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Research Article

# Investigation of Best Potting Media to Enhance Flowering Performance of *Petunia Hybrida*

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## Abstract

*Petunia hybrida* is a worldwide most popular annual bedding ornamental plants and economically profitable potted plants. Potting media is most important factor which plays a key role of root growth, vegetative growth and quality production dependent on a relatively small volume of the medium. Hence present study was conducted to evaluate the best potting media to enhance flowering performance of *Petunia hybrida*. The experiment was conducted at the plant house located at botanical garden, Gampaha by using Petunia variety of F1 multi. Fenice. The experiment was laid out in a Completely Randomized Design (CRD) with seven treatments randomized in three replicates. Treatments were the seven different potting mixtures, i.e. river sand: Coir dust 1:1(control), river sand: Compost 1:1, river sand: Coir dust:compost1:1:1, river sand: Coir dust: Compost: Top soil 1:1:1:1, river sand: Coir dust: compost: Cow dung 1:1:1:1, river sand: Or dust: Compost: Leaf manure 1:1:1:1 and river sand: Coir dust: Compost: Half burned paddy husk 1:1:1:1 were used to check the best suitable medium for *Petunia* plants. Measurements were taken on vegetative growth, reproductive growth and floral attributes of *Petunia*. Physical and chemical characteristics of potting media, i.e. pH, EC, macro nutrients content (N, P, K) and moisture percentage were analyzed. The data were obtained tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS). Duncan's New Multiple Range Test (DNMRT) was performed to compare the differences among treatment means at P=0.05. Height of plant (cm) had significant differences ($p<0.05$) among different treatments tested. The highest plant height was reordered from T1, i.e. river sand: Coir dust 1:1 and the lowest from T2, i.e. river sand: Compost 1:1. Stem height was not significantly different ($p<0.05$) among T5, T6 and T7 treatments. Furthermore the best floral attributes was recorded from T3, i.e. River sand: Coir dust: Compost 1:1:1. The overall results showed that the T3 media prepared from River sand: Coir dust: Compost 1:1:1 was the most effective medium to enhance the growth and flowering performance of *Petunia hybrida*.

**Keywords:** Flowering performance: *Petunia hybrida*: *Potting media*: *Vegetative growth*

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## Introduction

*Petunia* is annual ornamental potted plants cultivated in different potting mixes [1]. Most potting mixes are compost or organic fertilizers can provide a suitable environment with sufficient water-holding capacity, nutrient content and aeration for plant growth and development. Gheorghe and Monica [2] reported the production of potted ornamental plants is greatly influenced especially by growth medium components prepared in different proportions. Potting media plays key role in quality and production of flowering plants. Growth substrates influenced the photosynthetic capacity, leaf area, and flowering potential, which play an important role in growth and development processes of plants [3-5]. A very important aspect in the production of potted ornamental plants is the controlled and induced vegetative and floral growth by horticultural practices. Growers typically use peat, perlite, vermiculite, sand, fallow land, and various organic and inorganic composted materials to prepare nutritious mixtures for floricultural plant production. Currently, in the entire world, different composting technologies are used for plant production; these are based on several types of wastes such as: municipal organic waste, sewage sludge, agricultural waste, animal manures and some sorts of industrial waste [6-9]. Growing media is defined as the mean where the roots of cultivated plants growth [10]. The physical and chemical properties as well as nitrogen, phosphorus and potassium concentration of potting media are dominant factors affecting the use of media, availability of nutrients to plant, mobility of water into or through media and penetration of roots in the potting media [11]. It's difficult to do maintenance activities and fertilization in potted plants. Therefore, reduction of morphological qualities, Healthy and vigorous of the plants. Growth medium is known to have effect of value of potted ornamental plants [12]. Visual quality of ornamental plants is a key parameter playing a major role in the purchase triggering for consumers [13-15]. Keeping plant morphological qualities are most important to ornamental flowering plant. Keeping in view the importance of growing media, the present study was conducted to identify the most appropriate growing media for this important ornamental plant.

## Materials and Methods

### Experimental site

Experiment was conducted in plant house (Covered with UV treatment polythene and 60% shade net) located at Botanical Garden, Henarathgoda, Sri Lanka.

### Experimental design

The experimental design was arranged as Complete Randomized Design (CRD) with seven treatments randomized in three replicates. Treatments were the seven different potting mixtures as below (Table 1).

| Treatments | Composition |
|---|---|
| T1 (Control) | River sand 1: Coir dust 1 |
| T2 | River sand 1: Compost 1 |
| T3 | River sand 1: Compost 1: Coir dust 1 |
| T4 | River sand 1: Compost 1: Coir dust1: Top soil 1 |
| T5 | River sand 1: Compost 1:Coir dust 1: Cow dung 1 |
| T6 | River sand 1: Compost 1:Coir dust 1: Leaf mold 1 |
| T7 | River sand 1: Compost 1:Coir dust 1: half burned paddy husk 1 |

**Table 1:** Treatments and composition of the potting mixtures of the experiment.

### Planting material and handling

Nursery trays were prepared with sterilized media. Then seeds were established and kept propagating. After germination propagator was removed and daily observe and watering. Then pots were prepared for plant *Petunia*, each pot filled up with a mixture of as above potting mixture. Healthy and vigorous plants were selected from the nursery were thoroughly washed to remove any old media and repotted to new media immediately to avoid drying of roots. Plants were allowed to grow under normal conditions. All cultural practices were done similar to other *Petunia* plants.

### Measurements

#### Plant growth

The data for plant growth characteristics were recorded once a week. Plants height was measured from surface of potting media to the top of plant using ruler (cm). Flowers diameter was measured by using ruler (cm). Number of leaves, first flower emergence, number of flowers, Diameter of flower (cm), Shelf life of flower (days) and mortality percentage were calculated during the study period.

### Analysis of potting media

Before and after planted were checked values of soil pH, EC and N, P, K values of each treatments.

### Chemical and physical properties of potting media

The pH value of soil was recorded by pH meter with glass electrode using buffers of pH 4.0 and 9.0 for standardizing the instrument. The pH was determined by pH meter in suspension by mixing 10 g of media mixture with 50 ml distilled water [16]. Electrical Conductivity (EC) of the saturation extract was measured by using conductivity meter [17,18]. Total nitrogen was determined by using Gunning & Hibbards method of sulphuric acid digestion and distillation with Marco Kjeldahl apparatus [19]. Available phosphorus was calculated as previously described by Watanabe and Olsen and available potassium was determined by Flame Analyzer.

### Statistical analysis

Data of the field experiment were tabulated and analyzed by using Analysis of Variance (ANOVA) Procedure of Statistical Analysis System (SAS). Duncan's New Multiple Range Test (DNMRT) was used to compare the differences among the treatment means at p = 0.05.

The Laboratory experiment was verified based on one-way ANOVA and mean comparison of different treatment was performed using Dunnett's Multiple Range Comparison Test at p=0.05 in SAS 9.1.

## Results and Discussion

### Growth attributed of Petunia

Among different treatments tested the highest stem height was recorded from T1, i.e. river sand: Coir dust ratio 1:1 and lowest was from T2, i.e. river sand: Compost. However higher number of leaves per plant were formed in T5, i.e. River sand: Coir dust: Compost: Cow dung 1:1:1:1 and the lowest number of leaves was observed in T2, i.e. river sand: Compost 1:1 (Table 2).

| Treatments | Height of Plant (cm) | Number of Leaves |
|---|---|---|
| T1 | $16.07^{a}$ | $94.53^{a}$ |
| T2 | $9.92^{c}$ | $61.78^{b}$ |
| T3 | $13.15^{b}$ | $94.83^{a}$ |
| T4 | $10.11^{c}$ | $81.12^{ab}$ |
| T5 | $11.84^{bc}$ | $100.67^{a}$ |
| T6 | $11.60^{bc}$ | $100.05^{a}$ |
| T7 | $11.44^{c}$ | $94.90^{a}$ |

**Table 2:** Effect of different potting media on growth attributes of *Petunia*.

**Note:** Means with same letters along the column are not significantly difference at p<0.05. Measurements are the means of three replicates.

Rooting media greatly affects the plant height and availability of growing substrate with the supplement of essential nutrients is essential for attaining maximum plant height [20]. Results showed that use of different potting media affect plant height differently.

Organic materials from agriculture, forestry, green areas, and livestock farming as well as residues from municipal and industrial waste are rich sources of different nutrients [21] and all have been strongly recommended for use as renewable resources in pot production, an effort that would help to palliate their harmful impact on local and global environmental degradation [22]. Growth medium is known to have effect on value of potted ornamental plants and plays an important role in germination rate, and many other physiological parameters including plant height, number of leaves, spike length, number of florets per spike, spike diameter and yield etc. [12].

### Floral attributes of petunia

The highest number of flowers was recorded in T3, i.e. river sand: Compost: Coir dust ratio 1:1:1 and the lowest number of flowers were recorded in T2, i.e. sand: Compost ratio 1:1. Other treatments which T1, T4, T5, T6 and T7 results are not significantly different in this study. Among different treatments tested the highest value of diameter of flower was recorded in T3, i.e. river sand: Coir dust: Compost ratio 1:1:1 and the lowest value were recorded from T2, i.e. river sand: Compost ratio 1:1. T1, T4 and T7 results was not significantly different. Significantly highest shelf life was recorded from T3, i.e. river sand: compost: coir dust ratio 1:1:1 potting media plants showed longer shelf life of 5.39 days and it was not significantly different with T1, i.e. river sand: coir dust 1:1. The lowest value was recorded in T2,

i.e. river sand: Compost ratio 1:1 potting media plants were showed shorter shelf life than others of 4.65 days. Other treatments results were not significantly different during the study period (Table 3).

| Treatments | First Flower Emergence Date (No of Days) | Number of Flowers | Diameter of Flowers (cm) | Shelf life of Flowers (No of Days) |
|---|---|---|---|---|
| T1 | 73.20$^{ab}$ | 38.27$^{b}$ | 4.67$^{b}$ | 5.11$^{a}$ |
| T2 | 77.73$^{a}$ | 15.77$^{c}$ | 3.98$^{d}$ | 4.65$^{b}$ |
| T3 | 67.13$^{c}$ | 54.21$^{a}$ | 4.81$^{a}$ | 5.39$^{a}$ |
| T4 | 74.07$^{ab}$ | 34.81$^{b}$ | 4.6 5$^{b}$ | 4.62$^{b}$ |
| T5 | 72.67$^{ab}$ | 36.09$^{b}$ | 4.51$^{c}$ | 4.54$^{b}$ |
| T6 | 71.80$^{bc}$ | 35.03$^{b}$ | 4.56$^{bc}$ | 4.75$^{b}$ |
| T7 | 71.53$^{bc}$ | 36.27$^{b}$ | 4.62$^{b}$ | 4.76$^{b}$ |

**Table 3:** Effect of different potting media on floral attributes of *Petunia*.

**Note:** Means with same letters along the column are not significantly difference at p<0.05 measurements are the means of three replicates.

Flowering capacity of petunia plants can be influenced by breeding and cultivation technology [23]. Daily light integral influences crop timing and plant quality in many floricultural crops [24-26]. Some species grown under a high DLI (e.g. greater than 15 molm-2d-1) flower earlier because they develop fewer nodes before flower initiation. In addition, a high DLI usually promotes flowering and improves plant quality attributes (e.g., flower number and branching) in many floriculture crops. For example, increasing DLI hastened flowering in vinca [*Catharanthus roseus (L.)* Don.; Pietsch et al.[27], *Petunia* [28] and eight other bedding plants [29]. Growing flower crops compared with traditional crops provide more marketing at both small and large scale for growers and it becomes more selective choice now days. Globally, horticultural crops are cultivated in more than 140 countries [30]. Potting soil mixes are the most important factors for the quality production of flowers in floriculture. Ornamental floral species tend to have a higher global demand, depending on consumer preferences. [31]. Significantly highest shelf life was recorded from T3, i.e. river sand: compost: coir dust ratio 1:1:1 potting media plants and the lowest value was recorded in T2, i.e. river sand: Compost ratio 1:1 potting media plants were showed shorter shelf life than others of 4.65 days. Other treatments results were not significantly different during the study period.

Hardening off, or toning, at the end of the greenhouse production cycle by reducing fertilizer rate, temperature, light intensity and soil moisture levels is a practice that has long been known to increase shelf life of floriculture crops such as *Chrysanthemum* (*Chrysanthemum indicum*), Poinsettia (*Euphorbia pulcherrima*) and other bedding plants [32].

## Correlation analysis

Linear correlation analysis was performed for the overall data set, there was a highly significant (p<0.0001) positive correlation was observed from the plant height, first flower emergence, number of flower diameter of flower, shelf life of flower. And, there was negative correlation between height of the plant and number of leaves, number of leaves and diameter of flowers (Table 4).

| | HT | NOL | FFED | NOFF | DOF | SHLF |
|---|---|---|---|---|---|---|
| HT | - | | | | | |
| NOL | -0.01669ns | | | | | |
| FFED | 0.99522*** | 0.01331 | | | | |
| NOFF | 0.00934** | 0.98435*** | 0.03814ns | | | |
| DOF | 0.99031*** | - 0.01538ns | 0.99601*** | 0.00773** | | |
| SHLF | 0.02193ns | 0.98640*** | 0.05052ns | 0.99795*** | 0.01959ns | |

**Table 4:** Linear correlation coefficients between Height of plant (HT), Number of Leaves (NOL), First Flower Emergence Date (FFED), Number of Flower (NOFF), Shelf Life of Flower (SHLF), Diameter of Flower (DOF) of *Petunia hybrid*.

**Note:** ns - non significant at p=0.05, * significant at p<0.05, ** Significant at p<0.01,

*** Significant at p<0.0001

## Physical and chemical characteristics of potting media

According to the results the plant height, number of leaves, number of flowers, diameter of flowers, shelf life of flowers was minimized and highest values of first flower emergence date and mortality percentage maximized in T2, i.e. coir dust: compost 1:1 treatment at a higher EC (3.29 ds/m) and lower moisture percentage (21.35%) was reordered than the other treatments (Table 5). Tested EC of the nutrient solution is related to the amount of ions available to plants in the root zone [33]. The optimal EC is crop specific, and depends on environmental conditions [34,35]. In general, higher EC hinders nutrient uptake by increasing the osmotic pressure of the nutrient solution, wastes nutrients, and the increases discharged of nutrients into the environment, resulting in environmental pollution. Lower EC may severely affect plant health and yield [36,37].

Accessibility of nutrients to plants in growing media is coupled with the changes in media pH. Increase or decrease in pH has direct effect on plant growth and development. Changes in pH above or low than the optimum range adversely affect plants by damaging roots and decreasing nutrient availability [38]. Y.Awang et al. [39], reported the best pH range (5.9-7.0) for plants better growth and development. Our findings showed that pH was ranged between 7.5-7.7 in all the treatments (Table 5). Total moisture content was significantly lower in T2 media. The moisture content was significantly different (p=0.05) among all the treatments tested during the study period. The highest nitrogen content was reordered in T6, i.e. River sand: Coir dust: Compost: Leaf mold 1:1:1:1 and the lowest value reordered in T2, river sand: Compost 1:1. Lowest value of height of plant was recorded in T2 potting media. The highest nitrogen content was reordered in T6, *i.e.* River sand: Coir dust: Compost: Leaf mold 1:1:1:1 and lowest value reordered in T4, river sand: Coir dust: Compost: Top soil 1:1:1:1. Phosphorus is considered as a primary nutrient for plant growth [40] and it needed to sustain optimum plant production and quality [41]. The Phosphorus element is essential for cell division, reproduction, and plant metabolism; moreover, its role is related to the acquisition, storage, and use of energy [42]. In addition to that Phosphorus plays an important role in lateral root morphology and root branching [43] and influences not only root development, but also the availability of nutrients [44].

The highest potassium content was observed from T1, i.e. river sand: Coir dust 1:1 and it was not significantly different (p=0.05) with T3, i.e. river sand: Coir dust: Compost 1:1:1 which recorded in highest number of flower, the highest value of flower diameter, shelf life of flower. Potassium improves the flower quality attributes of the plant [45] Potassium is usually needed for the better growth and production of flowers [46]. The study findings present research were in accordance with Baloch et al. [47], who reported fewer

| Treatment | pH Value | | EC value ds/m | Moisture Content (%) | N ppm | P Ppm | K ppm |
|---|---|---|---|---|---|---|---|
| | Before | After | | | | | |
| **T1** | 6.65$^{d}$ | 6.55$^{e}$ | 1.44$^{g}$ | 22.45$^{f}$ | 0.21$^{b}$ | 15.5$^{d}$ | 180.60$^{a}$ |
| **T2** | 6.64$^{e}$ | 6.76$^{b}$ | 3.29$^{a}$ | 21.35$^{g}$ | 0.07$^{c}$ | 16.5$^{c}$ | 174.40$^{b}$ |
| **T3** | 6.62$^{f}$ | 6.5$^{g}$ | 2.74$^{c}$ | 31.81$^{a}$ | 0.26$^{a}$ | 17.07$^{a}$ | 178.93$^{a}$ |
| **T4** | 6.77$^{b}$ | 6.63$^{c}$ | 2.15$^{e}$ | 28.98$^{b}$ | 0.13$^{d}$ | 15.57$^{d}$ | 177.07$^{ab}$ |
| **T5** | 6.80$^{a}$ | 6.84$^{a}$ | 2.1$^{f}$ | 23.21$^{e}$ | 0.18$^{bc}$ | 16.37$^{c}$ | 177.77$^{ab}$ |
| **T6** | 6.80$^{a}$ | 6.62$^{d}$ | 2.85$^{b}$ | 25.76$^{d}$ | 0.29$^{a}$ | 17.27$^{a}$ | 177$^{ab}$ |
| **T7** | 6.72$^{c}$ | 6.53$^{f}$ | 2.39$^{d}$ | 28.50$^{c}$ | 0.17$^{c}$ | 16.57$^{c}$ | 175.07$^{b}$ |

**Table 5:** Physical and chemical properties of different treatments.

days to flowering in *Zinnia* with the application of higher dose of potassium. Bradfield et al. [48], also reported that potassium at optimum level initiates the early production of flowers. Potassium is an essential input to the early flowering of the plant. In fact potassium initiates the availability of phosphorous which accelerates early flowering. Potassium improves the reproductive growth of the plant and plays an essential role in flower production [49].

## Conclusion

According to the study findings the highest growth performance was manifested from T1, i.e. river sand: Coir dust 1:1 medium as it fulfills the proper nitrogen content requirements for the growth of *Petunia hybrida*. It was evident that when T2, i.e. river sand: Compost 1:1 used as substrate given the least results regarding all plant growth parameters and floral attributes. Its availability to plant was restricted due to highest level of EC, lower level of Nitrogen and Potassium was contained in the potting media. Therefore, Petunia plants gown in river sand: compost 1:1 (T2) potting media showed the poor growth performance as well as the highest mortality percentage during the study period.

The overall results clearly revealed that the application of T3, i.e. river sand: Compost: Coir dust 1:1:1 media as the most effective medium to enhance flowering performance of *Petunia*. That was contained proper nitrogen, phosphorus, potassium nutrients and low level of pH for increase the ornamental values of Petunia plants. According to the study findings, river sand 1: Compost 1: Coir dust 1 can be suggested as the best potting media in order to enhance growth and flowering attributes of *Petunia*.

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