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Standardization of nano urea and composition of potting media on growth and quality of *Philodendron scandens*

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Abstract

The present investigation “Standardization of nano urea and composition of potting media on growth and quality of *Philodendron scandens*” was carried out at College of Horticulture, Mojerla, SKLTSHU, during December 2021 to May 2022. The experiment was laid out in FRBD with two factors in which first factor consists of six levels of nano urea viz., N₀: No spray of nano urea, 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, N₅: Nano urea 2 ml L⁻¹ and second factor consists of four levels of composition of potting media viz., M₁: Red earth, M₂: Red earth + Cocopeat (1:1), M₃: Red earth + Cocopeat + FYM (1:1:1), M₄: Red earth + Cocopeat + FYM (2:1:1). Among the nano urea levels, Nano urea, 2 ml L⁻¹ (N₅) recorded maximum values for plant height (24.22, 31.64 and 38.98 cm), number of leaves (12.63, 27.26 and 52.23), leaf width (10.118 cm at 125 DAP), leaf area (105.73, 142.73 and 169.25 cm²) and LAI (0.92, 2.12 and 6.05), while conventional urea 2 g L⁻¹ (N₁) recorded maximum values (239.77, 257.91 and 266.051 cm² g⁻¹) and nano urea 5 ml L⁻¹ (N₅) recorded minimum values (183.37, 196.34 and 197.24 cm² g⁻¹) for SLA. With respect to potting media composition, Red Earth + Cocopeat + FYM (1:1:1) (M₃) recorded the maximum values for plant height (24.18, 30.38 and 36.12 cm), number of leaves (11.84, 23.5 and 48.45), leaf width (10.19 cm at 125 DAP), leaf area (109.93, 143.71 and 167.08 cm²), LAI (1.3, 3.62 and 10.52) and for SLA (237.625, 247.475 and 247.854 cm² g⁻¹) at 65, 95 and 125 days after planting. These results revealed that significant effect on the Plant height, number of leaves, leaf length, leaf width, leaf area and LAI registered with the treatment combination of nano urea (2.0 ml L⁻¹) and Red Earth + Cocopeat + FYM in the ratio (1:1:1).

Keywords: *Philodendron scandens*, nano urea, potting media, leaf area index (LAI) and specific leaf area (SLA)

Introduction

Philodendron scandens is also known as *Philodendron oxycardium* and *Philodendron cordatum*. The genus *Philodendron* contains approximately 700 species, making it the second largest genus in the family Araceae (Croat, 1997) [5]. *Philodendron*'s name is derived from Greek ‘philio’ (loving) and ‘dendron’ (tree), which means tree loving because many are tree climbers with their clinging roots.

The success in growing foliage plants depends largely on the ability of growers to provide a satisfactory environment and growing media. Utilization of chemical fertilisers has long been condemned because of their harmful impacts on the environment and their deteriorating quality of agricultural products. Nano-fertilizers are appropriate alternatives to conventional fertilizers for a gradual and controlled supply of nutrients in the soil. Alternative nano-fertilizers such as nanochelate can reduce pollution over chemical fertilizers and found to be economical (Mousavi and Faezania, 2008) [11].

Nano-materials are defined as materials with a single unit between one and a hundred nm in size with a minimum of one dimension (Liu and Lal, 2015) [9]. Nano urea contains 4% total nitrogen (w/v). The nano-nitrogen particle size varies from 20–50 nm. These particles are evenly dispersed in the water. It contains 40,000 mg L⁻¹ of nitrogen in a 500 ml bottle, which is equivalent to the amount of nitrogen nutrient provided by one bag (45 kg) of conventional urea. When sprayed on leaves of plants at critical growth stages, it enters through stomata and other openings and is assimilated by the plant cells. Because of phloem transport, it is distributed from source to sink inside the plant wherever it is required. Unutilized nitrogen is stored in the plant vacuole and is slowly released for proper growth and development of the plant (Kantwa and Yadav, 2022) [7].

Along with the nitrogen supply, potting medium also plays an important role in the growth of indoor plants. The purpose of a potting medium is to satisfy the needs for good plant growth within the limited space of a container. The medium physically supports a growing plant and both stores and supplies nutrients, trace elements, water and air to the root system. Therefore, it is essential to compare and analyse the efficiency of media combinations with that of appropriate soil in order to figure out the best combinations of growing media so as to provide the best possible growth by making the right initial choice.

Materials and Methods

The experiment was conducted in a shade net at Floriculture block, of College of Horticulture, Mojerla, Wanaparthy, situated at an altitude of 347.3 m above mean sea level on 78° 29' East longitude and 17° 19' North latitude. The experiment was conducted in Factorial Randomized Block Design with three replications and two factors with Factor 1 consisting of six levels of Nano urea (N₀-Without spray of Nano Urea, N₁-Conventional urea (2 g L⁻¹), N₂-0.5 ml L⁻¹, N₃-1.0 ml L⁻¹, N₄-1.5 ml L⁻¹, N₅-2.0 ml L⁻¹) and Factor 2 comprising of four levels of potting media (M₁-Red earth, M₂-Redearth +Cocopeat (1:1), M₃- Red earth + Cocopeat + FYM (1:1:1), M₄-Redearth + Cocopeat + FYM (2:1:1)). Treatment combinations are displayed in Table 1. First spraying was done at 35 days after planting. Other sprays were applied at every 15 days interval for three months. Total 6 sprays were carried out.

Data collected

All the growing parameters (plant height, number of leaves, leaf length, leaf width and leaf area) and physiological parameters (LAI (Leaf Area Index), SLA (Specific Leaf Area, cm² g⁻¹), SLW (Specific Leaf Weight, g cm⁻²)) were recorded at 65, 95 and 125 days after planting for every 30 days interval. Physiological parameters were calculated by using following formulae.

Leaf Area Index (LAI)

It was expressed numbers proposed by Williams (1946).

$$LAI = \frac{\text{Total leaf area of the plant}}{\text{ground area occupied by the plant}}$$

Specific Leaf AREA (SLA cm² g⁻¹)

Proposed by Kvet *et al.* (1971) [8].

$$SLA = \frac{\text{leaf area}}{\text{Dry leaf weight}} \text{ cm}^2 \text{ g}^{-1}$$

Specific Leaf weight (g cm⁻²)

Suggested by Pearce *et al.* (1968) [12].

$$SLW = \frac{\text{leaf weight}}{\text{leaf area}} \text{ g cm}^{-2}$$

Results and Discussion plant height

Among nano urea levels, Nano urea 2 ml L⁻¹(N₅) recorded maximum values for plant height (24.22, 31.64 and 38.98 cm) followed by N₄ (Nano urea 1.5 ml L⁻¹) (21.913, 29.762, 34.855 cm) while no spray (N₀) recorded minimum values for

plant height (18.24, 22.33 and 25.69 cm) at 65, 95 and 125 DAP. Results were presented in table 2a, 2b and depicted in Fig 4.5a, b, c.

With respect to potting media composition, Red Earth + Cocopeat + FYM (1:1:1) (M₃) recorded the maximum values for plant height (24.18, 30.38 and 36.12 cm) followed by M₄ (Red Earth +Coco peat + FYM (2:1:1)) (23.56, 28.94, 33.59 cm) while Red Earth (M₁) recorded minimum values for plant height (17.85, 23.5 and 28.64 cm) at 65, 95 and 125 DAP.

Among the interactions, the treatment combination of (T₂₃: N₅M₃) Nano urea 2 ml L⁻¹ with Red Earth + Cocopeat + FYM (1:1:1) recorded maximum values (28.32, 37.39 and 46.29 cm at 65, 95 and 125 DAP respectively) followed by T₂₄-N₅M₄ (Nano urea 2 ml L⁻¹ with Red Earth + Coco peat + FYM (2:1:1)) (27.02 and 41.04 cm at 65 and 125 DAP respectively) and T₁₉-N₄M₃ (Nano urea 1.5 ml L⁻¹ with Red Earth + Coco peat + FYM (1:1:1) (34.84 cm) at 95 DAP, while minimum values (15.91, 19.9 and 27.21 cm at 65, 95 and 125 DAP respectively) was recorded in no spray with Red Earth combination (T₁: N₀M₁).

Number of leaves

Among the 6 level of nano urea sprays, Nano urea 2 ml L⁻¹(N₅) recorded maximum number of leaves (12.63, 27.26 and 52.23) which is followed by N₄ (Nano urea 1.5 ml L⁻¹) (10.63, 23.11 and 44.23) and minimum number of leaves (7.34, 13.78 and 27.85) at 65, 95 and 125 DAP. Results were presented in table 3a, 3b and depicted in Fig 2.

Among the composition potting media, maximum number of leaves recorded in media M₃ (Red Earth + Coco peat + FYM (1:1:1)) (11.84, 23.5 and 48.45), followed by M₄ (Red Earth + Coco peat + FYM (2:1:1)) (10.34, 21.06, 43.8 cm). While minimum number of leaves per plant was recorded in M₁ (Red Earth) (7.82, 17.21 and 30.51) at 65, 95 and 125 DAP.

Among the interaction effects maximum number of leaves recorded with the treatment combination of T₂₃-N₅M₃ (Nano urea 2 ml L⁻¹ with Red Earth + Coco peat + FYM (1:1:1)) (17.17, 33.4 and 62.13) followed by T₂₄-N₅M₄ (nano urea 2 ml L⁻¹ with Red Earth + Coco peat + FYM (2:1:1)) (13.34, 29.1, 56.067). While minimum number of leaves was observed with treatment combination T₁-N₀M₁ (No spray with Red Earth as media) (6.17, 12.23 and 21.5) at 65, 95 and 125 DAP.

Leaf length

The effect of nano urea levels and media composition on leaf length at 65, 95 and 125 DAP was found to be insignificant was less prominent and no significant difference was noticed between treatments. The mean data pertaining to the leaf length is presented in Table 4a, 4b and depicted in Fig 3.

Leaf width

The effect of nano urea levels and media composition was less prominent and no significant difference was noticed at 65 and 95 days after planting. But there was a significant difference found at 125 days after planting.

Among the different levels of nano urea, maximum leaf width (10.118 cm) was recorded in N₅ (Nano urea 2 ml L⁻¹) and was on par with N₄ (Nano urea 1.5 ml L⁻¹) (9.681 cm) followed by N₃ (Nano urea 1 ml L⁻¹) (9.133 cm) which was in turn on par with N₂ (Nano urea 0.5 ml/L) (8.563 cm) are with nano urea spray while minimum leaf width (6.753 cm) was noticed with N₀ (No spray) at 125 DAP.

Among different composition of potting media, maximum leaf width (10.19 cm) was recorded in M₃ (Red Earth + Coco peat + FYM (1:1:1)) which was followed by M₄ (Red Earth + Coco peat + FYM (2:1:1)) (9.28 cm) and it was on par with M₂ (Red Earth + Coco peat (1:1:1)) while minimum (7.028 cm) was recorded in M₁ (Red Earth) at 125 DAP. Interaction effect for leaf width was found to be insignificant. Results were presented in table 5a, 5b, a and depicted in Fig 3.

Leaf area

With respect to the leaf area, maximum values (105.73, 142.73 and 169.25 cm²) recorded with the nano urea spray N₅ (Nano urea 2 ml L⁻¹) followed by N₄ (Nano urea 1.5 ml L⁻¹) (79, 111.58 138.17 cm²), while minimum leaf area (55.49, 65.95 and 75.581 cm²) was noticed with N₀ (No spray) among the nano urea levels and M₃ (Red Earth + Coco peat + FYM (1:1:1)) recorded maximum leaf area (109.93, 143.71 and 167.08 cm²) followed by M₄ (Red Earth + Coco peat + FYM (2:1:1)) (90.97, 122.37, 147.06 cm²) while M₁ (Red Earth) recorded minimum leaf area (42.96, 59.58 and 77.21 cm²) among the composition of potting media at 65, 95 and 125 days after planting. Results were presented in table 6a, 6b and depicted in Fig 4.

Among the interaction effects the treatment combination T₂₃-N₅M₃ (Nano urea 2 ml L⁻¹ with Red Earth + Coco peat + FYM (1:1:1)) recorded maximum leaf area (147.38, 186.75 and 213.49 cm²) followed by T₂₄-N₅M₄ (Nano urea 2 ml L⁻¹ with Red Earth + Coco peat + FYM (2:1:1)) (147.38, 168.22, 192.70 cm²) while minimum leaf area recorded with T₁-N₀M₁ (No spray with Red Earth as media) (30.13, 33.96 and 39.38 cm²) at 65, 95 and 125 DAP.

Physiological parameters

The mean data pertaining to Leaf Area Index (LAI) and SLA (Specific Leaf Area, cm² g⁻¹) as influenced by nano urea levels and media composition was presented in Table 4.7a, 4.7b and depicted in Fig 5 and 6.

LAI (Leaf Area Index)

Among nano urea levels, Nano urea 2 ml L⁻¹ (N₅) recorded maximum values (1.39, 4.19 and 11.34) followed by N₄ (Nano urea 1.5 ml L⁻¹) (1.17), N₃ (Nano urea 1 ml L⁻¹) (1.07, 3.55 and 9.51) while (N₀) no spray recorded minimum values for LAI (0.92, 2.12 and 6.05) at 65, 95 and 125 DAP.

The potting media composition *i.e.*, Red Earth + Cocopeat + FYM (1:1:1) (M₃) recorded maximum values for LAI (1.3, 3.62 and 10.52) which is followed by M₄ (Red Earth +Coco peat + FYM (2:1:1)) (1.14, 3.24 and 9.51) while Red Earth (M₁) recorded minimum values for LAI (0.86, 2.65 and 6.63) at 65, 95 and 125 DAP. Among the interaction effect, the treatment combination of Nano urea 2 ml L⁻¹ with Red Earth + Cocopeat + FYM (1:1:1) (T₂₃: N₅M₃) recorded maximum values (1.89, 5.14 and 13.49 at 65, 95 and 125 DAP respectively) followed by T₂₄-N₅M₄ (nano urea 2 ml L⁻¹ with Red Earth + Coco peat + FYM (2:1:1)) (1.477, 4.476 and 12.174) while no spray with Red Earth combination (T₁: N₀M₁) recorded minimum values (0.68, 1.88 and 4.67 at 65, 95 and 125 DAP.

SLA (Specific Leaf Area, cm² g⁻¹)

With respect to the SLA conventional urea 2 g L⁻¹ (N₁)

recorded maximum values (239.77, 257.91 and 266.051 cm² g⁻¹), while nano urea 5 ml L⁻¹ (N₅) recorded minimum values (183.37, 196.34 and 197.245 cm² g⁻¹) at 65, 95 125 DAP.

With respect to the composition of potting media for SLA (237.625, 247.475 and 247.854 cm² g⁻¹) while minimum SLA (182.25, 200.235 and 200.235 cm² g⁻¹) was recorded in M₁ (Red Earth) at 65, 95 and 125 DAP.

Among the interaction effects conventional urea 2 g L⁻¹ with Red Earth + Coco peat + FYM (1:1:1)) (T₇-N₁M₃) recorded maximum values (270.868 and 292.379 cm² g⁻¹ at 65 and 95 DAP respectively) while No spray with Red Earth + Coco peat + FYM (1:1:1) (T₃- N₀M₃) recorded maximum SLA (305.88 cm² g⁻¹) at 125 DAP and nano urea 2 ml L⁻¹ with Red Earth (T₂₁- N₅M₁) recorded minimum values (167.036 cm² g⁻¹) at 65 DAP while nano urea 2 ml L⁻¹ with Red Earth + Coco peat + FYM (1:1:1) (T₂₃-N₅M₃) recorded minimum values (177.871 and 171.44 cm² g⁻¹ at 95 and 125 DAP) for SLA.

SLW (Specific leaf weight, g cm⁻²)

The effect of different nano urea levels and media composition on of Specific Leaf Weight (Table 4.10a, 4.10b) was less prominent and no significant difference was noticed at 65, 95 and 125 125 DAP.

Discussion

It clearly indicates that N₅ (Nano urea 2 ml L⁻¹) found be superior for all parameters (leaving SLA) this might be due to the fact that nano-fertilizers have large surface area with particle size less than the pore size of leaves thereby increases penetration into the plant and improves uptake and nutrient use efficiency of the nano- Nitrogen (Sharma *et al.*, 2022) [15]. Nano urea application results in enhancement of enzymatic activity that may leads to formation and transportation of photosynthates (Sai kumar *et al.*, 2022) [14]. Stimulating effect of nitrogen on Auxin production encourages cell division and elongation in the vegetative growth of the plant (El-Shawa *et al.* (2022) [6], Sun *et al.* (2014) [16], Mahmoud *et al.* (2020)) [10]. Similar results were found with nano urea application in lettuce (Abdel, 2018) [2], reported in philodendron by El-Shawa *et al.* (2022) [6]. In case of SLA the decrease in SLA among the nano urea sprays could result from reduction in the translocation rate, since the bulk of the newly formed assimilates was still in the leaves. However, the ratio of dry matter accumulation of leaves per unit leaf area (SLA) was increased (Cornelissen, 2003) [4].

Among the potting media composition M₁ (Red Earth) recorded the least results for all growth parameters it might be due to the red earth alone has high compact nature, the poor aerating and poor water holding capacity. Here, Cocopeat found to be considered as a good growing media with acceptable pH, electrical conductivity and other chemical attributes (Abad *et al.* (2002) [1]. While FYM improves the soil structure, soil organic carbon and microbial biomass. It also provides significant quantities of major and micro nutrients to the plants. In this experiment M₃ (Red Earth + Coco peat + FYM (1:1:1)) found to be superior for all growth parameters. It might be due to the highest percentage of cocopeat and FYM in M₃ compared to the other media compositions. Results are in accordance with Ngetich *et al.* (2012) [13] and Chweya *et al.* (1997) [3] in spider plant.

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	15.91r	16.383g	18.31n	17.877o	17.977o	20.67j	17.854d	19.9r	20.807q	23.017o	23.967n	26.27k	27.02i	23.497d
M ₂	16.11qr	17.41p	18.92m	18.807m	19.45l	20.91ij	18.601c	20.077r	21.937p	23.92n	24.943m	27.073i	28.223h	24.362c
M ₃	19.93k	21.827h	24.287ef	24.993d	25.713c	28.317a	24.178a	24.18n	26.563j	29.29f	30.037e	34.843b	37.387a	30.383a
M ₄	21.03i	20.913ij	23.917g	24.007fg	24.47e	27.017b	23.559b	25.143m	25.533l	28.653g	29.523f	30.86d	33.927c	28.94b
MEAN	18.24e	19.13d	21.358c	21.421c	21.903b	24.228a		22.325f	23.71e	26.22d	27.118c	29.762b	31.639a	
	S.E.M							C.D. 5%						
N	0.0533							0.152						
M	0.0436							0.042						
N*M	0.1067							0.103						

No: 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 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							
	125 days after planting							
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean	
M ₁	23.27p	27.207n	28.09m	28.983l	30.933j	33.383g	28.644d	
M ₂	24.293o	27.997m	28.94l	29.91k	31.94i	35.183e	29.711c	
M ₃	28.057m	32.247h	33.793f	36.307d	40.043c	46.293a	36.123a	
M ₄	27.15n	31.07j	32.15hi	33.63fg	36.503d	41.043b	33.591b	
Mean	25.693f	29.63e	30.743d	32.208c	34.855b	38.976a		
	S.E.M				C.D. 5%			
N	0.0434				0.123			
M	0.0354				0.101			
N*M	0.0867				0.247			

No: 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	6.167o	7.1m	7.533l	7.933jk	8.567h	9.633f	7.822d	12.233p	15.133m	16.067l	17.367k	19.367i	23.1e	17.211d
M ₂	6.567n	7.567l	7.8kl	8.233i	9.1g	10.267e	8.256c	13.3o	16.3l	17.2k	18.433j	20.267h	23.433e	18.156c
M ₃	8.533h	9.467f	10.167e	12.367c	13.367b	17.167a	11.844a	15.333m	19.233i	22.267f	23.4e	27.367c	33.4a	23.5a
M ₄	8.1ij	9.167g	9.6f	10.3e	11.467d	13.433b	10.344b	14.233n	16.133l	20.3h	21.167g	25.433d	29.1b	21.061b
MEAN	7.342f	8.325e	8.775d	9.708c	10.625b	12.625a		13.775f	16.7e	18.958d	20.092c	23.108b	27.258a	
	S.Em							C.D. 5%						
N	0.0465							0.1324						
M	0.038							0.0595						
N*M	0.09							0.1458						

No: 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 2b: Effect of nano urea levels and composition of potting media on number of leaves at 125 days after planting in *Philodendron scandens*

Media composition	Nano urea levels						
	125 Days after planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean
M ₁	21.5n	25.233mn	27.2lm	30.367kl	35.333ij	43.433efg	30.511d
M ₂	24.267mn	27.367lm	30.4kl	33.267jk	38.867hi	47.267cde	33.572c
M ₃	34.367jk	44.333defg	46.233cdef	49.333c	54.3b	62.133a	48.45a
M ₄	31.267jkl	40.3gh	42.333fgh	44.433defg	48.4cd	56.067b	43.8b
MEAN	27.85f	34.308e	36.542d	39.35c	44.225b	52.225a	
	S.Em			C.D. 5%			
N	0.0725			0.2064			
M	0.0592			0.1685			
N*M	0.145			0.4128			

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 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	9.1	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	17.5	16.9	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	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.Em			C.D. 5%				S.Em			C.D. 5%			
N	NS			NS				NS			NS			
M	NS			NS				NS			NS			
N*M	NS			NS				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 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						
	125 Days after planting						
	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	14.51d
M ₂	12.96	16.65	17.2	17.93	18.68	20.98	17.4c
M ₃	18.14	21.18	21.84	22.46	22.78	26.52	22.16a
M ₄	16.22	19.4	20.2	20.56	21.52	24.6	20.42b
MEAN	14.35	17.75	18.41	19	19.72	22.51	18.62
	S.Em			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 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	4.45	4.88	5.29	5.46	5.65	6.24	5.33	4.89	5.9	6.43	6.73	6.98	7.79	6.46
M ₂	5.5	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	8.3	10.06	8.12	7.38	8.93	9.31	9.45	9.94	11.95	9.5
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			

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 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						
	125 Days after planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean
M ₁	5.243h	6.313gh	6.943fgh	7.323efgh	7.633efgh	10.363bcd	7.028b
M ₂	6.353gh	7.443efgh	8.383bcdefg	8.973bcdefg	9.243bcdef	13.203a	8.46ab
M ₃	7.883defgh	9.613bcdef	9.083bcdef	10.343bcd	10.993ab	8.19cdefg	10.187a
M ₄	7.533efgh	9.353bcdef	9.843bcde	9.893bcde	10.853abc	10.363bcd	9.278ab
MEAN	6.753b	8.181ab	8.563ab	9.133ab	9.681a	10.118a	
	S.E.M			C.D. 5%			
N	0.3974			1.1312			
M	0.3244			0.9236			
N*M	0.7947			2.2623			

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	30.13i	39.05hi	39.82h	42.6h	45.6h	60.567fg	42.96d	33.96p	52.34o	56.24no	60.92n	67.75m	86.29jkl	59.58d
M ₂	44.84h	58.25g	61.41fg	65.1fg	68.02f	88.24de	64.31c	50.42o	79.98l	83.83kl	87.82jk	91.68j	129.66ef	87.23c
M ₃	81.29e	103.05c	108.69c	108.85c	110.35c	147.38a	109.93a	98.62i	134.52de	141.44d	149.72c	151.21c	186.75a	143.71a
M ₄	65.67fg	84.9de	88.11de	88.37de	92.01d	126.75b	90.97b	80.81kl	109.01h	116.91g	123.57fg	135.67de	168.22b	122.37b
MEAN	55.49c	71.31b	74.51b	76.23b	79.00b	105.73a		65.95e	93.96d	99.60cd	105.51bc	111.58b	142.73a	
	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			

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 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						
	125 Days after planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean
M ₁	39.383s	67.577q	76.073p	80.08p	87.11o	113.037l	77.21d
M ₂	59.833r	95.05n	104.38m	112.82l	126.127k	157.753gh	109.327c
M ₃	115.16l	160.177fg	166.823de	171.54cd	175.257c	213.493a	167.075a
M ₄	87.947o	136.41j	148.867i	152.28hi	164.18ef	192.703b	147.064b
MEAN	75.581e	114.803d	124.036c	129.18c	138.168b	169.247a	
	S.Em			C.D. 5%			
N	1.0344			2.9446			
M	0.8446			2.4042			
N*M	2.0688			5.8892			

No: 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 6a: Effect of nano urea levels and composition of potting media on Leaf Area Index 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	0.678o	0.78m	0.828l	0.872jk	0.942h	1.059f	0.86d	1.882p	2.328m	2.471l	2.671k	2.979i	3.553e	2.647d
M ₂	0.722n	0.832l	0.857kl	0.905i	1g	1.128e	0.907c	2.046o	2.507l	2.646k	2.835j	3.117h	3.604e	2.792c
M ₃	0.938h	1.041f	1.117e	1.359c	1.469b	1.887a	1.302a	2.358m	2.958i	3.425f	3.599e	4.209c	5.137a	3.615a
M ₄	0.89ij	1.008g	1.055f	1.132e	1.26d	1.477b	1.137b	2.189n	2.481l	3.122h	3.256g	3.912d	4.476b	3.239b
MEAN	0.807f	0.915e	0.965d	1.067c	1.168b	1.388a		2.119f	2.569e	2.916d	3.09c	3.554b	4.193a	
	S.Em			C.D. 5%				S.Em			C.D. 5%			
N	0.0051			0.0146				0.0112			0.0319			
M	0.0042			0.0119				0.0092			0.0261			
N*M	0.0102			0.0291				0.0224			0.0638			

No: 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 6b: Effect of nano urea levels and composition of potting media on Leaf Area Index at 125 days after planting in *Philodendron scandens*

Media composition	Nano urea levels						
	125 Days after planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean
M ₁	4.668u	5.479s	5.906r	6.594q	7.672m	9.431i	6.625d
M ₂	5.269t	5.942r	6.601q	7.223o	8.439l	10.263f	7.29c
M ₃	7.462n	9.627h	10.039g	10.712d	11.791c	13.492a	10.52a
M ₄	6.789p	8.751k	9.192j	9.648h	10.51e	12.174b	9.511b
Mean	6.047f	7.45e	7.935d	8.544c	9.603b	11.34a	
	S.Em			C.D. 5%			
N	0.0157			0.0448			
M	0.0129			0.0366			
N*M	0.0315			0.0896			

No: 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 7a: Effect of nano urea levels and composition of potting media on Specific Leaf Area (cm² g⁻¹) 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	191.81fgh	201.83efg	186.50fgh	177.35gh	168.99h	167.04h	182.25b	182.05kl	215.22fgh	216.25fgh	196.43ijk	199.24hij	192.23jkl	200.235b
M ₂	250.30ab	236.56bc	230.48bc	224.38cde	203.81def	168.67h	219.03a	240.15d	258.13bc	239.58d	231.19def	218.21fg	214.90fgh	233.692a
M ₃	265.05a	270.87a	265.27a	226.87bcd	201.10efg	196.60fg	237.63a	287.17a	292.38a	271.92b	245.46cd	210.09ghi	177.87l	247.475a
M ₄	231.55bc	249.80ab	224.00cde	203.91def	183.98fgh	201.17efg	215.73a	260.84bc	265.90b	238.62de	223.17efg	208.81ghij	200.36hij	232.948a
Mean	234.68a	239.77a	226.56ab	208.13bc	189.47cd	183.37d		242.54b	257.91a	241.60b	224.06c	209.09cd	196.34d	
	S.Em			C.D. 5%				S.Em			C.D. 5%			
N	3.8007			10.8194				1.9469			7.5217			
M	3.1033			8.834				1.5896			6.1415			
N*M	7.6015			21.6388				3.8937			15.0435			

No: 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 7b: Effect of nano urea levels and composition of potting media on Specific Leaf Area (cm² g⁻¹) at 125 days after planting in *Philodendron scandens*

Media composition	Nano urea levels						
	125 Days After Planting						
	N ₀	N ₁	N ₂	N ₃	N ₄	N ₅	Mean
M ₁	181.859l	224.309fghi	232.995efgh	203.803jk	203.655jk	206.408ijk	208.838b
M ₂	242.673ef	261.672cd	244.696de	238.611efg	240.489efg	221.195ghij	241.556a
M ₃	305.88a	297.886a	270.475bc	236.845efgh	204.601jk	171.44l	247.854a
M ₄	250.446de	280.336b	262.77bcd	236.824efgh	218.972hij	189.935kl	239.88a
Mean	245.214bc	266.051a	252.734ab	229.021cd	216.929d	197.245e	
	S.E.M			C.D. 5%			
N	3.0019			8.5453			
M	2.451			6.9772			
N*M	6.0037			17.0905			

No: 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)		

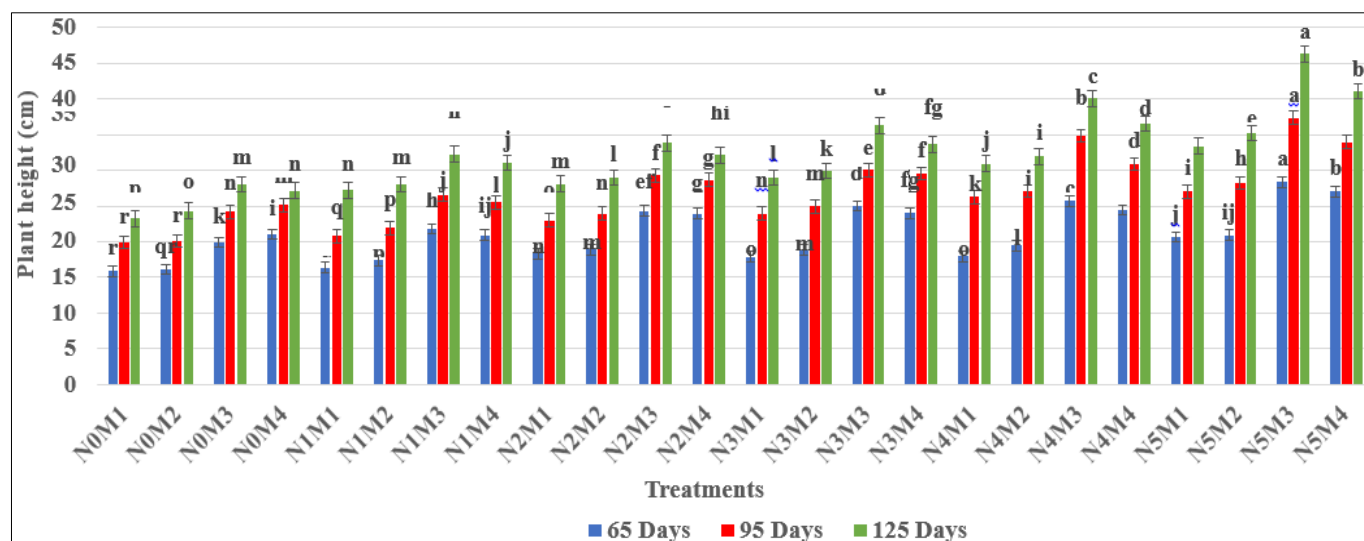


Fig 1: Interaction effect of nano urea levels and composition of potting media on plant height (cm) in *Philodendron scandens*

No: 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)		

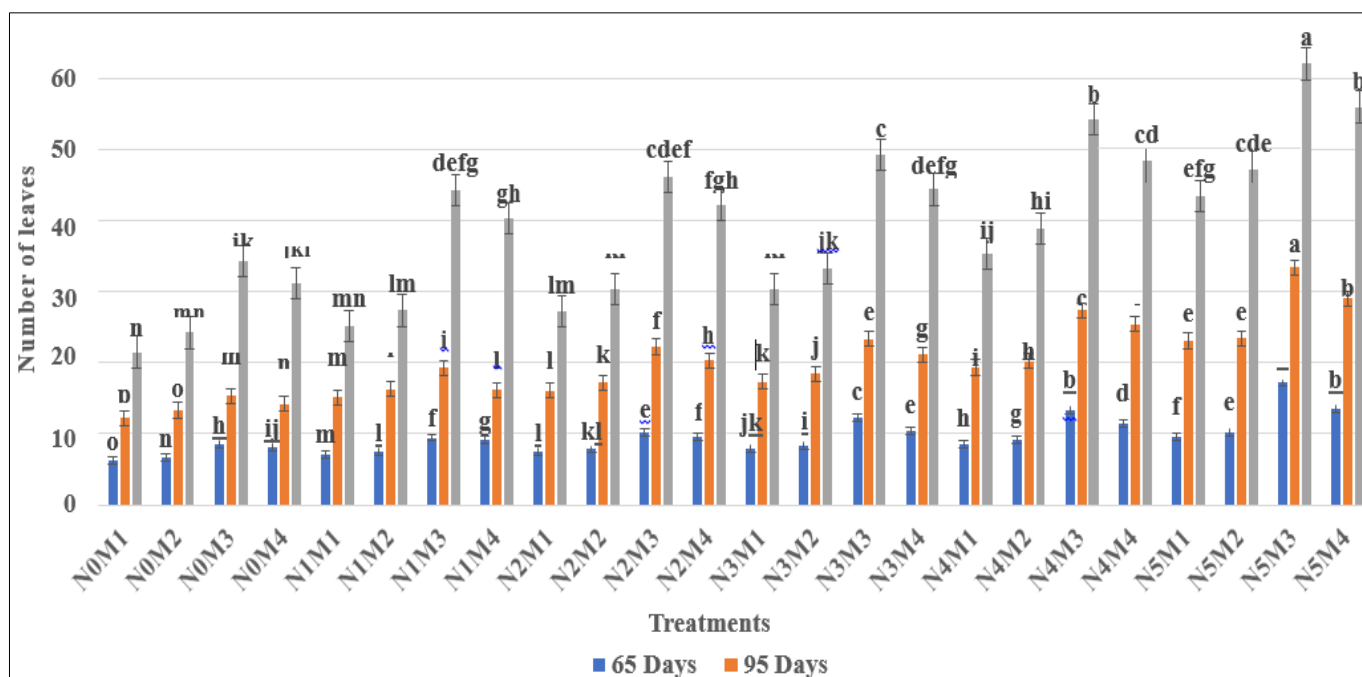


Fig 2: Interaction effect of nano urea levels and composition of potting media on number of leaves in *Philodendron scandens*

No: 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)		

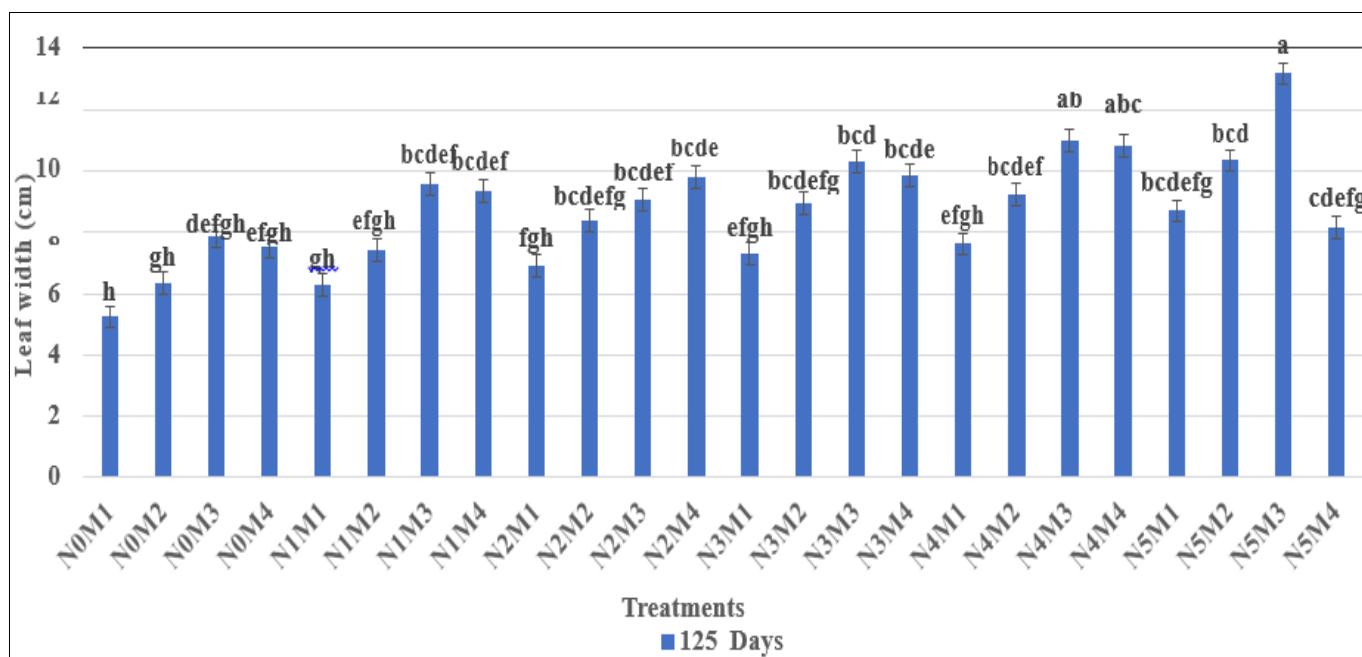


Fig 3: Interaction effect of nano urea levels and composition of potting media on leaf width (cm) in *Philodendron scandens*

No: 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)		

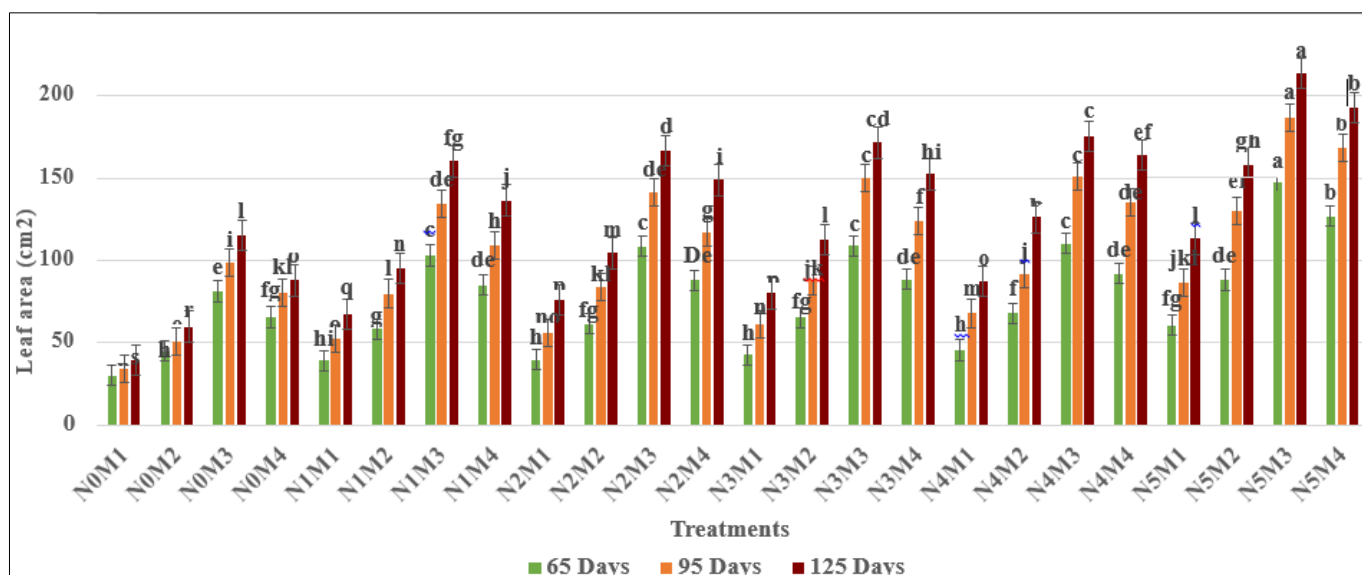


Fig 4: Interaction effect of nano urea levels and media composition of potting media on leaf area (cm²) in *Philodendron scandens*

No: 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)		

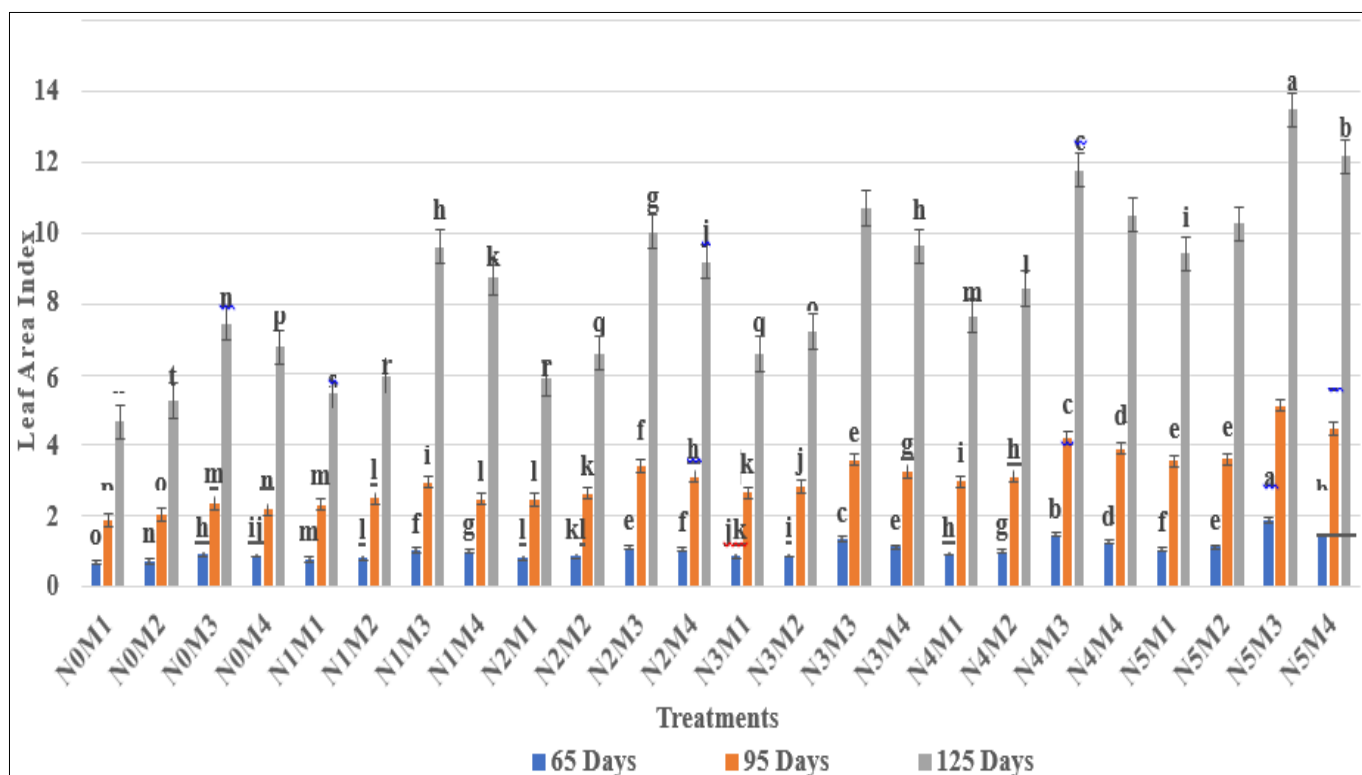


Fig 5: Interaction effect of nano urea levels and composition of potting media on Leaf Area Index in *Philodendron scandens*

No: 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)		

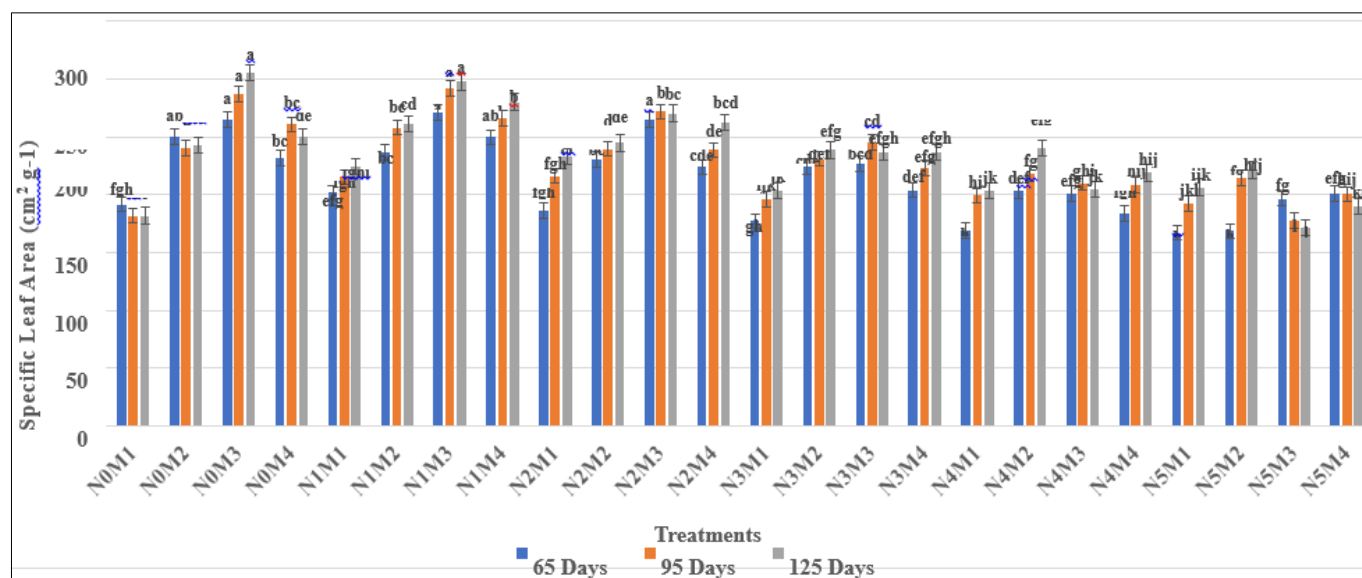


Fig 6: Interaction effect of nano urea levels and composition of potting media on Specific Leaf Area (cm² g⁻¹) *Philodendron scandens*

No: 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)		

Conclusion

From the experimental results, it can be concluded that significant effect on the growth and physiological parameters were registered with the treatment combination of nano urea (2.0 ml L⁻¹) and Red Earth + Cocopeat + FYM in the ratio (1:1:1) followed by nano urea (2.0 ml L⁻¹) and Red Earth + Cocopeat + FYM in the ratio (2:1:1).

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