Short communication

# Standardization of soilless growth media for raising potted ornamental foliage plants for export purpose

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Received 16 October 2020; received in revised form 24 March 2021; accepted 28 April 2021

**Abstract**

An investigation was carried out at Department of Floriculture and Landscaping, College of Agriculture Vellanikkara to standardize a suitable soilless medium for growing ornamental foliage plants intended for export. Popular herbaceous foliage plant *Aglaonema commutatum* var. 'Silver Frost' was used for the study. The experiment consisted of five potting media (volume by volume basis) *viz.,* $T_1$: cocopeat (70%) + rice husk (10%) + vermicompost (10% ) + sand (10%), $T_2$: cocopeat (50%) + rice husk (25%) + vermicompost (15%) + sand (10%), $T_3$: cocopeat (50%) + biochar (25%) + vermicompost (15%) + sand (10%), $T_4$: cocopeat (25%) + biochar (25%) + vermicompost (25%) + sand (15%) + perlite (10%) and $T_5$ : cocopeat (50%) + vermicompost (20%) + perlite (15%) + vermiculite (15%), laid out in completely randomized block design with four replications. As per the recommended grades and standards for potted foliage plants (FMA and FNGA, 1994), *Aglaonema commutatum* in eight inch pot should have a height and spread of 16''- 20" (40.64 cm to 50.80 cm) and number of suckers should be 6 – 12. In the present study, the medium ($T_5$) consisting of cocopeat (50%), vermicompost (20%), perlite (15%) and vermiculite (15%) was found to satisfy all these quality parameters and it was also light in weight with high water holding capacity (178.50%), low bulk density(0.35g/cm$^3$) and high porosity(79.53%). Hence this can be recommended as a suitable medium for export of potted ornamental foliage plants.

**Key words:** *Aglaonema,* Biochar, Cocopeat, Perlite, Rice husk, Vermicompost, Vermiculite.

Potted ornamental foliage plants are getting momentum nowadays due to rapid urbanization and changing lifestyles of people across the world. They are very easy to transport and hence used for instant outdoor landscaping as well as indoor gardening. Potted plants include both flowering and foliage plants. Foliage plants are generally grown for their attractive foliage and can be kept for longer periods under indoor conditions. Among them *Aglaonema,* popularly known as Chinese evergreen is one of the most versatile, recognizable and widely used group of tropical herbaceous ornamental foliage plants used by professional interior landscapers for decades.

Potting medium plays an important role in growth of foliage plants. Successful production of container grown plants is largely dependent on the physico-chemical properties of the potting media. A good potting medium should provide suitable environment for the compact growth of plants. Conventionally, top soil is used as a major component of potting medium. However, nowadays soil based media are not permitted for export purpose, because of the weight of media and risk of soil borne pathogens. Hence there is a need to standardize a suitable soilless medium for export of potted ornamental foliage plants.

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*Table 1*. Effect of soilless potting media on growth characters of *Aglaonema commutatum* var. 'Silver Frost' at twelve months after planting

| Treatments | Plant height (cm) | Plant spread (cm) | Number of leaves | Leaf area per plant ($cm^2$) | Leaf production interval (days) | Number of suckers | Shoot length (cm) | Shoot girth (cm) | Fresh weight of leaves (g) | Dry weight of leaves (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 55.61 | 59.20 | 42.28 | 7767.89 | 17.72 | 4.45 | 36.88 | 6.96 | 357.50 | 41.20 |
| $T_2$ | 53.95 | 58.50 | 37.40 | 7076.25 | 18.32 | 3.50 | 33.56 | 6.13 | 303.38 | 30.60 |
| $T_3$ | 51.71 | 55.50 | 44.05 | 8091.26 | 18.42 | 5.00 | 31.50 | 6.44 | 250.83 | 24.40 |
| $T_4$ | 52.43 | 56.80 | 34.65 | 5775.98 | 19.57 | 3.05 | 28.69 | 6.06 | 335.75 | 28.85 |
| $T_5$ | 48.89 | 50.78 | 50.60 | 8323.73 | 17.17 | 6.10 | 31.13 | 6.29 | 347.67 | 31.35 |
| SEm | 1.24 | 1.44 | 1.69 | 376.66 | 0.38 | 0.25 | 1.47 | 0.36 | 12.30 | 1.48 |
| CD (0.05) | 3.73 | 4.33 | 5.10 | 1135.14 | 1.13 | 0.75 | 4.42 | NS | 37.08 | 4.45 |

$T_1$ :cocopeat (70%) + rice husk (10%) + vermicompost (10%) + sand (10% )
$T_2$: cocopeat (50%) + rice husk (25%) + vermicompost (15%) + sand (10%),
$T_3$: cocopeat (50%) + biochar (25%) + vermicompost (15%) + sand (10%)
$T_4$: cocopeat (25%) + biochar (25%) + vermicompost (25%) + sand (15%) + perlite (10%)
$T_5$: cocopeat (50%) + vermicompost (20%) + perlite (15%) + vermiculite (15%)

The present investigation was carried out in Department of Floriculture and Landscaping, College of Agriculture, Vellanikkara, Kerala during the period June 2019- June 2020. Popular herbaceous foliage plant *Aglaonema commutatum* var. 'Silver Frost' was used for the study. The experiment was conducted in a protected structure cladded with 200 micron UV stabilized film and 50 per cent shade net and laid out in completely randomized block design with five treatments and four replications. Each treatment consisted of 20 pots of 8 inch size (20 cm x 20 cm). The treatments included different media combinations *viz.,* $T_1$: cocopeat (70%) + rice husk (10%) + vermicompost (10%) + sand (10%), $T_2$: cocopeat (50%) + rice husk (25%) + vermicompost (15%) + sand (10%), $T_3$: cocopeat (50%) + biochar (25%) + vermicompost (15%) + sand (10%), $T_4$: cocopeat (25%) + biochar (25%) + vermicompost (25%) + sand (15%) + perlite (10%) and $T_5$ : cocopeat (50%) + vermicompost (20%) + perlite (15%) + vermiculite (15%). Uniform management practices were given for all treatments. As nutrient management, foliar spray of NPK (19:19:19) at 5g/l was given at monthly intervals. The observations on growth parameters were recorded at quarterly intervals and root parameters were recorded at the end of experiment.

Physical properties of the media *viz.,* water-holding capacity, bulk density and porosity were estimated before the experiment, and media were evaluated for chemical properties *viz.,* pH, EC and NPK content before as well as after the experiment.

*Influence of soilless media on growth characters*

Significant variation among treatments was observed with respect to growth parameters such as plant height and plant spread during the period of experiment. In the present study, greater plant height (55.61 cm, 53.95 cm and 52.43 cm) was observed in $T_1$[cocopeat (70%), rice husk (10%),

*Table 2*. Effect of soilless potting media on root characters of *Aglaonema commutatum* var. 'Silver Frost' at twelve months after planting

| Treatments | Number of lateral roots | Root volume ($cm^3$) | Root length (cm) | Fresh weight of roots (g) | Dry weight of roots (g) |
|---|---|---|---|---|---|
| $T_1$ | 84.13 | 198.33 | 52.25 | 247.50 | 11.54 |
| $T_2$ | 69.83 | 138.75 | 55.25 | 136.17 | 8.38 |
| $T_3$ | 59.33 | 120.00 | 53.75 | 197.67 | 8.41 |
| $T_4$ | 73.17 | 113.33 | 55.50 | 124.42 | 6.84 |
| $T_5$ | 73.67 | 184.38 | 48.38 | 190.00 | 10.15 |
| SEm | 5.23 | 9.67 | 2.95 | 5.04 | 0.99 |
| CD (0.05) | NS | 29.13 | NS | 15.18 | 3.00 |

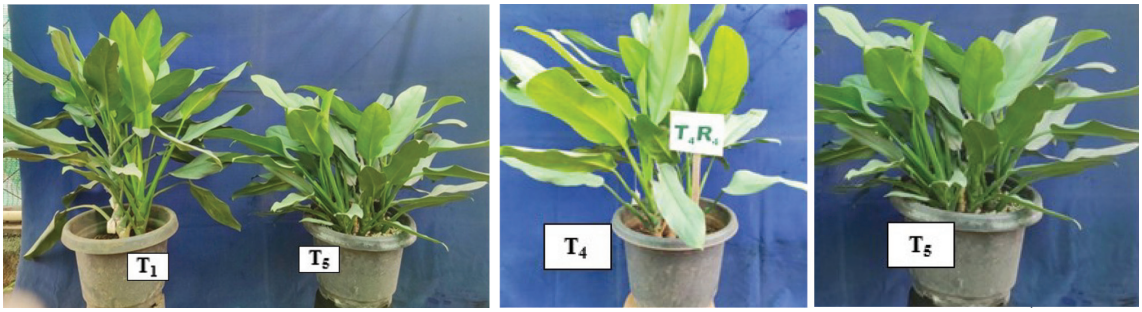


*Plate 1.* Effect of potting media on plant height at 12 months after planting

vermicompost (10%) and sand (10%)], $T_2$[cocopeat (50%) + rice husk (25%) + vermicompost (15%) + sand (10%)] and $T_4$[cocopeat (25%), biochar (25%), vermicompost (25%), sand (15%) and perlite (10%)] respectively. The lowest plant height was recorded in $T_5$ (48.89 cm) at twelve months after planting [cocopeat (50%) + vermicompost (20%) + perlite (15%) + vermiculite (15%)] (Table 1, Plate1).

With regard to plant spread, all treatments except $T_5$ were on par at twelve months after planting. Number of leaves is one of the important growth characters with regard to foliage plants which contribute to the overall beauty of potted plants.The highest number of leaves (50.60) at the end of experiment could be observed in $T_5$. The highest leaf area (8323.73 $cm^2$) was also observed in $T_5$ at twelve months after planting which was followed by $T_3$ (8091.26 $cm^2$) [cocopeat (50%) + biochar (25%) + vermicompost (15%) + sand (10%)] and $T_1$ [cocopeat (70%), rice husk (10%), vermicompost (10%) and sand (10%)]. Increase in number of leaves might have contributed to increase in leaf area in these treatments.

As leaves enhance the beauty of foliage plants, more number of leaves should be produced at shortest intervals. In this study, the minimum interval between the production of leaves (17.17 days) was noted in $T_5$, the medium composed of cocopeat (50%), vermicompost (20%), perlite (15%) and vermiculite (15%). Longer interval between the production of leaves was observed in $T_4$ (19.57 days), the medium composed of cocopeat (25%), biochar (25%), vermicompost (25%), sand (15%) and perlite (10%).

Number of suckers decides the fullness of the entire pot with foliage. The higher number of suckers was noted in $T_5$ (6.10) at twelve months after planting and lowest (3.05) in $T_4$ [cocopeat (25%), biochar (25%), vermicompost (25%) + sand (15%) + perlite (10%)] and $T_2$ (3.50) [cocopeat (50%) + rice husk (25%) + vermicompost (15%) + sand (10%)].

Plant with less shoot length is a desirable character for foliage plants as it contributes to fullness of the pot at the base. Lower shoot length was observed in all treatments except $T_1$. Fresh weight of leaves decides the quality of foliage and this parameter was found to the highest in $T_1$ (357.50g) comprising of cocopeat (70%), rice husk (10%), vermicompost (10%) and sand (10%), which was on par with $T_5$and $T_4$ (347.67 g and 335.75 g). The lowest fresh weight of leaves was observed in $T_3$ (250.83g) consisting of cocopeat (50%), biochar (25%), vermicompost (15%) and sand (10%). Dry weight of leaves was found to highest in $T_1$ (41.20 g) comprising of cocopeat (70%), rice husk (10%), vermicompost

*Table 3.* Physical properties of different growing media

| Treatments | Water holding capacity (%) | Bulk density ($g/cm^3$) | Porosity (%) |
|---|---|---|---|
| $T_1$ | 61.87 | 0.55 | 61.04 |
| $T_2$ | 78.50 | 0.41 | 71.33 |
| $T_3$ | 84.83 | 0.37 | 76.43 |
| $T_4$ | 68.30 | 0.45 | 66.17 |
| $T_5$ | 178.50 | 0.35 | 79.53 |

*Table 4*. Chemical properties of growing media before the experiment

| Treatments | pH | EC (dS/m) | N (%) | P (%) | K (%) |
|---|---|---|---|---|---|
| $T_1$ | 5.49 | 1.24 | 0.35 | 0.031 | 1.02 |
| $T_2$ | 5.71 | 1.32 | 0.53 | 0.125 | 0.82 |
| $T_3$ | 5.48 | 1.87 | 0.61 | 0.281 | 1.26 |
| $T_4$ | 5.07 | 2.8 | 0.62 | 0.172 | 1.17 |
| $T_5$ | 4.92 | 2.20 | 0.79 | 0.190 | 7.56 |

*Table 5*. Chemical properties of growing media after the experiment

| Treatments | pH | EC (dS/m) | N (%) | P (%) | K (%) |
|---|---|---|---|---|---|
| $T_1$ | 5.66 | 0.27 | 1.05 | 0.033 | 0.58 |
| $T_2$ | 6.32 | 0.37 | 2.63 | 0.033 | 1.48 |
| $T_3$ | 5.6 | 0.56 | 0.7 | 0.083 | 0.46 |
| $T_4$ | 5.13 | 1.02 | 1.23 | 0.083 | 0.92 |
| $T_5$ | 7.05 | 0.56 | 3.15 | 0.016 | 10.8 |

*Table 6*. Nutrient uptake by plants

| Treatments | N uptake (g/plant) | P uptake (g/plant) | K uptake (g/plant) |
|---|---|---|---|
| $T_1$ | 4.28 | 0.52 | 4.74 |
| $T_2$ | 3.48 | 0.43 | 3.86 |
| $T_3$ | 3.13 | 0.38 | 3.47 |
| $T_4$ | 3.29 | 0.40 | 3.65 |
| $T_5$ | 3.63 | 0.44 | 4.02 |
| SEm | 0.12 | 0.01 | 0.13 |
| CD (0.05) | 0.35 | 0.04 | 0.39 |

(10%) and sand (10%).The lowest value of dry weight of leaves was observed in the treatment in $T_3$ (24.40 g).

Improvement in growth characters observed in superior treatments might be due to high porosity contributed by perlite and vermiculite, and increased water holding capacity of the growing media contributed by different media components such as cocopeat and vermiculite as well as the supply of nutrients by cocopeat and vermicompost. Similar results were reported by Basheer and Thekkayam (2012) in anthurium, Ikram et al. (2012) in tuberose, Moghadam et al. (2012) in *Lilium*, Swetha et al. (2014) in *Aglaonema,* Sandeep et al. (2018) in *Nephrolepis falcata* and Kavipriya et al. (2019) in *Draceana reflexa.*

*Influence of soilless media on root characters*

A good growing medium should be able to provide suitable environment for the growth of root system so as to provide enough anchorage to plant and permit the gaseous exchange between plant roots and atmosphere. In present study, there was no significant variation among treatments with regard to root parameters *viz.,* number of lateral roots and root length. Fresh and dry weights of roots were higher (247.50 g and 11.54 g) in medium composed of cocopeat (70%), rice husk (10%), vermicompost (10%) and sand (10%) ($T_1$). The treatments $T_1$and $T_5$were also observed to be superior with respect to root volume (198.33 $cm^3$ in $T_1$and 184.38 $cm^3$ in $T_5$) (Table 2). Improvement in root parameters in these treatments might be due to the higher water retaining ability, aeration and nutrient content of the cocopeat based media which facilitates better root growth. These finding are in accordance with the observation of Khayyat et al. (2007), Olosunde et al. (2015), Nair and Bharathi (2015) and Sandeep et al. (2018) in *Epipremnum aureum*, *Dracaena*

Table 7. Cost of growing media per pot

| Treatments | Components | Quantity of component per pot | Total weight of growing media per pot (kg) | Cost of growing media per pot (Rs) |
|---|---|---|---|---|
| $T_1$ | Cocopeat (70%) + rice husk (10%) + vermicompost (10%) + sand (10% | Cocopeat (1.12 kg) + rice husk (0.04 kg) + vermicompost ((0.30 kg) + sand (0.75 kg) | 2.21 | 25.55 |
| $T_2$ | Cocopeat (50%) + rice husk (25%) + vermicompost (15%) + sand (10%) | Cocopeat (0.80 kg) + rice husk (0.1 kg) + vermicompost (0.45 kg) + sand (0.75 kg) | 2.10 | 29.00 |
| $T_3$ | Cocopeat (50%) + biochar (25%) + vermicompost (15%) + sand (10%) | Cocopeat (0.80 kg) + biochar (0.175 kg) + vermicompost (0.45 kg) + sand (0.75 kg) | 2.17 | 25.88 |
| $T_4$ | Cocopeat (25%) + biochar (25%) + vermi compost (25%) + sand (15%) + perlite (10%) | Cocopeat ( 0.40 kg) + biochar (0.175 kg) + vermicompost (0.75 kg) + sand (1.125 kg) + perlite (0.07 kg) | 2.52 | 32.60 |
| $T_5$ | Cocopeat (50%) + vermicompost (20%) + perlite (15%) + vermiculite (15%)) | Cocopeat (0.80 kg) + vermicompost (0.60 kg) + perlite (0.105 kg) + vermiculite (0.240 kg) | 1.74 | 42.00 |

*fragrans,* and chrysanthemum and *Nephrolepis multilora* respectively.

*Media analysis*

The lower the bulk density, higher will be the pore space which in turn allows the medium to retain more water within the pore spaces. The highest water holding capacity (178.50%) and porosity (79.53%) and the lowest bulk density (0.35g/cc) was recorded in $T_5$, the medium comprising of cocopeat (50%), vermicompost (20%), perlite (15%) and vermiculite (15%) (Table 3).

The optimum pH range for growth of potted ornamental foliage plants should be within 5.5 – 7.00 (Chen and McConnell, 2002). When the pH of growing media is within the optimum range, there will be better availability of nutrients to the plants. According to Chen and McConnell (2002), the optimum range of EC of the medium required for potted foliage plants should be within the range of 1–2.5 dS/m. The treatments $T_1$ [cocopeat (70%) + rice husk (10%) + vermicompost (10%) + sand (10%)], $T_2$ [cocopeat (50%) + rice husk (25%) + vermi compost (15%) + sand (10%)], $T_3$ [cocopeat (50%) + biochar (25%) + vermicompost (15%) + sand (10%)] and $T_5$ [cocopeat (50%) + vermicompost (20%) + perlite (15%) + vermiculite (15%)] ) were under this range, before the experiment. The treatment $T_5$ had highest contents of nitrogen and potassium (Table 4). This was attributed to the presence of media components cocopeat and vermicompost in large proportions. Vermiculite also might have contributed to the potassium content of the medium. This result was in line with observation of Wilson et al. (2009) in Aglaonema. Highest phosphorus content was observed in $T_3$ before and after the experiment (Table 5). Nutrient uptake analysis at the end of experiment revealed that $T_1$ was superior with respect to nitrogen, phosphorous and potassium uptake as compared to other treatments, resulting in an improvement in vegetative growth in this treatment.

In present study, $T_1$ was found to be the cheapest growing medium (Rs. 25.55) since the cost of components was less. The cost of the medium per pot was the highest (Rs. 42.00 ) for $T_5$ [cocopeat (50%), vermicompost (20%), perlite (15%) and vermiculite (15%)] (Table 7).

Even though significant improvement could be observed due to different treatments in terms of vegetative and root characteristics, potted plants should satisfy certain quality criteria for export purpose. As per the recommended grades and standards for potted foliage plants (FMA and FNGA, 1994), *Aglaonema commutatum* under 8 inch pot should have a plant height and spread of 16”- 20” (40.64 cm to 50.80 cm) and number of suckers should be six to twelve. There should be more number of leaves and leaf area. In the present study, the medium$T_5$, consisting of cocopeat (50%), vermicompost (20%), perlite (15%) and vermiculite (15%), was found to satisfy all these quality parameters and it had properties such as high water holding capacity, low bulk density and high porosity which reduced the irrigation requirement. The weight of the medium was also less which facilitated easy handling of potted plants. Hence this could be recommended as a suitable medium for export of potted ornamental foliage plants.

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