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Effect of Different Inorganic Fertilizers on Growth and Development of *Philodendron scandens* Grown Under Shade Net Condition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Owing to the importance of foliage plants in indoor gardening, the experiment was carried out to determine the effect of different levels of NPK on growth and development of Sweet--heart plant (*Philodendron scandens*). The study was carried out at the College of Horticulture, Rajendranagar,

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Hyderabad, Sri Konda Laxman Telangana State Horticultural University. This was during *Kharif* season of the year 2019-20 in Completely Randomized Design with seven treatments and replicated thrice. There was an increase in growth parameters like plant height (44.00 cm), stem diameter (37.46 mm), number of leaves per plant (49.50) when *Philodendron* plants treated with N:P:K (1:1:1) – 2 g per poly bag at 30 days interval (T_1). Whereas, application of N:P:K (1:1:1) – 2 g per poly bag at 45 days interval - T_2 significantly resulted maximum plant spread (E-W) (49.67 cm), plant spread (N-S) (52.33 cm). Contrary to this among the treatments, T_7- Control (without fertilizers) plants showed shorter plant height (36.83 cm), lower plant spread (E-W) (36.33 cm), plant spread (N-S) (42.67 cm), stem diameter (30.33 mm), significantly minimum number of leaves per plant (42.00).

Keywords: Philodendron; fertilizers; NPK; foliage plants.

1. INTRODUCTION

Sweet-heart plant *(Philodendrons)* known as foliage kings, which are also recognised to remove harmful chemicals from the air, formaldehyde being its chemical of choice to remove from the air. Further, large, waxy leaves are also mean dust trappers. As *Philodendron* plants are mostly grown as potted plants the growth of plant is restricted in given media. In such conditions, the availability of nutrients in pots and their uptake by plants is a limiting factor for proper growth and development. Nutrition plays an important role for the production of healthy foliage plants. Nutrients and their quantity and method of application should be understood and well known before selecting the source of fertilizer to be used as well as the method of application.

Hence, fertilization is one of the important cultural practices that decide growth and production of aesthetic appeal of foliage plants. Mineral fertilization is considered one of the most important factor affecting the growth and appeal of the ornamental plants. The fertilization with NPK provided by commercial fertilizers improves the vegetative growth of foliage plants. Poole and Conover [1] found that high fertilizer application during production increased leaf drop following dark storage of *Ficus benjamina.* They further noted that application of fertilizer at lower rate produced chlorotic plants in *Dieffenbachia.* Fertilizer requirements for tropical foliage plants vary depending on the species. For example, Poole and Chase [2] recommended 333 and 389 ppm N for *Brassaia* and *Peperomia,* respectively. Conover and Poole [3] recommended 467 ppm N for *Ctenanthe* 'Dragon Tracks'. Therefore, determining appropriate fertilizer source and its method, rate and schedule of application are major factors influencing the growth and quality of *Philodendron.* In view of above facts the present work has been taken up to study the effect of different inorganic fertilizers on growth and development of *Philodendron scandens* grown under shade net condition.

2. MATERIALS AND METHODS

The experiment was conducted to study the effect of different levels of NPK on growth and development of *Philodendron scandens* plants at College of Horticulture, Rajendranagar, Hyderabad, Sri Konda Laxman Telangana State Horticultural University during *Kharif* season of the year 2019-20. Poly bags of 10 × 12 inches size were selected and filled with media. Media was composed of red soil, well decomposed Farm yard manure and sand (2:1:1 v/v). The experiment site was cleaned and made free of weeds, grasses and stones. The site was levelled to place poly bags evenly on the surface, the poly bags were set according to the treatments design. Each treatment was replicated thrice in a Completely Randomized block Design and each replicate consisted of five plants. A gap 45 cm was left in between the plants. Well established uniform sprouted cuttings were selected for the experimentation. The treatments consists of T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 days interval, T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 days interval, T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 days interval, T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 days interval, T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 days interval, T_6- N:P:K (3:1:2) – 1g/poly bag at 60 days interval and T_7- Control (without fertilizers). Nitrogen, phosphorus and potassium were applied in the form of Urea, Single Super Phosphate and Muriate of Potash respectively. Nitrogen and potassium were applied after establishment of plants according to the treatment schedule and total dose of phosphorus was given as basal application. The data collected were subjected to statistical analysis as per Panse and Sukhatme [4].

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

The data recorded on the plant height of *Philodendron* plants as resulted by different inorganic fertilizer dose and their time of application is presented in the Table 1 and illustrated in Fig. 1.

The results indicated that there (Table 1 and Fig. 1) was a significant effect on the plant height among the inorganic fertilizer treatments. The maximum plant height (44.00 cm) was observed when plants were treated with N:P:K (1:1:1) – 2 g per poly bag at 30 days interval (T_1) which was at par with T_2- N:P:K (1:1:1) – 2 g per poly bag at 45 days interval (43.17 cm) and minimum height was recorded in T_7 -control (36.83 cm) (Plate 1).

Hence, it was observed that, application of inorganic fertilizers at equal proportion with shorter interval has shown increase in plant height when compared to that of the plants which were treated with inorganic fertilizers with longer interval at different levels of nutrients.

3.2 Plant Spread (E × W) & (N × S) (cm)

The data pertaining to plant spread (in both directions *i.e.* E-W and N-S) recorded in *Philodendron* as resulted by various levels and application schedule of fertilizers is presented in the Table 2 (Plate 1). The application of different levels of fertilizers and their schedule of application influenced significantly on plant spread (E-W). Maximum plant spread (E-W) was recorded in plants treated with N:P:K (1:1:1) – 2 g per poly bag at 45 DI - T_2 (49.67 cm) which was statistically at par T_1 and T_4 (46.67 & 44.50 cm, respectively) and lowest was recorded in control (T_7) (36.33 cm).

Further, maximum plant spread (N-S) was recorded in plants treated with T_2 - N:P:K (1:1:1) – 2 g per poly bag at 45 DI (52.33 cm) which was followed by N:P:K (1:1:1) – 2 g per poly bag at 30 DI – T_1 (45.83 cm), rest of all treatments were at par with each other and lowest was recorded in control (T_7) (42.67 cm). Hence, it was observed that application of inorganic fertilizers at longer intervals was inferior to shorter intervals.

Table 1. Effect of different inorganic nutrients on plant height (cm) of *Philodendron scandens*

Treatments	Plant height (cm)
T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI	44.00
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	43.17
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	38.00
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	39.50
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	38.00
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	37.83
T_7- Control (without fertilizers)	36.83
S.Em ±	1.06
CD (P= 0.05)	3.23

Table 2. Effect of different inorganic nutrients on plant spread (cm) of *Philodendron scandens*

Treatments	Plant spread (cm)	
	(E-W)	(N– S)
T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI	46.67	45.83
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	49.67	52.33
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	41.00	45.00
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	44.50	45.17
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	43.00	45.50
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	39.67	44.67
T_7- Control (without fertilizers)	36.33	42.67
S.Em ±	1.92	1.48
CD (P= 0.05)	5.83	4.50

E-W: East – West, N- S: North – South

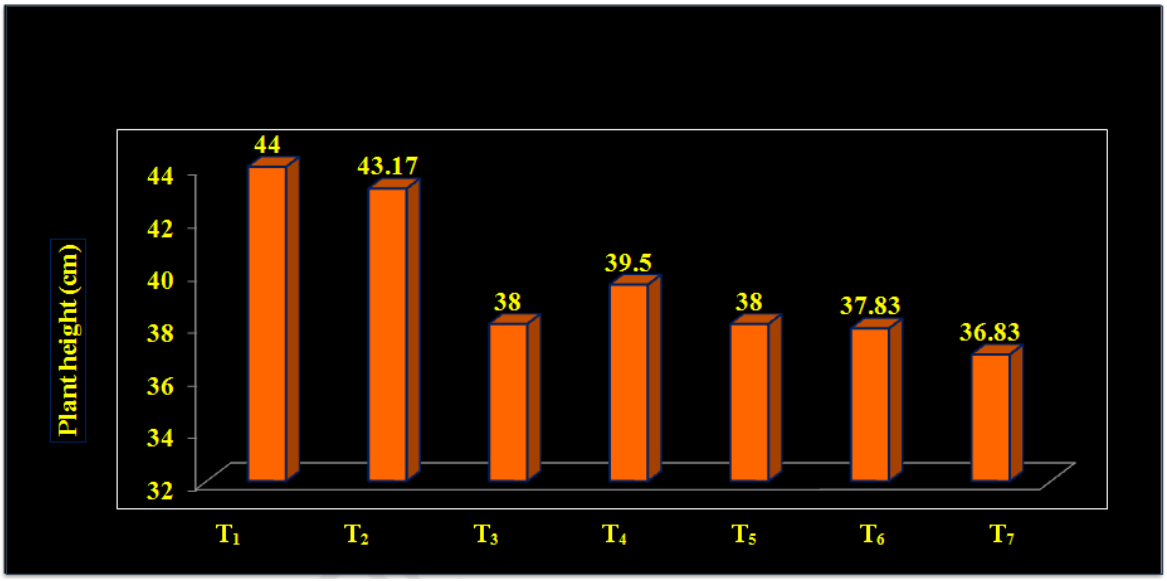

Fig. 1. Effect of different inorganic nutrients on plant height (cm) of *Philodendron scandens*

Treatments:
T_1- N:P:K (1:1:1) – 2g /poly bag at 30 days interval; T_2- N:P:K (1:1:1) – 2g/poly bag at 45 days interval
T_3- N:P:K (1:1:1)–2g/poly bag at 60 days interval; T_4- N:P:K (3:1:2) – 1g/poly bag at 30 days interval
T_5- N:P:K (3:1:2) – 1g/poly bag at 45 days interval; T_6- N:P:K (3:1:2) – 1g/poly bag at 60 days interval
T_7- Control (without fertilizers)

Plate 1. Effect of different inorganic nutrients on plant height and plant spread of *Philodendron scandens*

Treatments:
T_2- N:P:K (1:1:1) – 2g/polybag at 45 days interval; T_5- N:P:K (3:1:2) – 1g/polybag at 45 days interval
T_6- N:P:K (3:1:2) – 1g/polybag at 60 days interval

From the results, it was observed that longer application interval *i.e.* 60 days resulted reduced plant growth and development. NPK nutrients at 2 grams per poly bag dosage at 30 and 45 days interval resulted better plant height and spread of *Philodendron* plants compared to other treatments. Significantly maximum plant height and plant spread in both the directions might be due to application of required level of macronutrients at suitable frequency of 30 and 45 days interval leads to higher uptake of N, P and K nutrients.

Nitrogen at the rate of 2 grams per poly bag at shorter interval might be optimum dosage for *Philodendron* plant growth and development compared to other treatments. Nitrogen is a very important constituent of protoplasm and its favourable effect on chlorophyll content of leaves might have increased the synthesis of carbohydrates, amino acids *etc*., from which the phytohormones such as auxins, gibberellins, cytokinins and ethylene are synthesized resulting in increased plant height and spread [5], rapid elongation of cells because of adequate uptake of nitrogen seems to be the favourable influence on plant growth. In the present experiment, increased plant growth with same level of nutrients at 45 and 30 days interval might be due to production of higher level of auxins and cytokinins [6].

N:P:K (3:1:2) – 1 g/poly bag at 30, 45 and 60 days interval recorded lesser plant height and plant spread compared to other treatments. It might be due to higher doses of N and leaching losses of nutrients between longer application duration have suppressed the growth of this plant to some extent. These findings are in confirmity with the earlier reports of Atta-Alla [7] in *Dracaena marginata, Ficus benjamina, Schefflera arboricola* and *Syngonium podophyllum*, Abou Dahab et al. [8] in *Chamaedorea elegans and* Azza et al. [9] in *Ixora*.

3.3 Number of Leaves per Plant

The data clearly (Table 3 & Fig. 2) indicates that different fertilizer treatments and their schedule of application had significantly influenced the number of leaves per plant.

The number of leaves per plant was found to be significant due to the effect of different fertilizer treatments. Plants treated with N:P:K (1:1:1) – 2 g per poly bag at 30 DI (T_1) enhanced the number of leaves per plant (49.50), which was found at par with T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI (47.83). Significantly lowest number of leaves per plant was noted at T_7 -control (42.00).

3.4 Stem Diameter (mm)

The stem diameter was found to be significant due to the application of different fertilizer treatments with varied application rates (Table 3). Plants treated with T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI had maximum stem diameter (37.46 mm) followed by T_2 - N:P:K (1:1:1) – 2 g per poly bag at 45 DI (36.17 mm) and minimum stem diameter was recorded in T_7 - control (30.33 mm).

Maximum stem diameter was observed in T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 days interval compared to other treatments. It might be due to application of nutrients at lower dose and frequent intervals made nutrients available to the plants with less leaching losses. Phosphorus also encourages in the expansion of cell walls width and length eventually resulting in increased stem diameter of *Philodendron*. Phosphorus also gets plants off to a good start and forms a good root filter system in the soil to efficiently pick up the other available nutrients and water. It improves the strength and stamina of the plant resulting in maximum plant spread, stem diameter, number of leaves and leaf size of *Philodendron*. Higher uptake of potassium resulted in maximum stem diameter as it strengthens cell walls. Similar result was recorded by Mousa et al. [10] in *Scindapsus aureus* and Abou Dahab et al*.* [8] in *Chamaedorea elegans.*

3.5 Growth Rate (cm/day)

The data (Table 4 & Fig. 3) clearly indicates that different fertilizer treatments and their schedule of application had significantly influenced the growth rate. The growth rate regarding plant height was found to be significant due to the effect of different fertilizer treatments. Plants treated with N:P:K (1:1:1) – 2 g/poly bag at 30 days interval (T_1) enhanced the growth rate at 45 days interval 0.84 cm/day, in 90 and 135 days (1.80 and 2.06 cm/day, respectively) interval with treatment of T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI which was at par with treatment of T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI in 90 and 135 days interval (1.75 and 2.03 cm/day), whereas lowest growth rate was noted at 45 days interval with T_4 - N:P:K (3:1:2) – 1 g per poly

bag at 30 DI (0.65), at 90 and 135 days interval lowest was recorded in T_7- control (1.62 and 1.81 cm/day, respectively). Application of inorganic fertilizers at same level at 30 and 45 days intervals has shown the significant growth rate when compared to control treatment.

Table 3. Effect of different inorganic nutrients on number of leaves /plant and stem diameter of *Philodendron scandens*

Treatments	Number of leaves /plant	Stem diameter (mm)
T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI	49.50	37.46
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	47.83	36.17
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	43.00	32.52
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	47.04	35.63
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	45.67	33.01
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	42.72	31.32
T_7- Control (without fertilizers)	42.00	30.33
S.Em ±	0.66	0.41
CD (P= 0.05)	1.99	1.24

Table 4. Effect of different inorganic nutrients on growth rate (cm/day) of *Philodendron scandens*

Treatments	Growth rate (cm/day)		
	45 DI	90DI	135 DI
T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI	0.84	1.75	2.03
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	0.81	1.80	2.06
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	0.70	1.66	1.86
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	0.65	1.72	1.96
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	0.69	1.70	1.93
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	0.74	1.65	1.83
T_7- Control (without Tertilizers)	0.71	1.62	1.81
S.Em ±	0.01	0.02	0.02
CD (P= 0.05)	0.04	0.06	0.05

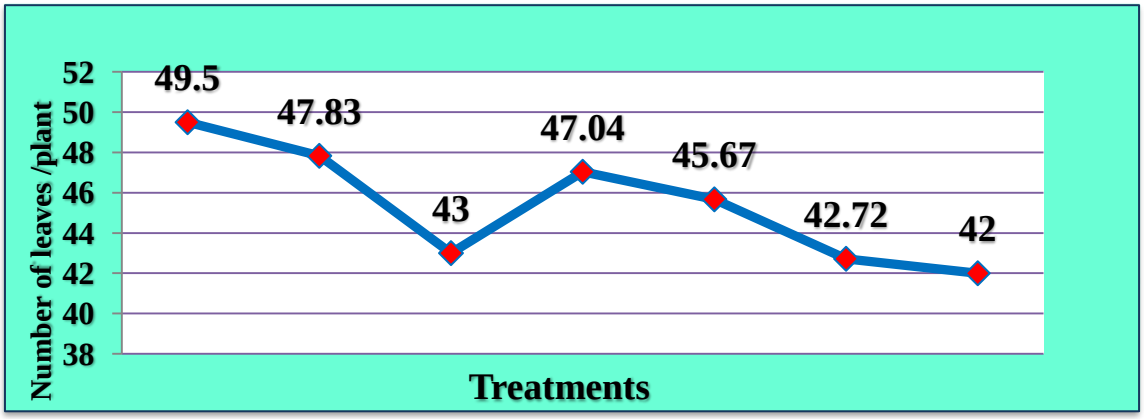

Fig. 2. Effect of different inorganic nutrients on number of leaves /plant of *Philodendron scandens*

Treatments:

T_1- N:P:K (1:1:1) – 2g/poly bag at 30 days interval; T_2- N:P:K (1:1:1) – 2g/poly bag at 45 days interval
T_3- N:P:K (1:1:1)–2g/poly bag at 60 days interval; T_4- N:P:K (3:1:2) – 1g/poly bag at 30 days interval
T_5- N:P:K (3:1:2) – 1g/poly bag at 45 days interval; T_6- N:P:K (3:1:2) – 1g/poly bag at 60 days interval
T_7- Control (without fertilizers)

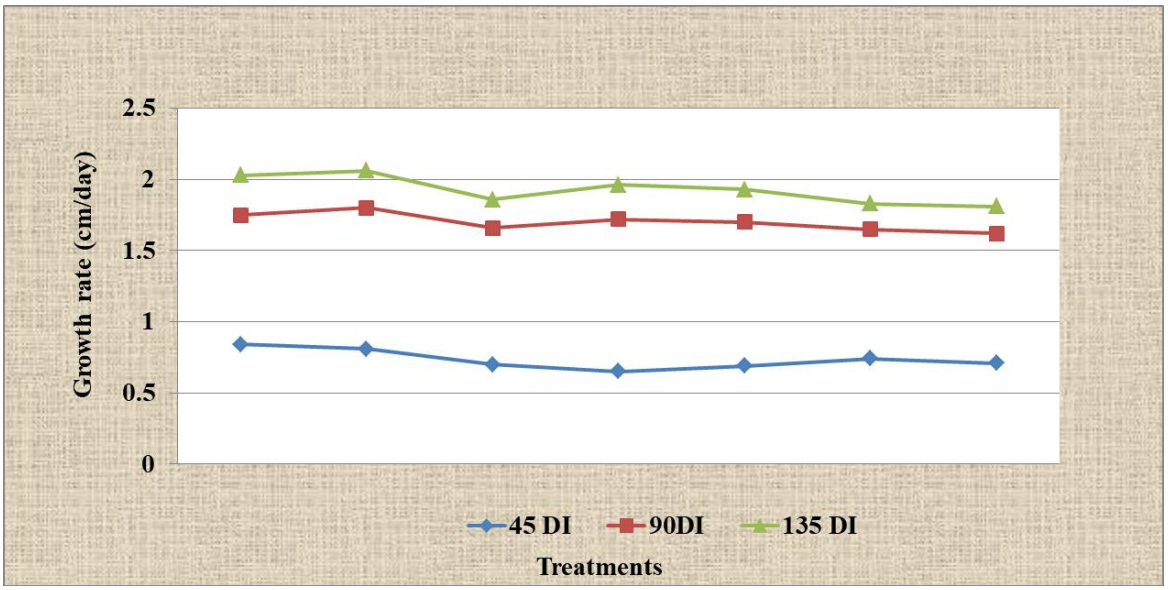

Fig. 3. Effect of different inorganic nutrients on growth rate (cm/day) of *Philodendron scandens*

Treatments:
T_1- N:P:K (1:1:1) – 2g/poly bag at 30 days interval; T_2- N:P:K (1:1:1) – 2g/poly bag at 45 days interval
T_3- N:P:K (1:1:1)–2g/poly bag at 60 days interval; T_4- N:P:K (3:1:2) – 1g/poly bag at 30 days interval
T_5- N:P:K (3:1:2) – 1g/poly bag at 45 days interval; T_6- N:P:K (3:1:2) – 1g/poly bag at 60 days interval
T_7- Control (without fertilizers)

Application of equal proportion of inorganic fertilizers at 30 and 45 days interval has resulted in increased growth rate than N:P:K (3:1:2) – 1 g per poly bag longer application interval treatments. Higher doses and longer interval application have suppressed the growth of this plant to some extent might be due to leaching losses of nutrients between longer duration of application. Lower growth rate was recorded in control. It might be due to lack of macro nutrients, which are helpful for plant vegetative growth and development.

Significantly maximum growth rate might be due to application of required level of nitrogen at suitable frequency of 30 and 45 days interval leads to higher uptake of N, P and K nutrients. Macro nutrients were found to be the most crucial for increase in plant height because nitrogen is a constituent of protein and nucleic acid, which is helpful in plant growth [11] and also promotes rapid growth. Taya et al. [12] also reported that increase in growth rate has directly related to the level of nitrogen applied.

This investigation was in confirmity with the earlier findings of Richard et al. [13] in *Srassaia actinophylla, Calathea makoyana* and *Chrysalidocarpus lutescens* and Badwy et al. [14] in *Chamaedorea elegans* and *C. constricta*.

4. CONCLUSION

On the basis of results obtained in the present investigation, among different inorganic fertilizer treatments, application of N:P:K (1:1:1) – 2 g/poly bag at 45 DI (T_2) followed by T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI significantly improved the plant growth and development of *Philodendron* plants under shade net condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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