INFLUENCE OF THE POSITION ANGLE OF SIX ORNAMENTAL PLANTS ON THEIR SENSITIVITY TO GRAVITY AND THEIR SUITABILITY FOR VERTICAL GARDENING

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Introduction

Vertical gardening is relatively a new approach and the best solution for the space-limited landscape designing which uses the vertical space for growing plants. Landscape designers may have different choices in selecting plant species for vertical gardens depending on the general or specific requirements of the client. However, in placing plants in vertical gardens, upward movement of the shoots due to negative geotropism is a critical problem.

The upward movement, when placed horizontally, occurs as a basic response to the gravity. Growing plants in horizontal manner is not a usual practice. It may be a stress for the plant which leads to lower growth rate, deficiencies and other growth-related retarded reactions [1]. Gravity-sensitive plant movement regulates the above adverse effect. However, in landscaping aspect, upward curvature can be identified as a phenomenon that leads away from the structural plan of the green wall and reduces the aesthetic landscape value. As a resolution, suitable plants and correct establishment methods are need to be identified. Therefore, the objective of this study was to test suitability of six ornamental plant species for vertical gardening based on their sensitivity to gravity.

Materials and Methods

The study was conducted inside the net house in the Royal Botanic Gardens, Peradeniya (70˚15'N latitude, 80˚36' longitude) which belongs to Mid Country, Wet Zone (WM_3). The inside temperature of the net house was ranged between 30° C to 35° C while relative humidity was between 55% - 65% during the experimental period. Six plant species; *Ophiopogon japonicus, Tradescantia spathacea* 'Tricolor'*, Chlorophytum* sp*, Dracaena sanderiana* var. 'white', *Dianthus* sp and *Coleus* sp were selected for the investigation. Selected plant species were established in three different positions; 0°, 45° and 90° with respect to vertical axis.

Plants were replicated in 50 cm length PVC tubes (90 mm diameter) with five small holes that were established within 10 cm equal spacing. Fifteen tubes were assigned for one plant species and sets that contained five tubes were allocated for each three position angles; 0˚, 45˚ and 90˚with respect to vertical axis. Three wooden 'A' racks (210 cm length; 180 cm width and 165 cm height) framed by galvanized iron nets were used to place the PVC tubes.

Regular potting mixture (top soil: compost: sand 4:2:1) was used to fill PVC tubes. Well mixed medium was filled into each tube and either sides of the tubes were sealed by plastic plates. First five tubes with plants were attached to the racks and positioned with vertical plane. Next, set of replicates with five tubes were oriented in 45˚ with respect to vertical plane while last five tubes were angled into 90˚ against vertical line, so that they were positioned horizontally. Irrigation was done manually by applying equal amount of water for each plant once per week. Specific fertilizer application was not practiced, but weeding was done regularly.

Selected true stem plants; *Coleu*s sp, *Dracaena sanderiana* and *Dianthus* sp were measured for the following variables; upward curvature, length of curvature, length to curving point from base and tip, number of nodes to curving point and dry weight of plants. Selected non-stemmed plants; *Ophiopogon japonicus, Tradescantia spathacea, Chlorophytum* sp were measured for following variables; curvature against gravity, length of curvature, number of leaves and length of upper and lower halves. Above variables were compared among species and among three positions; 0˚; 45˚ and 90˚ with respect to vertical plane. Total study period was 3 months. Parametric data were analyzed as two factor factorial Complete Randomized Design (CRD) using generalized linear model. Mean separation was done by Duncan's Multiple Range Test.

Results and Discussion

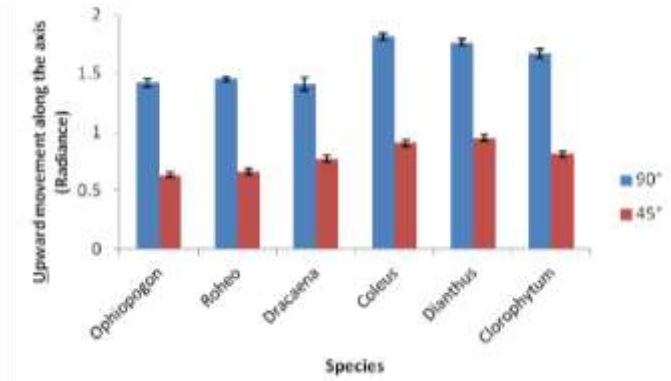

Figure 1: Variation in upward movement along the position angle of six plant species with the two positions; 90˚ and 45˚

The mean radiance values given for the upward curvature were significantly different in each position among the species tested. *Coleus* sp and *Dianthus* sp reported a higher upward movement while *Ophiopogon* sp, *Tradescantia* sp and *Dracaena* sp curved less (Figure 1).

Chlorophytum sp, *Tradescantia* sp and *Orphiopogon* sp. (non-stemmed type) showed a similar pattern of length variation among three positions. Mean length of the base was not significantly different in each plant species, but curved area or tip area showed a significant difference in mean values among three positions. However, the most important factor was, within species, there was no significant difference in mean length of apical part (curved area and tip). Even though *Dianthus* sp was considered as a true-stemmed plant, it also showed a similar kind of variation among three positions.

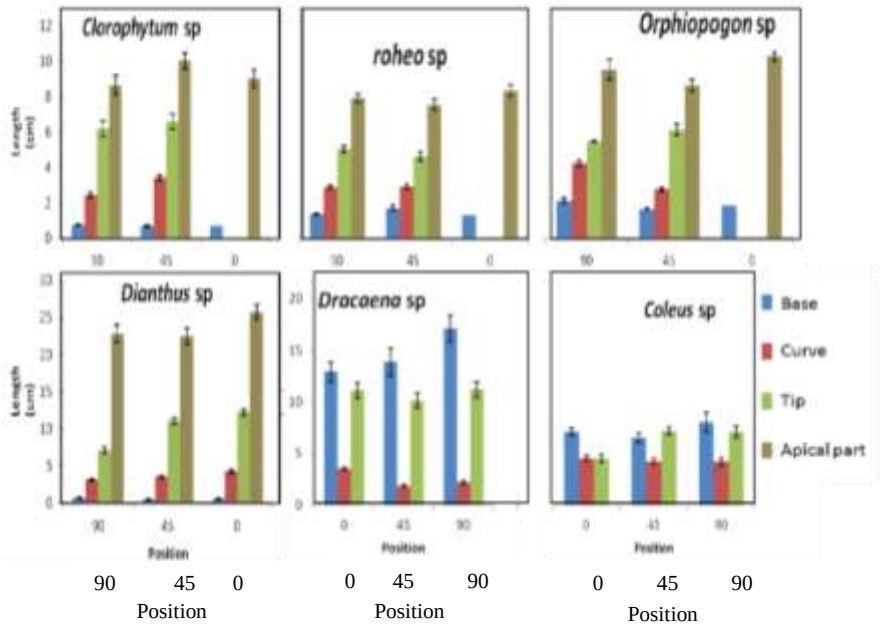

Figure 2: Lengths of base, curved area, tip and apical part of tested species as affected by position angle

On the other hand, in *Coleus* sp and *Dracaena* sp, base lengths increased with the position and both species showed a significant difference in mean base length at 0° and 90°. In addition, mean curve length of 0° and 90° positions were significantly different while 0° position showed the least mean curve length. Tip length and apical length changed depending on the species. *Dracaena* sp did not show a significant difference in mean length in tip part but mean values of length in whole apical part of 0° and 45° were significantly different and 45° shows the least apical length. In *Coleus* sp, both tip and apical parts in 45° position showed the maximum tip and apical length and in mean lengths of tip part, 45° and 0° positions were significantly different but mean lengths of apical part were not significantly different (Figure 2).

When the number of leaves is considered, in *Ophiopogon* sp, *Dracaena* sp and *Coleus* sp, there was a significant difference in number of leaves in upper and lower side of the plant. Number of upper leaves in *Ophiopogon* sp decreased with 0˚ to 90˚ while showing a significant difference between 0˚ and 90˚. In the lower side,

number of leaves increased while keeping a significant difference among three positions. Both upper and lower parts of *Dracaena* sp and *Coleus* sp showed a significantly different number of leaves in three positions. However, *Tradescantia* sp and *Chlorophytum* did not show any significant difference in number of leaves among positions as well as between two halves. Other than that, in both species there was no significant difference in mean leaf length among positions in between two halves (data not shown). Number of nodes to the starting point of curvature was specific to each species and due to the position angle, number of nodes were not significantly changed (data not shown). Similar responses have been also reported in several woody ornamentals [2].

When upward movement was considered, *Ophiopogon* sp showed the least upward movement along the position axis. *Coleus* sp showed the highest. However, upward movement of *Dracaena* sp and *Coleus* sp can be changed according to the position and *Coleus* sp showed a higher upward movement in 90° position (horizontal axis) due to the highest sensitivity to the gravity among all the species tested.

In the study of lengths of each base, tip and curved area two types of plants showed different patterns. Non-stemmed type plants changed their lengths in base or curvature but they kept the same apical or tip length among three different positions and by that, it can be said that non-stemmed type plants tried to keep the size of the apical part constant. In true-stem plants, length of the base of the plants increased while curvature was decreasing with 0° to 90°. True-stem plants give more priority to develop their stem and lead to elongate their base and curved [3].

Conclusions and Recommendations

Among the species tested, *Chlorophytum* sp can be considered as the best plant species that can perform well in vertical gardens with low level of structural changes and growth limitations. In addition, it has the ability to grow successfully in both positions (45° and 90°) that were examined in the study under water limiting conditions.

References

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