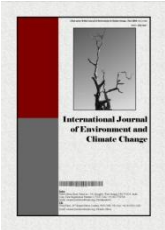

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Effect of Different Inorganic Fertilizers on Growth and Development of *Dieffenbachia seguine* (Jacq.) Schott

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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

A shade house (75%) experiment was carried out to determine the effect of different levels of NPK on growth and development of *Dieffenbachia seguine* (Jacq.) Schott plants at College of Horticulture, Rajendranagar, Hyderabad, Sri Konda Laxman Telangana State Horticultural University during *Kharif* season of the year 2019-20 in Completely randomized design with seven treatments and replicated thrice. The results revealed that different levels of NPK significantly influenced the *Dieffenbachia* plants growth and development. Among different inorganic fertilizer treatments, application of N:P:K (1:1:1) – 2 g per poly bag at 30 days interval (T_1) significantly

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recorded maximum plant height (76.00 cm), growth rate in respect of plant height at 45, 90 and 135 days interval (2.01, 2.50 and 3.07 cm/day respectively), plant spread (E-W) (59.00 cm), stem diameter (37.63 mm) and number of leaves per plant (7.33).

Keywords: Dieffenbachia; fertilizers; NPK; foliage plants; ornamentals.

1. INTRODUCTION

Dieffenbachia seguine is an attractive, perfect, herbaceous perennial house plant that is admired for its rich, tropical leaves. As *Dieffenbachia* 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 quantity and their method of application should be well understood and known before selecting the source of fertilizer to be used as well as the method of application to the pot plants.

Hence, fertilization is one of the important cultural practices that decide growth and production of aesthetic appeal of foliage plants. Mineral fertilization is considered as 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 *Dieffenbachia*. 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 *Dieffenbachia seguine* (Jacq.) Schott grown under shade net condition.

2. MATERIALS AND METHODS

The experiment was conducted 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 poly bags. 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 on plant height, plant spread, number of leaves, stem diameter and growth rate collected were subjected to statistical analysis as per Panse and Sukhatme [4].

3. RESULTS AND DISCUSSION

Plant growth is a dynamic process and is affected by the complex interaction between environmental factors and physiological processes. Besides these factors, nutrition plays a very important role.

3.1 Plant Height (cm)

Plant height is an important parameter and stands in the central position of a species to determine the carbon gain strategy and photosynthetic efficiency, because height is the major determinant of a plant's ability to compete

for light and further due existence of correlation between the plant height and traits such as leaf mass fraction, leaf area ratio, leaf nitrogen per area, leaf mass per area and canopy area [5].

The results indicated that there was a significant effect on the plant height (Table 1 and Fig. 1) with the application of different inorganic fertilizer treatments with varied doses and treatment intervals. The maximum plant height (76.00 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 followed by T_4 - N:P:K (3:1:2) – 1 g per poly bag at 30 days interval (69.67 cm) and minimum plant height (64.67 cm) was recorded in T_7- Control (without fertilizers). Hence, it was observed that application of inorganic fertilizers with shorter application interval has shown increase in plant height when compared to that of the plants which were treated with inorganic fertilizers with long time interval.

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

Plant spread is an important criteria for the ornamental foliage plants which adds to their beauty and enhances the view appeal. Mostly, widely and uniformly spread foliage plants are attractive and appealing. The application of different levels of fertilizers and their schedule of application resulted significantly on plant spread (E-W) (Table 2). Maximum plant spread (E-W) was recorded in plants treated with T_1 - N:P:K (1:1:1) – 2 g per poly bag at 30 days interval (59.00 cm) which was statistically at par (58.67 cm) with N:P:K (3:1:2) – 1 g per poly bag at 30 days interval (T_4) and lowest was recorded in T_7- Control (without fertilizers) (52.67 cm). Further, maximum plant spread (N-S) was recorded in plants treated with T_4 - N:P:K (3:1:2) – 1 g per poly bag at 30 days interval (64.23 cm) which was statistically at par (63.67 cm) with N:P:K (1:1:1) – 2 g per poly bag at 30 days interval (T_1) and lowest was recorded in T_7- control (54.67 cm). Irrespective of NPK proportion shorter fertilizer interval *i.e.* at 30 days interval resulted appreciable spread in both directions of plant when compared to other treatments. Whereas, decrease in plant spread was observed with increased fertilizer application interval.

Higher doses and leaching losses of nutrients between longer duration of application might have suppressed the growth of the plants to some extent. 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 days interval leads to higher uptake of N, P and K nutrients. Although, all the fertilizers applied have their importance for the overall growth of the plant, the macro nutrients were found to be the most crucial for increase in plant height and plant spread. Because nitrogen is a constituent of protein and nucleic acid, which is helpful in plant growth [6] and also promotes rapid growth.

Minimum plant height and plant spread in both the directions in T_7- Control (without fertilizers) might be due to unavailability of sufficient nutrients required for plant growth and development.

Poole and Conover [7] noticed that plant height of *Dieffenbachia maculata* 'Camille' was increased when fertilizer rate at 0.42 g/l of NPK (24:8:16). These findings are in agreement with Richard et al. [8] in *Srassaia actinophylla, Calathea makoyana* and *Chrysalidocarpus lutescens* and Abou Dahab et al. [9] in Chamaedorea elegans.

Table 1. Effect of different inorganic nutrients on plant height (cm) of *Dieffenbachia seguine* (Jacq.) Schott

Treatments	Plant height (cm)
T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI	76.00
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	67.00
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	67.33
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	69.67
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	68.00
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	65.33
T_7- Control (without fertilizers)	64.67
S.Em ±	0.85
CD (P= 0.05)	2.59

Table 2. Effect of different inorganic nutrients on plant spread (cm) of *Dieffenbachia seguine* (Jacq.) Schott

Treatments	Plant spread (cm)	
	(E-W)	(N– S)
T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI	59.00	63.67
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	54.67	61.00
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	53.33	57.33
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	58.67	64.23
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	55.67	58.00
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	53.00	57.33
T_7- Control (without fertilizers)	52.67	54.67
S.Em ±	0.78	0.97
CD (P= 0.05)	2.36	2.95

E-W: East – West, N- S: North – South

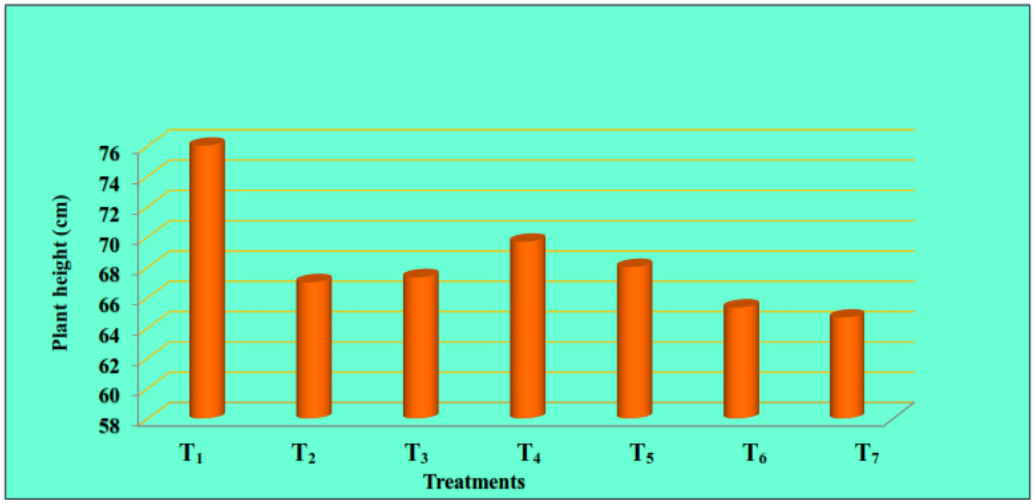

Fig. 1. Effect of different inorganic nutrients on plant height (cm) of Dieffenbachia seguine

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)

3.3 Number of Leaves per Plant

Number of leaves per plant is the criteria which determines the plant growth rate and indicates the health condition of the plant. The data (Table 3 & Fig. 2) clearly indicates that different fertilizer treatments and their schedule of application was significantly influenced the number of leaves per plant.

The number of leaves was found significantly higher in plants treated with T_1 -N:P:K (1:1:1) – 2 g per poly bag at 30 days interval enhanced number of leaves per plant (7.33), which was found at par with T_5 - N:P:K (3:1:2) – 1 g/poly bag at 45 DI and T_4 - N:P:K (3:1:2) – 1 g/poly bag at 30 DI (6.97 & 6.93 respectively). Significantly lower number of leaves per plant was noted at T_7- Control (without fertilizers) (6.00).

Nitrogen functions in plants by being a part of chlorophyll which is responsible for photosynthesis, helps plants with rapid growth and improves the leaf number and leaf size. Reduced leaf number and leaf size in other treatments might be due to application of nutrients more than plant requirement and longer time application interval. Minimum number of leaves and leaf size in F_7- Control (without fertilizers) might be due to non - availability of nutrients for plant growth and development.

Similar observations were earlier reported by Atif Riaz et al. (2008) in Zinnia, Wijayabandara et al. (2015) in Ophiopogon japonicas, Abou Dahab et al. (2017) in *Chamaedorea elegans* and Elboraie and Kasem (2019) in *Epipremnum aureum.*

Table 3. Effect of different inorganic nutrients on number of leaves /plant and leaf length (cm) of *Dieffenbachia seguine* (Jacq.) Schott

Treatments	Number of leaves /plant	Stem diameter (mm)
T_1- N:P:K (1:1:1) – 2 g/poly bag at 30 DI	7.33	37.63
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	6.33	35.30
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	6.33	32.52
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	6.93	37.50
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	6.97	37.40
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	6.33	31.32
T_7- Control (without fertilizers)	6.00	30.00
S.Em ±	0.20	0.46
CD (P= 0.05)	0.61	1.38

Table 4. Effect of different inorganic nutrients on growth rate (cm/day) of *Dieffenbachia seguine* (Jacq.) Schott

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	2.01	2.50	3.07
T_2- N:P:K (1:1:1) – 2 g/poly bag at 45 DI	1.94	2.25	2.66
T_3- N:P:K (1:1:1) – 2 g/poly bag at 60 DI	1.95	2.30	2.70
T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 DI	1.98	2.38	2.84
T_5- N:P:K (3:1:2) – 1 g/poly bag at 45 DI	1.96	2.33	2.76
T_6- N:P:K (3:1:2) – 1 g/poly bag at 60 DI	1.93	2.29	2.65
T_7- Control (without fertilizers)	1.91	2.23	2.58
S.Em ±	0.01	0.03	0.02
CD (P= 0.05)	0.03	0.08	0.06

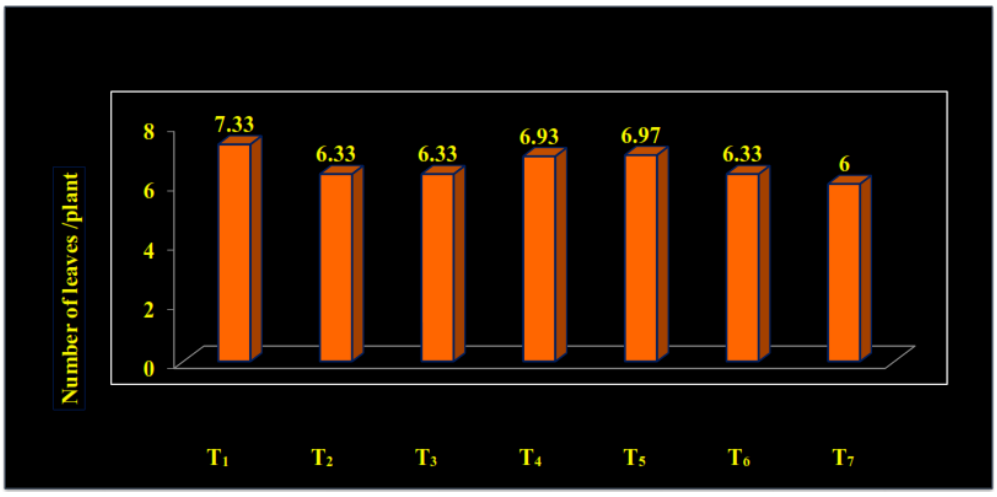

Fig. 2. Effect of different inorganic nutrients on number of leaves /plant of *Dieffenbachia seguine* (Jacq.) Schott

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)

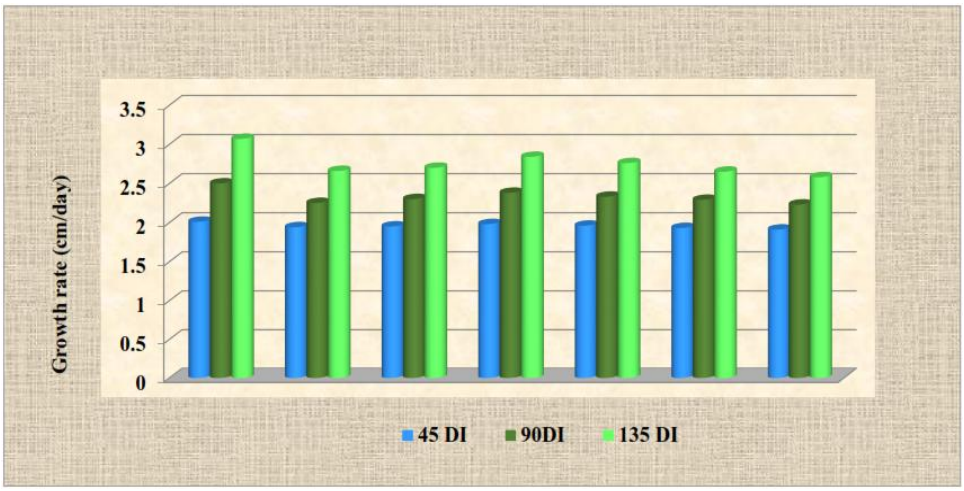

Fig. 3. Effect of different inorganic nutrients on growth rate (%) of *Dieffenbachia seguine*

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)

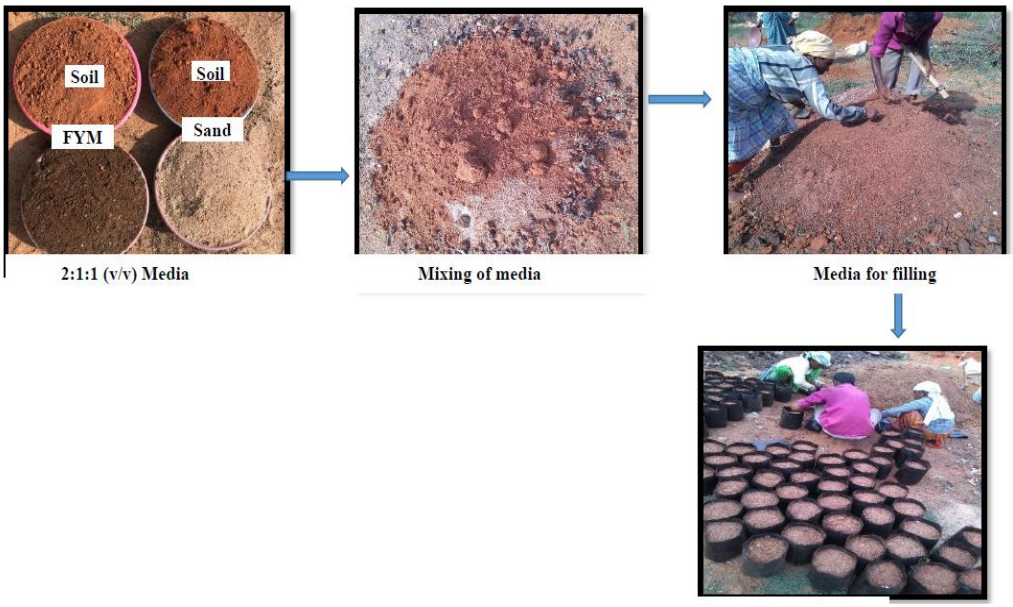

Plate 1. Preparation and filling of media in poly bags

3.4 Stem Diameter (mm)

Plants treated with T_1 - N:P:K (1:1:1) – 2 g/poly bag at 30 days interval had maximum stem diameter (37.63 mm), which was statistically at par with T_4 and T_5 (37.50 & 37.40 mm). Minimum stem diameter was recorded in T_7 - Control (30.00 mm) (Table 3). Application of inorganic nutrients at equal doses at shorter intervals has increased the stem diameter significantly than long intervals. Lower stem diameter was recorded in control compared to other treatments might be due to lack of sufficient nutrients for plant growth, which inturn might have resulted in lower cell division and carbohydrate synthesis.

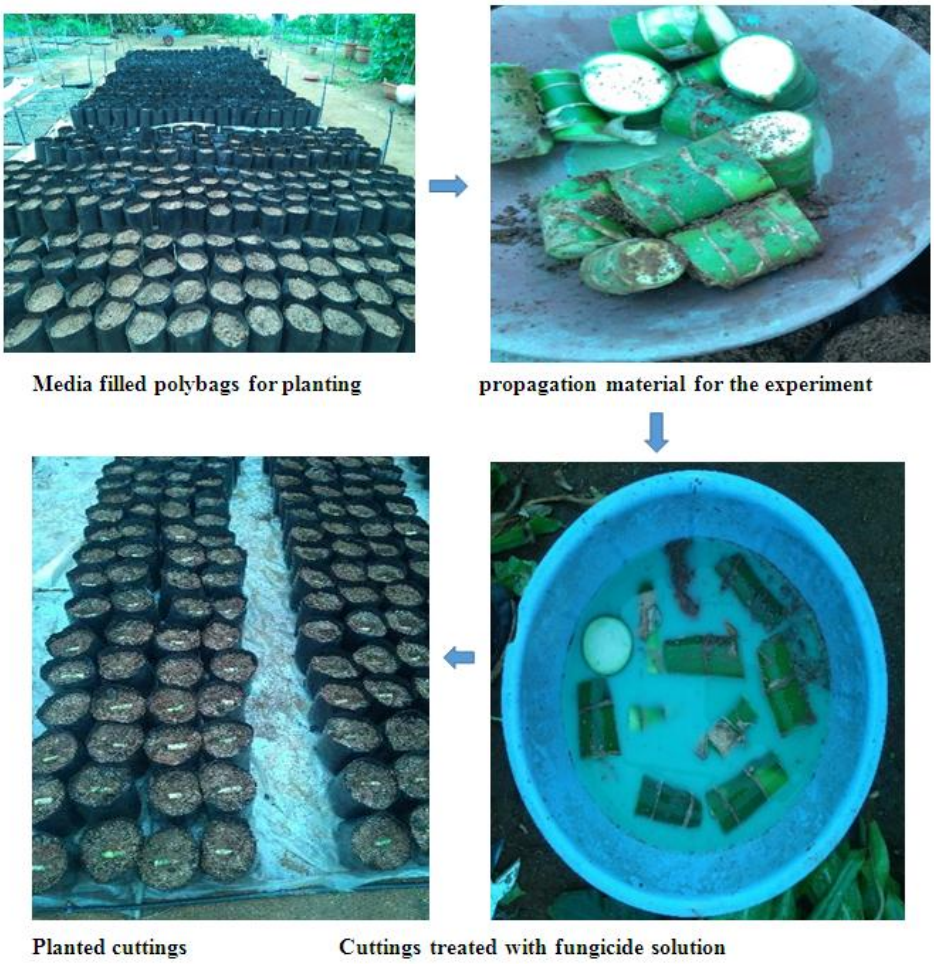

Plate 2. Propagation procedure of *Dieffenbachia seguine*

Plate 3. General view of experimental field

Appreciable 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 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 *Dieffenbachia*. Phosphorus also gets plants off to a good start and forms 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 *Dieffenbachia* (Abou Dahab et al. 2017). Potassium enhances the synthesis and translocation of carbohydrates. Potassium has also been reported to be involved in the synthesis of peptide bond, and protein and carbohydrate metabolism, and also participates in rapid cell division and differentiation [10]. Higher uptake of potassium resulted in maximum stem diameter as it strengthens cell walls. Similar result was recorded by Mousa et al. [11] in Scindapsus *aureus* and Abou Dahab et al. (2017) in Chamaedorea *elegans.*

3.5 Growth Rate (cm/day)

Growth rate indicates the relative increase in the plant height over a period of time by adapting to the environmental conditions. The data (Table 4 and Fig. 3) clearly indicates that different fertilizer treatments and their schedule of application had significantly influenced the growth rate of *Dieffenbachia* in terms of plant height at 45, 90 and 135 days after initiation of the experiment. Plants treated with N:P:K (1:1:1) – 2 g per poly bag at 30 days interval (T_1) enhanced the growth rate at 45, 90 and 135 days interval (2.01, 2.50 and 3.07 cm/day respectively) which was statistically at par at 45 days interval (1.98 cm/day) and followed by the treatment T_4- N:P:K (3:1:2) – 1 g/poly bag at 30 days interval and at 90 and 135 days interval (2.38 and 2.84 cm/day), whereas lowest growth rate was noted at 45, 90 and 135 days interval with T_7- Control (without fertilizers) (1.91, 2.23 and 2.58 cm/day, respectively). Application of inorganic fertilizers at 30 days interval has resulted in increased growth rate than 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 macronutrients at suitable frequency of 30 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 [6] and also promotes rapid growth. This concurs with the results of a study conducted by Poole and Conover [7] in *Dieffenbachia maculata* 'Camille' and Badwy et al. [12] 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) – 2g per poly bag at 30 days interval (T_1) is the best treatment followed by T_4- N:P:K (3:1:2) – 1g/poly bag at 30 days interval for getting better plant growth and development of *Dieffenbachia* plants.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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