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# Nutrient availability for container grown elephant foot yam as influenced by growth medium, nutrient schedule and irrigation schedule

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**Abstract**
An experiment was undertaken at College of Agriculture, Vellayani, Thiruvananthapuram, to formulate an effective growth medium with greater nutrient availability for container cultivation of elephant foot yam and to standardize the nutrient and irrigation practices that will contribute to higher nutrient availability and thus maximum yield. The experiment was done by raising elephant foot yam var. Gajendra in plastic sacks of uniform size with 12 treatment combinations involving three growth media ($M_1$ - soil : sand : FYM 1:1:1, $M_2$ - soil : coir pith : FYM 1:1:1 and $M_3$ - soil : coir pith : FYM 0.75:1.25:1), two nutrient schedule ($N_1$ – N and K in three splits and $N_2$ – N and K in six splits) and two irrigation schedule ($I_1$ - irrigation once in three days and $I_2$ - irrigation once in six days) with four replications in completely randomized design. After the experiment, the growth media $M_3$ registered higher EC and dehydrogenase activity followed by $M_2$. Even though not significant growth media $M_2$ recorded higher NPK status. Application of N and K in six splits recorded higher pH, EC and available K status in the growth medium than three splits. Irrigation once in three days registered higher dehydrogenase activity in the growth medium. Thus the study revealed that the growth media $M_2$ and $M_3$, owing to their higher nutrient availability and minimum weight, and the management practices such as application of N & K in six splits (through organic sources such as groundnut cake and wood ash) and irrigation once in three days can be recommended for container cultivation of elephant foot yam.

**Keywords:** container grown, elephant foot yam, growth medium, nutrient availability, nutrient and irrigation schedule

## Introduction
In the present situation as the cultivable land is decreasing in Kerala especially in urban areas, many peoples are taking up terrace farming to produce organic vegetables for household consumption. As container cultivation is the only option for growing plants on house terraces an ideal growth medium is also necessary which should have minimum weight and should supply all the nutrients needed for active plant growth. Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson), an important tropical tuberous vegetable rich in nutritive values and having good keeping quality, can also be raised in containers. As nutrient availability is the major factor that determines the yield in container cultivation, the study is undertaken in order to formulate an effective growth medium with greater nutrient availability for container cultivation of elephant foot yam and to standardize the nutrient and irrigation practices that will contribute to higher nutrient availability and thus maximum yield.

## Materials and Methods
The experiment was conducted during April to November 2016 by raising elephant foot yam var. Gajendra in plastic sacs with 12 treatment combinations involving three growth media ($M_1$ - soil : sand : FYM 1:1:1, $M_2$ - soil : coir pith : FYM 1:1:1 and $M_3$ - soil : coir pith : FYM 0.75:1.25:1), two nutrient schedule ($N_1$ – N and K in three splits and $N_2$ – N and K in six splits) and two irrigation schedule ($I_1$ - irrigation once in three days and $I_2$ - irrigation once in six days) with four replications in completely randomized design. Different growth media used in the experiment were prepared with soil, sand, FYM and coir pith in different proportions by volume. The growth medium $M_1$ was prepared by mixing 9 kg soil, 8 kg sand and 3 kg FYM, $M_2$ with 9 kg soil, 3 kg coir pith and 3kg FYM and $M_3$ with 7 kg soil, 3.75 kg coir pith and 3 kg FYM. Lime @ 10g and neem cake @ 100g sack-1 were applied initially in all growth media. Initially, the moisture content of growth media was brought to field capacity. Composite samples of growth media were analysed for their physico- chemical properties using standard procedures. Corm pieces of 250 g, treated with Trichoderma – cow dung slurry and shade dried, were planted in each sack on 11-04-2016.

The recommended dose of 100:50:150 kg NPK ha-1 for elephant foot yam (KAU, 2011) [1] was applied to each sack through organic manures like groundnut cake, bone meal and wood ash. The calculated quantities of groundnut cake (50 g), bone meal (10 g) and wood ash (100 g) based on their nutrient contents were applied in each sack. Uniform dose of bone meal was applied as a single basal dose in all sacs prior to planting of corm. The crop was harvested on 23-11- 2016. At the time of harvesting, the samples were analyzed for pH, EC, organic carbon, available N, available P and available K using standard procedures as presented in Table 1. The dehydrogenase activity of the samples were analyzed by following the procedure outlined by Casida *et al.* (1964) [2].

**Table 1:** Procedures followed in the analysis of growth media

| Sl. No. | Properties | Method | Reference |
|---|---|---|---|
| 1 | pH | pH meter method | Jackson (1973) [3] |
| 2 | EC | Conductivity meter method | Jackson (1973) [3] |
| 3 | Organic carbon | Walkley and Black rapid titration method | Jackson (1973) [3] |
| 4 | Available N | Alkaline potassium permanganate method | Subbiah and Asija (1956) [4] |
| 5 | Available P | Bray colorimeter method | Jackson (1973) [3] |
| 6 | Available K | Neutral normal ammonium acetate method | Jackson (1973) [3] |

## Result and Discussion

Initially (Table 2), all the growth media were having near neutral pH and electrical conductivity within tolerable limits. The growth medium $M_1$ had higher dehydrogenase activity and available N status and lower organic carbon and available P and K status. The growth medium $M_2$ was having higher pH, dehydrogenase activity and available N and P status and lower organic carbon than $M_3$. The growth media $M_2$ and $M_3$ were similar in their electrical conductivity and available K status.

**Table 2:** Physico- chemical properties of growth media prior to experiment

| Growth media | pH | EC ($dSm^{-1}$) | Dehydrogenase activity (µg TPF $g^{-1}$ 24 $h^{-1}$) | Organic Carbon (%) | Available N (%) | Available P (%) | Available K (%) |
|---|---|---|---|---|---|---|---|
| $M_1$ | 7.25 | 0.83 | 320.15 | 3.68 | 0.095 | 0.034 | 0.015 |
| $M_2$ | 7.12 | 1.78 | 263.24 | 5.65 | 0.084 | 0.042 | 0.017 |
| $M_3$ | 6.91 | 1.78 | 258.09 | 5.85 | 0.077 | 0.038 | 0.017 |

## Growth Media Analysis after the Experiment

### pH

Near neutral soil reaction (pH 6 to 7) is ideally suited for elephant foot yam (George, 2000 [5]; Ravi *et al*., 2011) [6]. Coir pith, a component used in the growth medium in the present study is reported to be acidic nature (Mukherjee, 2001[7]; Jeyseel and Raj, 2010) [8]. Hence lime @ 10 g $sack^{-1}$ was uniformly applied in all the growth media prior to the experiment and pH of the media were brought near to seven (Table 2). No marked variation in pH due to growth medium or irrigation schedule was observed (Table 3) but application of N and K in six splits raised pH than that produced by three splits.

### EC

Electrical conductivity of growth medium $M_1$ was less than that of $M_2$ and $M_3$ prior to the experiment (Table 2) and this difference was maintained even after the experiment (Table 3). This might be due to slow decomposition of coir pith in the growth media $M_2$ and $M_3$ and steady release of soluble salts in the media. Electrical conductivity was markedly increased when N and K were applied in six splits than three splits but not affected by irrigation schedule.

### Dehydrogenase Activity

The dehydrogenase activity is commonly used as an indicator of overall soil microbial activity (Gu *et al.*, 2009 [9]; Salazer *et al*., 2011[10]). Initially, the dehydrogenase activity was higher in the growth medium $M_1$ than $M_2$ and $M_3$ (Table 2) which might be due to higher population and increased activity of micro organisms present in the soil in $M_1$ and temperary suppression of microbial activity due to the raw coir pith present in $M_2$ and $M_3$. After the experiment, reverse trend was observed (Table 4). Nutrient schedule did not affect the dehydrogenase activity. But irrigation once in three days favoured dehydrogenase activity. Increased dehydrogenase activity due to increased soil moisture has been reported by Steinberger *et al*. (1998) [11].

### Organic Carbon Content

The organic carbon content in the growth media $M_2$ and $M_3$ were higher than $M_1$ before (Table 2) and after the experiment (Table 4) which might be due to the inclusion of coir pith in $M_2$ and $M_3$. However, the organic carbon content was not influenced by any of the treatments. The organic carbon content after the experiment increased over the initial value in $M_1$ and small increases have been noted in $M_2$ and $M_3$ compared to initial values.

### Available N, P and K status

Initially, the growth medium $M_1$ had higher content of available N and lower content of available P and K compared to $M_2$ and $M_3$ (Table 2). After the experiment (Table 5), the growth media $M_2$ and $M_3$ had higher status of available N, P and K which might be due to the decomposition of coir pith which was a component in the growth media $M_2$ and $M_3$. No remnants of raw coir pith could be seen in the growth media $M_2$ and $M_3$ after the experiment as they have been decomposed over time into black coloured porous media. In general, an increase in available N content and decrease in available K content in all the growth media have been observed after the experiment. Available N and P status in the growth media after the experiment were not influenced by the treatments. Available K status did not vary markedly with the growth medium or with irrigation schedule. But application of N and K in six splits increased the available K status which might be due to steady release of available K from added nutrients.

**Table 3:** Effect of growth medium, nutrient schedule and irrigation schedule on physio - chemical properties of growth media after the experiment

| Treatments | pH | EC ($dSm^{-1}$) |
|---|---|---|
| **Growth medium (M)** | | |
| $M_1$ - soil : sand : FYM 1:1:1 | 7.39 | 1.46 |
| $M_2$ - soil : coir pith : FYM 1:1:1 | 7.45 | 1.85 |
| $M_3$- soil : coir pith : FYM 0.75:1.25:1 | 7.40 | 2.02 |
| SEm± | 0.110 | 0.103 |
| CD (0.05) | - | 0.300 |
| **Nutrient schedule (N)** | | |
| $N_1$ - N&K in 3 splits | 7.29 | 1.56 |
| $N_2$ - N&K in 6 splits | 7.56 | 2.00 |
| SEm± | 0.090 | 0.084 |
| CD (0.05) | 0.261 | 0.245 |
| **Irrigation schedule (I)** | | |
| $I_1$ - Irrigation once in 3 days | 7.44 | 1.72 |
| $I_2$ - Irrigation once in 6 days | 7.41 | 1.86 |
| SEm± | 0.090 | 0.084 |
| CD (0.05) | - | - |

**Table 4:** Effect of growth medium, nutrient schedule and irrigation schedule on organic carbon content and dehydrogenase activity of growth media after the experiment

| Treatments | Organic carbon (%) | Dehydrogenase activity (µg TPF $24h^{-1}$ $g^{-1}$) |
|---|---|---|
| **Growth medium (M)** | | |
| $M_1$ - soil : sand : FYM 1:1:1 | 5.64 | 222.33 |
| $M_2$ - soil : coir pith : FYM 1:1:1 | 6.02 | 282.67 |
| $M_3$- soil : coir pith : FYM 0.75:1.25:1 | 6.10 | 287.83 |
| SEm± | 0.216 | 5.409 |
| CD(0.05) | - | 15.793 |
| **Nutrient schedule (N)** | | |
| $N_1$ - N&K in 3 splits | 5.94 | 261.33 |
| $N_2$ - N&K in 6 splits | 5.89 | 267.22 |
| SEm± | 0.176 | 4.417 |
| CD(0.05) | - | - |
| **Irrigation schedule (I)** | | |
| $I_1$ - Irrigation once in 3 days | 5.85 | 300.45 |
| $I_2$ - Irrigation once in 6 days | 5.98 | 228.11 |
| SEm± | 0.176 | 4.417 |
| CD(0.05) | - | 12.895 |

**Table 5:** Effect of growth medium, nutrient schedule and irrigation schedule on available N P K content of growth media after the experiment, %

| Treatments | Available N | Available P | Available K |
|---|---|---|---|
| **Growth medium (M)** | | | |
| $M_1$ - soil : sand : FYM 1:1:1 | 0.089 | 0.021 | 0.061 |
| $M_2$ - soil : coir pith : FYM 1:1:1 | 0.098 | 0.028 | 0.075 |
| $M_3$- soil : coir pith : FYM 0.75:1.25:1 | 0.096 | 0.026 | 0.070 |
| SEm± | 0.0048 | 0.0044 | 0.042 |
| CD(0.05) | - | - | - |
| **Nutrient schedule (N)** | | | |
| $N_1$ - N&K in 3 splits | 0.093 | 0.024 | 0.062 |
| $N_2$ - N&K in 6 splits | 0.096 | 0.026 | 0.075 |
| SEm± | 0.0039 | 0.0036 | 0.034 |
| CD(0.05) | - | - | 0.0099 |
| **Irrigation schedule (I)** | | | |
| $I_1$ - Irrigation once in 3 days | 0.094 | 0.026 | 0.069 |
| $I_2$ - Irrigation once in 6 days | 0.094 | 0.024 | 0.068 |
| SEm± | 0.0039 | 0.0036 | 0.0034 |
| CD(0.05) | - | - | - |

## Conclusion

The study revealed that the growth media $M_2$ and $M_3$, owing to their higher nutrient availability and minimum weight, and the management practices such as application of N & K in six splits and irrigation once in three days can be recommended for container cultivation of elephant foot yam. The nutrient status of the different growth media after the experiment revealed no depletion of nutrients except slight decrease in available P. Hence, the growth media can be reused for organic cultivation of crops by proper replenishment of nutrients depending upon the crop.

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