves at 125 days after planting

Media Composition	Nano Urea Levels						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	21.50	25.23	27.20	30.37	35.33	43.43	30.51 ^d
M ₂	24.27	27.37	30.40	33.27	38.87	47.27	33.57 ^c
M ₃	34.37	44.33	46.23	49.33	54.30	62.13	48.45 ^a
M ₄	31.27	40.30	42.33	44.43	48.40	56.07	43.80 ^b
MEAN	27.85 ^f	34.31 ^e	36.54 ^d	39.35 ^c	44.23 ^b	52.23 ^a	
	S.E.M			C.D. 5%			
N	0.07			0.21			
M	0.06			0.17			
N*M	0.15			0.41			

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

Fig 2a: Interaction effect of nano urea levels and composition of potting media on number of leaves in *Philodendron scandens*

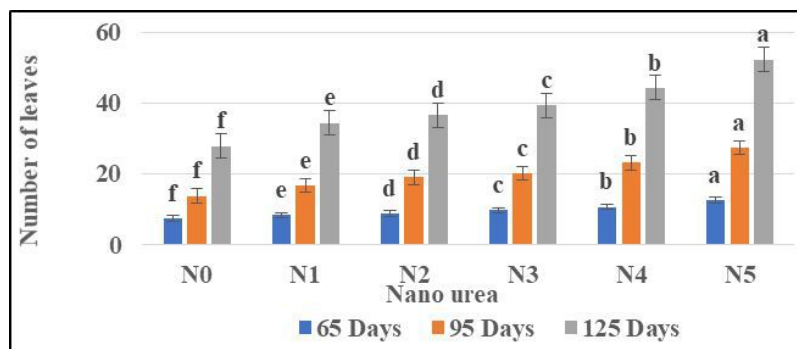


Fig 2b: Effect of nano urea levels on number of leaves

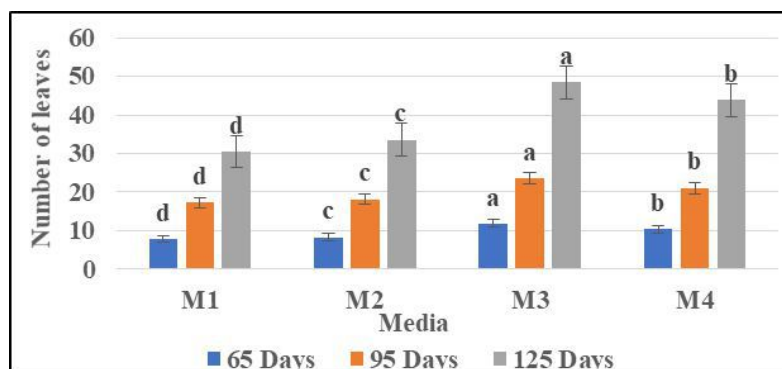


Fig 2c: Effect of composition of potting media on number of leaves

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

The physiological mechanism underlying these observations is the promotion of cell division and differentiation by nitrogen, a vital component of chlorophyll, nucleic acids, and proteins. Enhanced chlorophyll synthesis increases photosynthetic activity, providing energy for leaf primordia development. Nano urea's higher surface area and rapid foliar absorption accelerate these processes, resulting in a higher number of fully expanded leaves (Sharma *et al.*, 2022; Minz *et al.*, 2021) ^[13, 9]. Cocopeat and FYM-enriched media further contributed by maintaining optimal moisture and aeration, facilitating nutrient diffusion to roots and sustaining leaf expansion. These findings corroborate those of Choudhary *et al.* (2020) ^[6] in field crops and El-Shawa *et al.* (2022) ^[7] in *Philodendron*, where integrated nutrient and media management enhanced foliar development.

- **Leaf Length (cm):** Leaf length did not show significant differences among treatments (Tables 3a, 3b), suggesting a strong genetic regulation of this trait that is less responsive to foliar nitrogen or media composition. Similar observations were reported by Qureshi *et al.* (2018) ^[11], indicating that while nitrogen availability influences overall growth, elongation of individual leaves may be constrained by inherent developmental programming.
- **Leaf Width (cm):** Leaf width was non-significant at 65 and 95 DAP, but significant at 125 DAP (Tables 4a, 3b). Maximum leaf width was observed in N₅ (10.12 cm), followed by N₄ (9.69 cm), whereas N₀ was lowest (6.75 cm). Among media, M₃ produced the widest leaves (10.19 cm) and M₁ the narrowest (7.03 cm) (Tables 4a, 4b and fig 3a, b, c) Mechanistically,

enhanced leaf width results from improved nitrogen assimilation, stimulating cell expansion and division in the leaf lamina. Increased photosynthate production in leaves promotes cell turgor and elongation, contributing to greater leaf surface area (Singh *et al.*, 2017) ^[14]. The interaction of nano urea with cocopeat–FYM media likely provided sustained nutrient availability and optimal root–shoot balance, supporting lamina expansion.

- **Leaf Area (cm²):** Leaf area exhibited significant variation in response to nano urea application and potting media (Tables 2a, 5b; Fig.3a,b,c). Leaf area, a crucial determinant of photosynthetic capacity, was significantly influenced by nano urea levels, media composition, and their interaction at all stages. At 125 DAP, N₅ recorded the highest leaf area (169.25 cm²), followed by N₄ (138.17 cm²), while N₀ was the lowest (75.58 cm²). Media effects were significant, with M₃ producing the largest area (167.08 cm²) and M₁ the smallest (77.21 cm²). The N₅M₃ interaction yielded the maximum leaf area (213.49 cm²), demonstrating a synergistic effect of optimal nitrogen supply and balanced substrate composition.

Physiologically, nano urea promotes rapid nitrogen uptake, enhancing amino acid, protein, and chlorophyll synthesis, which stimulates cell division and elongation. FYM contributes additional macro- and micronutrients and improves microbial activity, further enhancing leaf expansion (Ajith Kumar *et al.*, 2021; Abdel-Salam *et al.*, 2018) ^[4, 3]. Reduced bulk density and higher water retention

in cocopeat-based media facilitate turgor-driven cell expansion, leading to larger leaves. These findings are in agreement with previous studies in *Philodendron* (El-Shawa

et al., 2022) [7], maize (Ajith Kumar *et al.*, 2021) [4], and lettuce (Abdel-Salam *et al.*, 2018) [3].

Table 3a: Effect of nano urea levels and composition of potting media on leaf length (cm) at 65 and 95 days after planting in *Philodendron scandens*

Media composition	Nano Urea Levels													
	65 Days After Planting							95 Days After Planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	8.09	9.98	10.31	10.73	11.11	13.03	10.54	9.10	12.04	12.5	13.04	13.74	15.79	12.7
M ₂	10.98	12.82	13.08	13.57	13.82	16.02	13.38	11.99	14.91	15.29	15.93	16.51	18.81	15.57
M ₃	15.09	17.05	17.46	17.5	17.66	20.26	17.50	16.90	19.21	19.77	20.32	20.52	24.06	20.13
M ₄	13.51	15.41	15.94	16.04	16.46	18.66	16.00	15.02	17.55	18.2	18.5	19.28	22.19	18.46
Mean	11.92	13.82	14.2	14.46	14.76	16.99	14.36	13.25	15.93	16.44	16.95	17.51	20.21	16.72
	S.E.M			C.D. 5%				S.E.M			C.D. 5%			
N	NS			NS				NS			NS			
M	NS			NS				NS			NS			
N*M	NS			NS				NS			NS			

Table 3b: Effect of nano urea levels and composition of potting media on leaf length (cm) at 125 days after planting in *Philodendron scandens*

Media Composition	Nano Urea Levels						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	10.06	13.75	14.37	15.03	15.88	17.93	14.51
M ₂	12.96	16.65	17.20	17.93	18.68	20.98	17.40
M ₃	18.14	21.18	21.84	22.46	22.78	26.52	22.16
M ₄	16.22	19.4	20.2	20.56	21.52	24.6	20.42
Mean	14.35	17.75	18.41	19.00	19.72	22.51	18.62
	S.E.M			C.D. 5%			
N	NS			NS			
M	NS			NS			
N*M	NS			NS			

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

Table 4a: Effect of nano urea levels and composition of potting media on leaf width (cm) at 65 and 95 days after planting in *Philodendron scandens*

Media Compo sition	Nano Urea Levels													
	65 Days After Planting							95 Days After Planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	4.45	4.88	5.29	5.46	5.65	6.24	5.33	4.89	5.90	6.43	6.73	6.98	7.79	6.46
M ₂	5.50	5.94	6.55	6.76	6.94	7.72	6.57	5.97	6.98	7.73	8.05	8.34	9.33	7.74
M ₃	6.84	7.69	7.89	7.94	8.30	10.06	8.12	7.38	8.93	9.31	9.45	9.94	11.95	9.50
M ₄	6.56	7.54	7.64	7.75	8.19	9.02	7.78	7.09	8.74	9.03	9.24	9.81	10.86	9.13
Mean	5.83	6.51	6.84	6.97	7.27	8.26		6.34	7.64	8.13	8.37	8.77	9.99	
	S.E.M			C.D. 5%				S.E.M			C.D. 5%			
N	NS			NS				NS			NS			
M	NS			NS				NS			NS			
N*M	NS			NS				NS			NS			

Table 4b: Effect of nano urea levels and composition of potting media on leaf width (cm) at 125 days after planting in *Philodendron scandens*

Media Composition	Nano Urea Levels						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean
M ₁	5.24	6.31	6.94	7.32	7.63	10.36	7.03^b
M ₂	6.35	7.44	8.38	8.97	9.24	13.20	8.46^{ab}
M ₃	7.88	9.61	9.08	10.34	10.99	8.19	10.19^a
M ₄	7.53	9.35	9.84	9.89	10.85	10.36	9.28^{ab}
Mean	6.75 ^b	8.18 ^{ab}	8.56 ^{ab}	9.13 ^{ab}	9.68 ^a	10.12 ^a	
	S.E.M			C.D. 5%			
N	0.40			1.13			
M	0.32			0.92			
N*M	0.80			2.26			

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

Table 5a: Effect of nano urea levels and composition of potting media on leaf area (cm²) at 65 and 95 days after planting in *Philodendron scandens*

Media composition	Nano Urea Levels													
	65 Days After Planting							95 Days After Planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	30.13	39.05	39.82	42.60	45.60	60.57	42.96 ^d	33.96	52.34	56.24	60.92	67.75	86.29	59.58 ^d
M ₂	44.84	58.25	61.41	65.10	68.02	88.24	64.31 ^c	50.42	79.98	83.83	87.82	91.68	129.66	87.23 ^c
M ₃	81.29	103.05	108.69	108.85	110.35	147.38	109.93 ^a	98.62	134.52	141.44	149.72	151.21	186.75	143.71 ^a
M ₄	65.67	84.90	88.11	88.37	92.01	126.75	90.97 ^b	80.81	109.01	116.91	123.57	135.67	168.22	122.37 ^b
Mean	55.49 ^c	71.31 ^b	74.51 ^b	76.23 ^b	79.00 ^b	105.73 ^a		65.95 ^e	93.96 ^d	99.60 ^{cd}	105.51 ^{bc}	111.58 ^b	142.73 ^a	
	S.E.M			C.D. 5%				S.E.M			C.D. 5%			
N	1.36			3.87				1.18			3.36			
M	1.11			3.16				0.99			2.74			
N*M	2.72			7.73				2.36			6.712			

Table 5b: Effect of nano urea levels and composition of potting media on leaf area (cm²) at 125 days after planting in *Philodendron scandens*

Media composition	Nano Urea Levels						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	MEAN
M ₁	39.38	67.58 ^a	76.07	80.08	87.11	113.04	77.21 ^d
M ₂	59.83	95.05 ^a	104.38	112.82	126.13	157.75	109.33 ^c
M ₃	115.16	160.18	166.82	171.54	175.26	213.49	167.08 ^a
M ₄	87.95	136.41	148.87	152.28	164.18	192.70	147.06 ^b
Mean	75.58 ^e	114.80 ^d	124.04 ^c	129.18 ^c	138.17 ^b	169.25 ^a	
	S.E.M			C.D. 5%			
N	1.03			2.94			
M	0.85			2.40			
N*M	2.07			5.89			

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

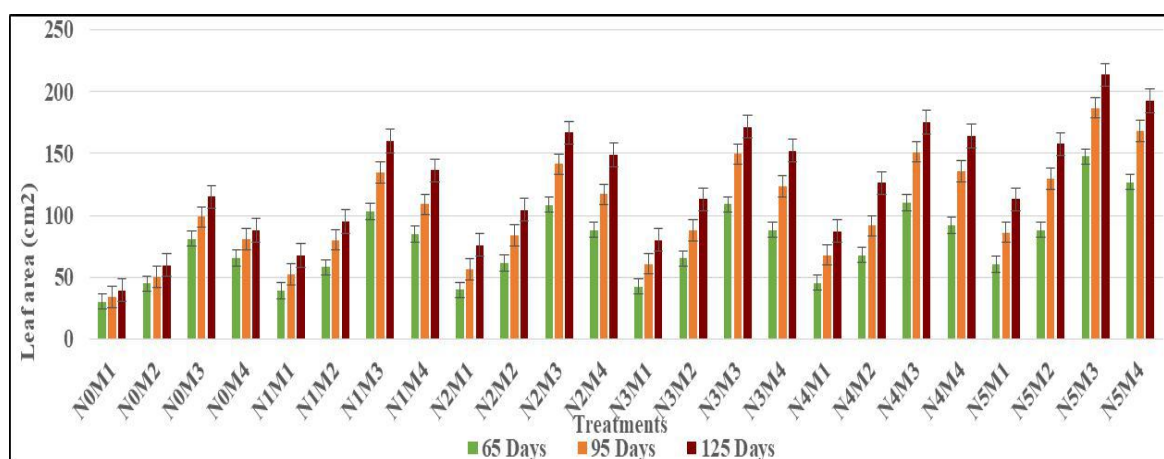
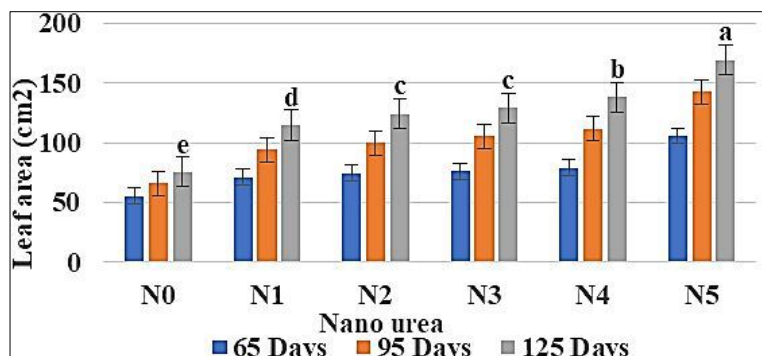
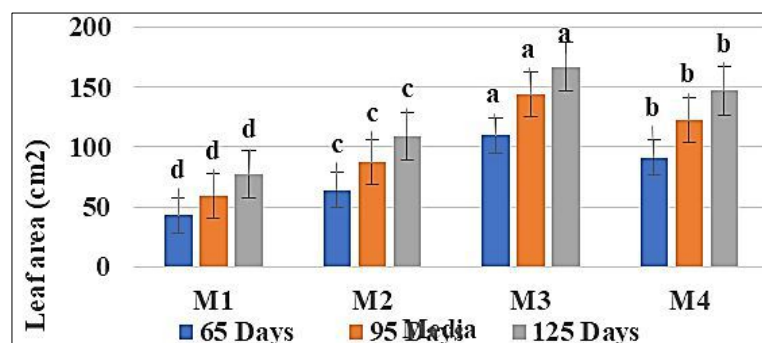


Fig 3a: Interaction effect of nano urea levels and media composition of potting media on leaf area (cm²) in *Philodendron scandens*

Fig 3b: Effect of nano urea levels on leaf area (cm²)Fig 3c: Effect of composition of potting media on leaf area (cm²)

N ₀ : Control (No sprays)	N ₃ : Nano urea 1 ml L ⁻¹	M ₁ : Red earth
N ₁ : Conventional Urea 2 g L ⁻¹	N ₄ : Nano urea 1.5 ml L ⁻¹	M ₂ : Red earth + Cocopeat (1:1)
N ₂ : Nano urea 0.5 ml L ⁻¹	N ₅ : Nano urea 2 ml L ⁻¹	M ₃ : Red earth + Cocopeat + FYM (1:1:1)
		M ₄ : Red earth + Cocopeat + FYM (2:1:1)

Conclusion

The present study demonstrated that the application of nano urea significantly enhanced the vegetative growth of Heart Leaf Philodendron (*Philodendron scandens*), as evidenced by improvements in plant height, number of leaves, leaf width, and leaf area. Among the different levels of nano urea, the highest concentration (N₅ – 2 ml L⁻¹) consistently produced superior growth responses at 65, 95, and 125 days after planting, highlighting the efficacy of nano-fertilizers in improving nutrient uptake and utilization. The enhanced growth can be attributed to the small particle size and high surface area of nano urea, which facilitated efficient penetration through the leaf stomata, stimulated auxin-mediated cell division and elongation, and promoted chlorophyll synthesis and photosynthetic activity.

Similarly, the composition of the potting media significantly influenced growth parameters. The combination of Red Earth, Cocopeat, and Farm Yard Manure in the ratio of 1:1:1 (M₃) provided an optimal balance of aeration, water retention, and organic nutrient content, resulting in improved vegetative growth compared to other media compositions. The interaction between nano urea application and media composition was statistically significant, with the treatment combination T₂₃-N₅M₃ (2 ml L⁻¹ Nano urea + Red Earth + Cocopeat + FYM, 1:1:1) consistently producing the highest plant height, number of leaves, leaf width, and leaf area. Overall, the study indicates that the integrated use of nano urea and a well-structured potting media enhances vegetative growth by improving nutrient availability, water retention, and physiological efficiency in *Philodendron*. These findings provide valuable insights for commercial cultivation and management of

ornamental foliage plants, suggesting that nano-fertilizer application in combination with nutrient-rich media can maximize plant growth, vigor, and overall ornamental quality.

References

1. Abad M, Noguera P, Noguera V. Substrate composition and its effect on plant growth: An overview. *HortScience*. 2002;37(4):678–684.
2. Abad M, Noguera P, Silvestre J. Physical properties of coconut coir dust and its potential as a peat substitute for container growing media. *Bioresour Technol*. 2002;82:241–245.
3. Abdel-Salam AM, El-Bassiouny HM, Abdel-Fattah AA. Influence of foliar nano nitrogen application on growth and yield of lettuce (*Lactuca sativa* L.). *J Plant Nutr*. 2018;41(12):1594–1603.
4. Ajith Kumar A, Suresh P, Ramesh S. Nano-fertilizer application enhances growth and nitrogen uptake in maize (*Zea mays* L.). *Indian J Hortic*. 2021;78(1):45–53.
5. Awang Y, Syakir MI, Nair PKR. Effects of coir dust amendment on soil physical properties and plant growth in container media. *HortTechnology*. 2009;19(2):393–398.
6. Choudhary A, Singh S, Kumar R. Nano urea as a potential foliar fertilizer in pearl millet (*Pennisetum glaucum*). *J Appl Nat Sci*. 2020;12(4):623–630.
7. El-Shawa HA, Mohamed ME, Hassan A. Foliar application of nano urea improves growth and photosynthetic pigments in *Philodendron*. *J Ornamental Plants*. 2022;12(1):11–22.

8. Mahmoud S, Saleh F, Khalil M. Nitrogen nutrition and plant growth: Physiological perspectives. *Plant Sci Today*. 2020;7(2):103–114.
9. Minz WS, Singh R, Sharma K. Nano urea improves growth and grain yield of pearl millet under semi-arid conditions. *Crop Improv*. 2021;48(2):155–162.
10. Nair R, Bharathi R. Influence of cocopeat-based potting media on vegetative growth and physiology of ornamental plants. *Indian J Hortic*. 2015;72(2):178–184.
11. Qureshi MF, Khan M, Iqbal M. Nano urea and its effect on leaf expansion and chlorophyll synthesis in horticultural crops. *Int J Plant Prod*. 2018;12(1):45–55.
12. Sai Kumar S, Ramesh P, Venkatesh K. Nano-fertilizers: Mechanisms and efficiency in enhancing nutrient uptake and plant growth. *J Plant Nutr*. 2022;45(10):1456–1468.
13. Sharma P, Singh R, Choudhary A. Foliar application of nano urea for improved growth and nitrogen use efficiency in potted ornamental plants. *Int J Hortic Sci*. 2022;28(3):123–134.
14. Singh A, Sharma P, Yadav R. Nano-fertilizers for sustainable agriculture: Physiological and agronomic perspectives. *Plant Nutr Sci*. 2017;3(2):55–64.