

Studies on the performance of arecanut (*Areca catechu* L.) seedlings to the nursery treatments

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Abstract: Studies on nursery treatments in arecanut showed that the seedlings performance differed significantly due to container size and pot mixture. In particular, the larger size container (25 x 15 cm) with pot mixture of soil + sand + Vesicular-Arbuscular Mycorrhizae (VAM) at 2:1:0.1 base produced vigorous seedlings followed by soil + sand + vermicompost at 2:1:1 mixture in nursery stage. It might be due to the better aeration in larger containers that facilitated easy root penetration and supply of adequate nutrients to the growing seedlings.

Key words: Arecanut, Vigorous seedling, Nursery mixture, Container size.

Introduction

Arecanut (*Areca catechu* L.) is one of the important plantation crops grown in India and India is the largest producer in the world. The plantation is mainly established by raising the seedlings in the nursery and hence, the production of good quality seedlings is of prime importance. Now a days raising the seedlings in containers are increasingly used to improve the survival and minimize the planting shock during the field planting. In addition, seedlings fortified with pot mixture are important to obtain better seedlings. Adopting ecologically friend organic manures, vermicompost and biofertilizers as pot mixtures to be economically rewarding, intellectually stimulating and environmentally sound. Hence, considering the research backgrounds present study in arecanut has been formulated to standardize the nursery techniques for the production of quality seedlings.

Materials and Methods

Freshly harvested uniform size arecanut seeds of variety Mettupalayam Local were collected from the farmer's plantation and used to conduct the experiment at Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 1998-

2001. Since, arecanut seed is a recalcitrant (Raja *et al.* 2001), and were immediately used for sowing. For the production of quality seedlings, the following pot mixtures and their combinations were used. In case of single biofertilizer inoculation, 100 g of biofertilizer was mixed with one kg of soil: sand (2:1) base. In dual biofertilizers inoculation, both the biofertilizers selected were mixed first at 1:1 ratio. Afterwards 100 g mixture were taken and again mixed with one kg of soil : sand (2:1) base as detailed below:

(i) Pot mixtures

T₁ - Sand, T₂ - Soil, T₃ - Soil + sand (2:1), T₄ - Soil + sand + FYM(2:1:1), T₅ - Soil + sand + poultry manure (2:1:1), T₆ - Soil + sand + vermicompost (2:1:1) T₇ - Soil + sand + ash (2:1:1) T₈ - Soil + sand + *Azospirillum* (2:1:0.1), T₉ - Soil + sand + *Azotobacter* (2:1:0.1), T₁₀ - Soil + sand + Phosphobacteria (2:1:0.1), T₁₁ - Soil + sand + Vesicular-Arbuscular Mycorrhizae (VAM) (2:1:0.1), T₁₂ - Soil + sand + {*Azospirillum* + Phosphobacteria (1:1)} (2:1:0.1), T₁₃ - Soil + sand + {*Azotobacter* + Phosphobacteria (1:1)} (2:1:0.1) T₁₄ - Soil + sand + {VAM + Phosphobacteria (1:1)} (2:1:0.1)

Table 1. Effect of container size and pot mixture on germination and number of leaves in arecanut var. Mettupalayam Local

| Pot mixture | Survival (%) | | | | | | | | | | Stem girth (cm) | | | | | |
|-----------------|----------------------|----------------|-------|----------------|----------------|-----------|----------------|----------------|------|----------------|-----------------|------|----------------|----------------|------|--|
| | Speed of germination | | | | | 6 MAS | | | | | 6 MAS | | | 10 MAS | | |
| | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | |
| T ₁ | 0.09 | 0.09 | 0.09 | 86(68.3) | 88(69.9) | 87(69.2) | 2.7 | 2.9 | 2.8 | 3.7 | 3.6 | 3.7 | 3.7 | 3.6 | 3.7 | |
| T ₂ | 0.14 | 0.14 | 0.14 | 100(90.0) | 100(90.0) | 100(90.0) | 3.1 | 3.0 | 3.1 | 4.0 | 4.1 | 4.1 | 4.0 | 4.1 | 4.1 | |
| T ₃ | 0.14 | 0.16 | 0.15 | 100(90.0) | 100(90.0) | 100(90.0) | 3.3 | 3.3 | 3.3 | 4.2 | 4.5 | 4.3 | 4.2 | 4.5 | 4.3 | |
| T ₄ | 0.13 | 0.12 | 0.13 | 100(90.0) | 97(83.5) | 98(86.8) | 2.6 | 3.0 | 2.8 | 3.9 | 3.8 | 3.9 | 3.9 | 3.8 | 3.9 | |
| T ₅ | 0.11 | 0.10 | 0.11 | 100(90.0) | 100(90.0) | 100(90.0) | 2.9 | 2.7 | 2.8 | 3.7 | 3.8 | 3.8 | 3.7 | 3.8 | 3.8 | |
| T ₆ | 0.15 | 0.15 | 0.15 | 100(90.0) | 100(90.0) | 100(90.0) | 3.4 | 3.4 | 3.4 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | |
| T ₇ | 0.11 | 0.14 | 0.13 | 100(90.0) | 100(90.0) | 100(90.0) | 3.0 | 3.0 | 3.0 | 4.2 | 4.1 | 4.2 | 4.2 | 4.1 | 4.2 | |
| T ₈ | 0.13 | 0.15 | 0.14 | 100(90.0) | 100(90.0) | 100(90.0) | 3.2 | 3.3 | 3.3 | 4.3 | 4.5 | 4.4 | 4.3 | 4.5 | 4.4 | |
| T ₉ | 0.15 | 0.12 | 0.13 | 100(90.0) | 100(90.0) | 100(90.0) | 3.1 | 2.9 | 3.0 | 4.0 | 3.9 | 4.0 | 4.0 | 3.9 | 4.0 | |
| T ₁₀ | 0.14 | 0.13 | 0.14 | 100(90.0) | 100(90.0) | 100(90.0) | 3.1 | 3.0 | 3.0 | 4.1 | 4.0 | 4.1 | 4.1 | 4.0 | 4.1 | |
| T ₁₁ | 0.14 | 0.17 | 0.15 | 100(90.0) | 100(90.0) | 100(90.0) | 3.3 | 3.3 | 3.3 | 4.3 | 4.6 | 4.5 | 4.3 | 4.6 | 4.5 | |
| T ₁₂ | 0.15 | 0.17 | 0.16 | 94(76.8) | 94(76.8) | 94(76.8) | 2.8 | 3.0 | 2.9 | 4.2 | 4.1 | 4.2 | 4.2 | 4.1 | 4.2 | |
| T ₁₃ | 0.13 | 0.18 | 0.16 | 94(76.8) | 100(90.0) | 97(83.4) | 3.1 | 3.1 | 3.1 | 4.1 | 4.0 | 4.1 | 4.1 | 4.0 | 4.1 | |
| T ₁₄ | 0.09 | 0.12 | 0.11 | 93(75.7) | 88(69.9) | 91(72.8) | 2.4 | 2.8 | 2.6 | 3.7 | 3.9 | 3.8 | 3.7 | 3.9 | 3.8 | |
| Mean | 0.13 | 0.14 | 0.13 | 97(85.6) | 97(85.7) | 97(85.7) | 3.0 | 3.1 | 3.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | |
| SEd | 0.009 | 0.003 | 0.012 | 1.24 | | 1.75 | 0.08 | 0.03 | 0.03 | 0.20 | | | 0.20 | | | |
| CD (P=5%) | 0.010 | 0.006 | 0.026 | 2.54 | NS | 3.59 | 0.16 | 0.06 | 0.06 | 0.42 | NS | NS | 0.42 | NS | NS | |

(Values in parentheses indicate arc sine values) MAS- Months after sowing; T- Treatment; C- Container; NS- Not significant

Table 2. Effect of container size and pot mixture on seedling height (cm) of seedling in arecanut var. Mettupalayam Local

| Pot mixture | Survival (%) | | | | Stem girth (cm) | | | | | | | |
|-----------------|----------------------|----------------|-------|----------------|-----------------|------|----------------|----------------|----------|--------|--------|-----------|
| | Speed of germination | | 6 MAS | | 6 MAS | | 10 MAS | | | | | |
| | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | | | |
| T ₁ | 18.8 | 18.5 | 18.7 | 38.7 | 34.7 | 36.7 | 49.8 | 51.8 | 50.8 | 158.1 | 160.5 | 159.3 |
| T ₂ | 27.9 | 25.2 | 26.5 | 52.0 | 52.6 | 52.3 | 103.8 | 102.5 | 103.2 | 168.6 | 221.6 | 195.1 |
| T ₃ | 27.8 | 29.6 | 28.7 | 53.6 | 57.7 | 55.6 | 108.7 | 109.4 | 109.0 | 231.7 | 246.4 | 239.1 |
| T ₄ | 20.2 | 23.8 | 22.0 | 39.0 | 43.1 | 41.1 | 100.8 | 100.9 | 100.9 | 137.6 | 165.3 | 151.5 |
| T ₅ | 21.2 | 20.1 | 20.7 | 51.2 | 41.5 | 46.4 | 87.9 | 102.8 | 95.4 | 197.6 | 153.5 | 175.5 |
| T ₆ | 29.1 | 29.3 | 29.2 | 56.8 | 62.8 | 59.8 | 121.4 | 135.5 | 128.5 | 240.9 | 283.7 | 262.3 |
| T ₇ | 23.1 | 27.2 | 25.2 | 51.4 | 56.7 | 54.0 | 95.0 | 99.2 | 97.1 | 205.7 | 216.1 | 210.9 |
| T ₈ | 29.5 | 30.0 | 29.8 | 55.1 | 59.1 | 57.1 | 131.6 | 134.6 | 133.1 | 239.7 | 250.5 | 245.1 |
| T ₉ | 28.2 | 28.8 | 28.5 | 52.6 | 56.8 | 54.7 | 102.8 | 101.9 | 102.4 | 183.3 | 205.8 | 194.6 |
| T ₁₀ | 26.4 | 28.9 | 27.6 | 52.1 | 57.4 | 54.7 | 104.7 | 106.7 | 105.7 | 213.7 | 206.5 | 210.1 |
| T ₁₁ | 30.3 | 32.8 | 31.5 | 59.3 | 64.5 | 61.9 | 141.9 | 148.2 | 145.0 | 241.6 | 289.9 | 265.7 |
| T ₁₂ | 26.5 | 28.3 | 27.4 | 47.8 | 53.8 | 50.8 | 100.6 | 102.3 | 101.5 | 193.2 | 229.5 | 211.3 |
| T ₁₃ | 26.8 | 28.4 | 27.6 | 50.0 | 55.0 | 52.5 | 103.6 | 106.7 | 105.2 | 207.6 | 202.4 | 205.0 |
| T ₁₄ | 21.3 | 27.4 | 24.4 | 43.6 | 49.2 | 46.4 | 85.5 | 88.7 | 87.1 | 157.2 | 196.0 | 176.8 |
| Mean | 25.5 | 27.0 | 26.3 | 50.2 | 53.2 | 50.7 | 102.7 | 106.5 | 101.6 | 198.3 | 216.3 | 205.3 |
| SEd | T 1.12 | C 0.42 | NS | T 2.13 | C 0.80 | NS | T 2.74 | C 1.03 | TXC 1.93 | T 8.09 | C 3.06 | TXC 11.47 |
| CD (P=5%) | 2.31 | 0.87 | | 4.38 | 1.65 | | 5.62 | 2.12 | 3.88 | 16.59 | 6.27 | 23.46 |

MAS - Months after sowing; T - Treatment; C - Container; NS - Not Significant

(ii) Container

The above pot mixture combinations were filled in polythene bags of two different sized viz. 15 x 10 cm (C₀) and 25 x 15 cm (C₂) to study the effect of container size on seedling growth and vigour.

The experiment was carried out in completely randomized design with two replications of 25 containers each. Seeds were sown singly in vertical position in polythene bags and watered daily. The various observations were taken at six and ten months after sowing (MAS) in ten randomly selected seedlings in each treatment.

During seed germination, the number of seeds germinated were counted from the day of first emergence and continued 90 days (Nagwekar *et al.* 1997) and then the speed of germination was computed (Maguire, 1962). Seedlings that survived after six months were counted to know the survival percentage. Stem girth of the seedlings was measured at collar region. Similarly seedling height was measured in the selected plants from the collar region to the tip of the shoot. The leaf area is an index for the seedling vigour, which was measured using CI-203 leaf area meter.

To observe the seedlings, biomass production, the seedlings were removed from the containers without damaging the root and washed thoroughly to remove the adhering soil particles. The shoots and roots were cut separately at the collar region of seedling and dried under shade for few hours and then dried in a hot air oven maintained at $85 \pm 1^\circ\text{C}$ for 24 h. After drying they were cooled in the desiccators for 30 min and weighed. Then the data collected were subjected to statistical analysis (Panse and Sukhatme, 1967).

Results and Discussion

The seedlings in the nursery will vary in vigour and other growth characters. It is

important that only vigorous seedlings are to be selected for planting based on characters such as early germination, number of leaves, girth at collar etc (Farooqi and Sreeramu, 1999). Also in order to reduce the transplanting shock, it is advisable to use polybag-raised seedlings. Here the advantage is that none of the roots are damaged at the time of planting in the main field. Moreover, the maintenance of the polybag seedling is easier than the nursery beds. Davidson and Sowa (1974) demonstrated that containerized seedlings performed well and because of intact root systems, they survived better and began to grow early. Besides the container, pot mixture is also important to obtain vigorous seedlings. Sharma Bhat and Abdul Khader (1982) stated that sand, soil or burnt earth is used as media for arecanut sowing. In the present study, soil + sand + {Azotobacter + Phosphobacteria (1:1)} (2:1:0.1) (T₁₃) have recorded higher speed of germination (0.18) in the polythene bag (25 x 15 cm) planted seeds. In case of seedlings survival, almost all the pot mixture treatments were performed well except sand (T₁). Stem girth was maximum (3.4 cm, 4.6 cm on 6 MAS and 10 MAS, respectively) in the seedlings from polythene bags (25 x 15 cm) contained soil + sand + vermicompost (T₆) at 2:1:1 ratio (Table 1). Deo *et al.* (1994) supported that soil, compost and sand at 2:1:1 ratio gave excellent result to prepare the soil mix for root trainers. Vermicompost is a good pot mixture contains rich nitrogen, phosphorus, potassium, magnesium, calcium and vitamins (Sreekrishna Bhat, 1999). It also has growth hormones like gibberellins, which regulate the plant growth. It can supply full requirement of micronutrients and it enhances the availability of both native and added micronutrients in soil (Purakayastha and Bhatnagar, 1997). This might be the reason for the maximum stem girth in the containerized arecanut seedlings.

The maximum seedling height (32.8 cm,

Table 3. Effect of container size and pot mixture on root length (cm) of seedling in arecanut var. Mettupalayam Local

| Pot mixture | Survival (%) | | | | | | | | | | | | Stem girth (cm) | | | | | |
|-----------------|----------------------|----------------|----------------|------|----------------|----------------|-------|----------------|----------------|------|----------------|----------------|-----------------|----------------|----------------|--------|--|--|
| | Speed of germination | | | | | | 6 MAS | | | | | | 6 MAS | | | 10 MAS | | |
| | Container | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | C ₁ | C ₂ | Mean | | |
| T ₁ | 23.1 | 16.9 | 20.0 | 24.0 | 28.3 | 26.1 | 5.5 | 5.5 | 5.5 | 5.5 | 5.8 | 5.5 | 5.8 | 6.3 | 6.0 | | | |
| T ₂ | 23.9 | 24.6 | 24.3 | 27.3 | 32.7 | 30.0 | 5.5 | 7.0 | 6.3 | 8.2 | 7.7 | 6.3 | 8.2 | 7.7 | 7.9 | | | |
| T ₃ | 25.4 | 29.5 | 27.4 | 29.5 | 39.6 | 34.5 | 7.5 | 8.0 | 7.8 | 8.8 | 8.7 | 7.8 | 8.8 | 8.7 | 8.8 | | | |
| T ₄ | 17.8 | 25.5 | 21.6 | 29.1 | 30.3 | 29.7 | 6.0 | 7.0 | 6.5 | 5.0 | 7.3 | 6.5 | 5.0 | 7.3 | 6.2 | | | |
| T ₅ | 22.2 | 21.3 | 21.7 | 26.8 | 27.8 | 27.3 | 7.0 | 7.5 | 7.3 | 8.0 | 7.8 | 7.3 | 8.0 | 7.8 | 7.9 | | | |
| T ₆ | 24.5 | 27.6 | 26.0 | 30.7 | 38.8 | 34.7 | 8.0 | 8.5 | 8.3 | 9.7 | 10.0 | 8.3 | 9.7 | 10.0 | 9.9 | | | |
| T ₇ | 16.1 | 22.0 | 19.1 | 28.4 | 32.9 | 30.6 | 4.5 | 6.0 | 5.3 | 7.8 | 7.5 | 5.3 | 7.8 | 7.5 | 7.7 | | | |
| T ₈ | 26.4 | 29.2 | 27.8 | 30.0 | 40.7 | 35.4 | 7.5 | 8.5 | 8.0 | 8.7 | 9.7 | 8.0 | 8.7 | 9.7 | 9.2 | | | |
| T ₉ | 23.0 | 26.7 | 24.9 | 26.2 | 36.5 | 31.3 | 7.0 | 8.0 | 7.5 | 7.3 | 7.3 | 7.5 | 7.3 | 7.3 | 7.3 | | | |
| T ₁₀ | 19.5 | 24.0 | 21.7 | 29.0 | 35.4 | 32.2 | 5.0 | 5.0 | 5.0 | 8.0 | 8.2 | 5.0 | 8.0 | 8.2 | 8.1 | | | |
| T ₁₁ | 27.2 | 29.3 | 28.2 | 32.0 | 41.7 | 36.9 | 8.5 | 8.5 | 8.5 | 10.0 | 10.3 | 8.5 | 10.0 | 10.3 | 10.2 | | | |
| T ₁₂ | 21.0 | 21.3 | 21.1 | 26.4 | 35.5 | 31.0 | 5.5 | 7.5 | 6.5 | 7.2 | 9.2 | 6.5 | 7.2 | 9.2 | 8.2 | | | |
| T ₁₃ | 21.9 | 24.5 | 23.2 | 36.3 | 34.1 | 35.2 | 5.5 | 7.0 | 6.3 | 9.2 | 9.3 | 6.3 | 9.2 | 9.3 | 9.3 | | | |
| T ₁₄ | 15.0 | 27.7 | 21.3 | 26.3 | 35.6 | 30.9 | 4.0 | 7.5 | 5.8 | 7.3 | 9.3 | 5.8 | 7.3 | 9.3 | 8.3 | | | |
| Mean | 21.9 | 25.0 | 21.3 | 28.7 | 35.0 | 30.9 | 6.2 | 7.3 | 6.2 | 7.9 | 8.5 | 6.2 | 7.9 | 8.5 | 7.7 | | | |

| SEd | 6 MAS | | | 10 MAS | | |
|-----------|-------|------|------|--------|------|------|
| | T | C | TXC | T | C | TXC |
| CD (P=5%) | 1.74 | 0.66 | 2.47 | 1.64 | 0.62 | 2.32 |
| | 3.58 | 1.35 | 5.06 | 3.37 | 1.27 | 4.76 |

MAS - Months after sowing; T - Treatment; C - Container; NS - Not Significant

Table 4. Effect of container size and pot mixture on shoot dry weight of seedling in arecanut var. Mettupalayam Local

| Pot mixture | Survival (%) | | | | | | | | | | | | Stem girth (cm) | | | | | | | | | | | | | | | | | |
|-----------------|----------------------|----------------|----------------|------|------|------|-------|----------------|----------------|------|------|------|-----------------|----------------|----------------|------|------|------|--------|----------------|----------------|------|------|------|------|------|------|------|------|------|
| | Speed of germination | | | | | | 6 MAS | | | | | | 6 MAS | | | | | | 10 MAS | | | | | | | | | | | |
| | Container | C ₁ | C ₂ | Mean | TXC | T | C | C ₁ | C ₂ | Mean | TXC | T | C | C ₁ | C ₂ | Mean | TXC | T | C | C ₁ | C ₂ | Mean | TXC | T | C | | | | | |
| T ₁ | 1.19 | 0.67 | 0.93 | 2.37 | 2.61 | 2.49 | 0.38 | 0.47 | 0.43 | 1.29 | 1.40 | 1.34 | 0.43 | 0.47 | 0.43 | 1.29 | 1.40 | 1.34 | 0.43 | 0.47 | 0.43 | 1.29 | 1.40 | 1.34 | 0.43 | 0.47 | 0.43 | 1.29 | 1.40 | 1.34 |
| T ₂ | 0.65 | 1.96 | 1.31 | 4.36 | 5.43 | 4.90 | 0.45 | 0.88 | 0.67 | 2.23 | 2.67 | 2.45 | 0.67 | 0.88 | 0.67 | 2.23 | 2.67 | 2.45 | 0.67 | 0.88 | 0.67 | 2.23 | 2.67 | 2.45 | 0.67 | 0.88 | 0.67 | 2.23 | 2.67 | 2.45 |
| T ₃ | 1.31 | 1.12 | 1.21 | 5.22 | 5.23 | 5.22 | 0.77 | 0.67 | 0.72 | 2.49 | 3.12 | 2.80 | 0.72 | 0.67 | 0.72 | 2.49 | 3.12 | 2.80 | 0.72 | 0.67 | 0.72 | 2.49 | 3.12 | 2.80 | 0.72 | 0.67 | 0.72 | 2.49 | 3.12 | 2.80 |
| T ₄ | 1.06 | 1.79 | 1.43 | 6.03 | 3.03 | 4.53 | 0.43 | 0.81 | 0.62 | 1.24 | 1.19 | 1.57 | 0.62 | 0.81 | 0.62 | 1.24 | 1.19 | 1.57 | 0.62 | 0.81 | 0.62 | 1.24 | 1.19 | 1.57 | 0.62 | 0.81 | 0.62 | 1.24 | 1.19 | 1.57 |
| T ₅ | 1.33 | 1.11 | 1.22 | 4.22 | 3.93 | 4.07 | 0.87 | 0.48 | 0.68 | 2.14 | 1.65 | 1.90 | 0.68 | 0.48 | 0.68 | 2.14 | 1.65 | 1.90 | 0.68 | 0.48 | 0.68 | 2.14 | 1.65 | 1.90 | 0.68 | 0.48 | 0.68 | 2.14 | 1.65 | 1.90 |
| T ₆ | 1.51 | 2.31 | 1.91 | 5.91 | 8.46 | 7.19 | 0.85 | 1.18 | 1.01 | 2.57 | 3.21 | 2.89 | 1.01 | 1.18 | 1.01 | 2.57 | 3.21 | 2.89 | 1.01 | 1.18 | 1.01 | 2.57 | 3.21 | 2.89 | 1.01 | 1.18 | 1.01 | 2.57 | 3.21 | 2.89 |
| T ₇ | 0.60 | 1.61 | 1.10 | 4.79 | 5.98 | 5.38 | 0.41 | 0.71 | 0.56 | 2.22 | 2.30 | 2.26 | 0.56 | 0.71 | 0.56 | 2.22 | 2.30 | 2.26 | 0.56 | 0.71 | 0.56 | 2.22 | 2.30 | 2.26 | 0.56 | 0.71 | 0.56 | 2.22 | 2.30 | 2.26 |
| T ₈ | 1.26 | 2.38 | 1.82 | 5.46 | 6.48 | 5.97 | 0.72 | 0.94 | 0.83 | 2.32 | 2.80 | 2.56 | 0.83 | 0.94 | 0.83 | 2.32 | 2.80 | 2.56 | 0.83 | 0.94 | 0.83 | 2.32 | 2.80 | 2.56 | 0.83 | 0.94 | 0.83 | 2.32 | 2.80 | 2.56 |
| T ₉ | 1.03 | 2.22 | 1.62 | 3.73 | 4.55 | 4.14 | 0.87 | 0.90 | 0.88 | 1.50 | 2.04 | 1.77 | 0.88 | 0.90 | 0.88 | 1.50 | 2.04 | 1.77 | 0.88 | 0.90 | 0.88 | 1.50 | 2.04 | 1.77 | 0.88 | 0.90 | 0.88 | 1.50 | 2.04 | 1.77 |
| T ₁₀ | 1.19 | 1.13 | 1.16 | 4.67 | 5.98 | 5.32 | 0.70 | 0.42 | 0.56 | 1.90 | 2.46 | 2.18 | 0.56 | 0.42 | 0.56 | 1.90 | 2.46 | 2.18 | 0.56 | 0.42 | 0.56 | 1.90 | 2.46 | 2.18 | 0.56 | 0.42 | 0.56 | 1.90 | 2.46 | 2.18 |
| T ₁₁ | 1.60 | 2.73 | 2.16 | 6.08 | 8.46 | 7.27 | 0.54 | 1.26 | 0.90 | 2.88 | 3.75 | 3.32 | 0.90 | 1.26 | 0.90 | 2.88 | 3.75 | 3.32 | 0.90 | 1.26 | 0.90 | 2.88 | 3.75 | 3.32 | 0.90 | 1.26 | 0.90 | 2.88 | 3.75 | 3.32 |
| T ₁₂ | 1.17 | 1.41 | 1.29 | 3.81 | 5.85 | 4.83 | 0.77 | 1.14 | 0.95 | 1.35 | 2.51 | 1.93 | 0.95 | 1.14 | 0.95 | 1.35 | 2.51 | 1.93 | 0.95 | 1.14 | 0.95 | 1.35 | 2.51 | 1.93 | 0.95 | 1.14 | 0.95 | 1.35 | 2.51 | 1.93 |
| T ₁₃ | 0.52 | 0.91 | 0.72 | 4.68 | 5.19 | 4.93 | 0.54 | 0.79 | 0.66 | 2.15 | 2.59 | 2.37 | 0.66 | 0.79 | 0.66 | 2.15 | 2.59 | 2.37 | 0.66 | 0.79 | 0.66 | 2.15 | 2.59 | 2.37 | 0.66 | 0.79 | 0.66 | 2.15 | 2.59 | 2.37 |
| T ₁₄ | 0.99 | 2.13 | 1.56 | 3.80 | 4.84 | 4.32 | 0.56 | 0.77 | 0.66 | 1.57 | 2.26 | 1.91 | 0.66 | 0.77 | 0.66 | 1.57 | 2.26 | 1.91 | 0.66 | 0.77 | 0.66 | 1.57 | 2.26 | 1.91 | 0.66 | 0.77 | 0.66 | 1.57 | 2.26 | 1.91 |
| Mean | 1.10 | 1.68 | 1.43 | 4.65 | 5.43 | 4.32 | 0.63 | 0.82 | 0.66 | 1.99 | 2.47 | 2.18 | 0.66 | 0.82 | 0.66 | 1.99 | 2.47 | 2.18 | 0.66 | 0.82 | 0.66 | 1.99 | 2.47 | 2.18 | 0.66 | 0.82 | 0.66 | 1.99 | 2.47 | 2.18 |
| SEd | 0.21 | 0.08 | 0.30 | 0.32 | 0.12 | 0.46 | 0.08 | 0.03 | 0.12 | 0.17 | 0.06 | NS | 0.12 | 0.03 | 0.12 | 0.17 | 0.06 | NS | 0.12 | 0.03 | 0.12 | 0.17 | 0.06 | NS | 0.12 | 0.03 | 0.12 | 0.17 | 0.06 | NS |
| CD (P=5%) | 0.43 | 0.16 | 0.61 | 0.66 | 0.25 | 0.94 | 0.18 | 0.06 | 0.25 | 0.36 | 0.13 | | 0.25 | 0.06 | 0.25 | 0.36 | 0.13 | | 0.25 | 0.06 | 0.25 | 0.36 | 0.13 | | 0.25 | 0.06 | 0.25 | 0.36 | 0.13 | |

MAS - Months after sowing; T - Treatment; C - Container; NS - Not Significant

64.5 cm) and leaf area (148.2 cm², 289.9 cm²) were recorded in the seedlings obtained from larger polythene bag (25 x 15 cm) contained soil + sand + VAM at 2:1:0.1 mixture (T₁₁) during six and ten months after sowing respectively when compared with other treatments (Table 2). Similarly this treatment proved betterment in seedling growth parameters such as root length (29.3 cm, 41.7 cm), number of roots (8.5, 10.3), shoot dry weight (2.73 g seedling⁻¹, 8.46 g seedling⁻¹) and root dry weight (1.26 g seedling⁻¹, 3.75 g seedling⁻¹) when observed at six and ten months after sowing respectively (Table 3 & 4). The plants grown in smaller size containers have growth problems due to poor aeration or low water holding capacity of the growing medium (Milks *et al.*, 1989). Aeration porosity is considered to be the most important physical property of any growing medium (Bragg and Chambers, 1988). It is understood that by using the larger containers the aeration can be increased to the seedlings root zone and also it provides better establishment of roots in the soil region.

While considering the pot mixture, it is well-established fact that root colonization by VAM fungi helps in host plant growth and nutrition (Phillips and Hayman, 1983). Durga and Gupta (1995) reported increased uptake of N, P, K, Cu, Zn, Fe and Mn due to VAM inoculation in teak seedling. This is mainly due to VAM infection units develop within the root cortex, with hyphae growing longitudinally between the cells and intracellular development of arbuscules. Vesicles, containing large amounts of lipid, are formed later in the maturation of an infection unit. At the same time as infection spreads within root, extramatrical hypha grows out into the soil (Smith, 1988) and absorbs the nutrients from the soil. Therefore, in flow (rate of uptake per unit length of root) of P from soil into the roots of mycorrhizal plants is faster, than into nonmycorrhizal plants (Hale and Sanders,

1982; Smith *et al.*, 1986). The mechanism underlying the increased rate of P uptake is the efficiency with which mycorrhizal roots exploits the soil profile, with hyphae extending beyond the depletion zone surrounding the absorbing root and its root hairs (Owusu - Bennoah and Wild, 1979; Clarkson, 1985). Such an occurrence in the present study cannot be ruled out. Reduced susceptibility or increased tolerance of roots to certain soil - borne pathogens is frequently associated with an established mycorrhizal infection (Dehne, 1982). Increase in synthesis of secondary metabolites like lignin, ethylene and phenols (Dehne, 1982), as well as phytoalexins (Morandi *et al.*, 1984) may all contribute to these "protective" effects. Such an occurrence in the present study may also be one of the reasons for the vigorous seedlings.

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