Original Research Article

# A study on vertical gardens in urban areas under agro climatic conditions of Prayagraj


## Abstract

An experiment was conducted on the topic “A study on vertical gardens in urban areas’’ during Rainy season 2021-22 at the Research Field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The observations were recorded on various growth and growth parameterVertical gardens are becoming a common component in contemporary garden designs at urban living spaces because of shrinking land spaces. Successful growing of plants in vertical garden systems depends up on growing container, plant chosen, growing media etc. Hence a study was carried out in the Department of Horticulture, Sam Higginbottom university of Agriculture, Technology and Sciences, Prayagraj, with the objective to study about suitable media composition along with vermicompost, perlite, coir pith, pumice stone and peat mosson growth and performance of ornamentals plant for establishment of vertical garden and to study the performance of ornamental plants viz.,*Duranta erecta*, *Hemelia patens, Iresine lindeni, Tabernamontana divaricata*, *Hemelia patens*,in plastic pot for establishment of vertical garden. The experiment was laid out in Completely Randomised Design in plastic pot with five treatment combination of various growing media mixtures comprising soil, river sand as basic components in combination with organic manures (vermicompost, coir pith, perlite, peat moss, pumice stone). The plant growth parameters and ornamental morphological characters observed. Among the five ornamentals plants used Golden duranta and Mini Chandani performed better as ornamental plants in vertical garden system with the growing media of soil:cocopeat:vermicompost:perlite(1:1:1:0.5).


**Keywords:** *taberemontana divaricata, hemelia patens, iresine lindenii, duranta erecta, vertical gardens.*

## 1. INTRODUCTION

Day by day greenery is being reduced mainly in the urban spaces. Plants play important role in today's cities where the urban development is causing many problems such as pollution, increased air temperature, lack of green space and excessive energy consumption. Following the concepts of sustainability, urban greening practices are becoming a popular way of reducing the undesired effects of increasing constructions and achieving ecological goals. Climate change has made the concept of changing our living ambiance very important to make quality living. Vertical gardens are the tools that can be employed to enhance the quality of air, solve the heat problems in urban areas and the same time improve aesthetics of our living places. Vertical gardens are becoming a common component in contemporary garden because of shrinking land spaces and multiplying high-rises with scanty space available for gardening. Though, the idea of vertical garden began in 600 BC from Hanging Gardens of Babylon and then it was not used often by successive gardeners like Persians, Mughals, Europeans and others. Today, with the rapid growth of industrial cities and for want of horizontal space for other utilities this concept was picked up rapidly by contemporary gardeners. Vertical gardens are living walls which are covered with vegetation. Successful growing of plants in vertical garden systems depends up on design of the vertical garden system, growing container, irrigation arrangement, plants chosen, growing media, etc. The shade loving indoor ornamental plants like Philodendron sp., Asparagus sp., Chlorophytum sp.,Polyscias fruticosa, Aglaonema, Rhoeo spathacea, Sempervivum, etc. are considered as suitable options based on their ornamental features, however, studies revealing the suitability of plants for vertical garden system is lacking in India. The members of Araceae, Asparagaceae and Araliaceae families viz., Philodendronerubescens, Chlorophytum comosum and Polyscias fruticose respectively are used in this study by virtue of their textural properties and easy adoptability in tropical to subtropical conditions. The growing medium is the most important component that decides the success of a vertical garden system. Increasing cost of these media components and shortage of the mineral media like peat, perlite and vermiculite are the reasons to find suitable alternative components from organic manures and hydrogel compounds

for plant growing containers used in vertical garden system. Further, restricted volume of media and competition due to higher planting density may cause a confined root system. In due course of maintenance this system needs heavy applications of fertilizer and water to maintain proper plant growth. In line with the above facts was carried out with the objectives to study the influence of coir pith, vermicompost, perlite, peat moss, as components of growing media along with pumice stone and performance of ornamental plants in plastic pot container for establishment of vertical garden and to standardize the growing media mixtures suitable for establishment of vertical garden.

**MATERIAL AND METHODS**

The experiment was conducted during the winter seasons of 2021-22 at the Research Field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj using Completely Randomized design with three replications. In this experiment living wall system of vertical garden was established with fabricated iron frames to hold the planter boxes. The plastic pots was fabricated with two slits in the front side to accommodate two rows of plants to cover the sides of the wall. 0n top of the planter box another row of ornamental plant was planted to cover the gap existing in alternate rows of the vertical frame. The vertical garden system made of plastic pot container (11cm x 11cm x 11cm) of square shape, black in colour. The experiment was laid out in Completely Randomized Design, replicated thrice with five treatment combination of various growing media mixture comprising soil, river sand, as basic components in combination with organic manures (vermicompost, cocopeat, peat moss, perlite, pumice stone). Control treatment was maintained with normal soil. The plant growth characters like days taken for establishment, plant height, plant spread, number of branches, number of leaves of per plant, leaf area, Internodal length and Root spread.

The statistical analysis of data was done by adopting the standard stastical procedure given by panse and sukhatme (1967).

2. **RESULT AND DISCUSSION**:

Results of the present experimental envisaged that the growth parameters viz., days taken for establishment, plant height, plant spread, Number of branches, Number of Leaves per plant, Internodal length, Root spread and leaf area were significantly increased due to the addition of growing

media components. In general addition of growing media with the composition of various mixtures performed better than the soil. Among the organic components used in media, vermicompost performed better in terms of all the growth parameters of the ornamental plants. In all the five ornamental plants, $T_1$ [soil + cocopeat + vermicompost + perlite (1:1:1:0.5)] has exhibited greater influence in terms of all the growth parameters with quicker establishment of plants. This was followed by $T_2$ [ soil + cocpeat + vermicompost + pumice stone (1:1:1:0.5)]. Enhancement of growth in all five ornamental plants due to above mentioned two growing media combinations might be attributed to the addition of vermicompost and coir pith in addition to normal growing media like soil and river sand. Enhancement in the growth attributes due to vermicompost in the present research is in line with the reports of (Rajamanickam et al. 2008) who revealed enhanced growth parameters in plants grown in potting mixture, treated with vermicompost. The report of (Golchin et al. 2006) in pistachio nut seedling was also in conformity of the present research. Further, the enhanced performance of ornamental plants grown in media containing vermicompost could be attributed by the fact that that vermicompost contains major and minor nutrients for the plants in available forms besides enzymes, antibiotics, vitamins, beneficial microorganisms and other plant growth hormones and have definite advantage over other organic; manures in respect of growth (Meerabai and Raj, 2001).

The quality parameters of the ornamentals plants grown containers can be determined by assessing the plants morphological characters. The best results obtained in these quality parameters might be attributed to the enhanced growth in terms of plants height, plant spread, number of leaves per plant, number of branches, leaf area, Internodal length, and Root spread. Best performance of all the five ornamental plants with highest values in quality parameters in the present study due to addition of organic growing components like vermicompost and coir pith is in accordance with the reports of Meerabai and Raj (2001) in ornamental plants and Hidalgo and Harkess (2002) in pointsettia. Enhancement in the quality parameters of the ornamental plants due to addition of coir pith might be enhanced water availability in the medium which increased the turgidity and freshness of the foliage (Bouranis et al., 1995).

By considering the mean performances of all the five ornamental plants (Table 1) it is concluded that Duranta erecta and Hemelia patens plants can be used as ornamental

plants for establishment of vertical garden system. The physio-chemical properties of the growing media mixtures and growth attributes and quality parameters of the five ornamental plants evinced that media combination of Treatment ($T_1$) soil + coir pith + vermicompost + perlite (1:1:1:0.5), Treatment ($T_2$) soil + coir pith + vermicompost + pumice stone (1:1:1:0.5) can be used to establish the above ornamental plants in plastic pot container of vertical garden systems fabricated in iron frames and found as best growing media composition.

**Table 1: Effect of growing media on growth of different ornamental plant species grown in vertical garden system**

| Treatment | Plant Height | Plant Spread | No. of Branches | No. of Leaves | Leaf Area | Root Spread | Internodal Length |
|---|---|---|---|---|---|---|---|
| **$M_1T_0$** | 28.67 | 17.33 | 6.50 | 26.15 | 15.08 | 11.23 | 0.90 |
| **$M_1$T1** | 32.83 | 20.50 | 7.83 | 28.65 | 16.86 | 12.50 | 0.90 |
| **$M_1$T2** | 31.83 | 19.87 | 7.33 | 27.15 | 16.79 | 12.28 | 0.94 |
| **$M_1$T3** | 28.17 | 17.83 | 7.50 | 23.15 | 16.11 | 11.00 | 0.95 |
| **$M_1$T4** | 28.00 | 16.83 | 6.17 | 25.15 | 16.29 | 10.99 | 0.98 |
| **M2$T_0$** | 29.67 | 19.83 | 3.97 | 23.15 | 15.79 | 11.65 | 1.00 |
| **M2T1** | 29.83 | 17.83 | 3.67 | 24.65 | 14.15 | 10.62 | 0.97 |
| **M2T2** | 28.67 | 17.50 | 3.83 | 22.65 | 15.79 | 11.86 | 0.96 |
| **M2T3** | 29.83 | 19.67 | 4.00 | 24.15 | 16.36 | 10.85 | 0.97 |
| **M2T4** | 31.33 | 19.17 | 4.00 | 23.65 | 15.29 | 10.34 | 0.96 |
| **M3$T_0$** | 28.83 | 18.33 | 5.50 | 26.15 | 15.79 | 11.45 | 1.00 |
| **M3T1** | 28.50 | 18.67 | 5.83 | 27.65 | 15.79 | 10.35 | 0.99 |
| **M3T2** | 29.33 | 18.50 | 5.67 | 25.65 | 15.55 | 11.62 | 0.98 |
| **M3T3** | 28.83 | 18.83 | 4.00 | 24.65 | 15.76 | 11.50 | 0.95 |
| **M3T4** | 28.33 | 16.00 | 5.33 | 25.65 | 14.65 | 10.52 | 0.90 |
| **M4$T_0$** | 27.00 | 19.17 | 4.67 | 25.15 | 13.98 | 11.00 | 1.02 |
| **M4T1** | 27.00 | 19.00 | 4.33 | 23.65 | 15.79 | 11.65 | 1.00 |
| **M4T2** | 32.50 | 18.17 | 4.67 | 22.65 | 14.29 | 10.48 | 1.03 |
| **M4T3** | 31.00 | 18.83 | 4.50 | 25.15 | 15.01 | 11.39 | 1.00 |
| **$M_4$T4** | 29.83 | 19.83 | 4.83 | 26.15 | 14.79 | 11.38 | 0.90 |
| **M5$T_0$** | 30.00 | 19.00 | 8.17 | 25.15 | 15.79 | 11.84 | 0.95 |
| **M5T1** | 25.67 | 15.63 | 6.00 | 22.15 | 13.79 | 10.48 | 0.90 |
| **M5T2** | 28.17 | 17.83 | 6.67 | 25.15 | 14.26 | 10.01 | 1.00 |
| **M5T3** | 31.00 | 19.17 | 7.00 | 23.15 | 12.73 | 10.87 | 0.97 |
| **M5T4** | 30.67 | 17.83 | 6.83 | 26.65 | 15.93 | 11.65 | 0.90 |
| **F Test** | S | S | S | S | S | S | S |
| **SE (m)** | 1.65 | 0.20 | 0.15 | 0.45 | 0.25 | 0.26 | 0.02 |
| **CD at 5%** | 0.001 | 0.001 | 0.43 | 0.36 | 0.20 | 0.19 | 0.02 |
| **CV** | 10.02 | 8.34 | 11.74 | 13.30 | 5.21 | 10.53 | 10.39 |

## CONCLUSION:

From the present investigation it is concluded that treatment $M_1T_1$ performed best in terms of growth and quality viz. plant height at 30 days (19.83), plant height at 60 days (30.50), plant height at 90 days (32.83), plant spread (20.50), No. of leaves (28.65), Root spread (12.50), Leaf area (16.86).

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