Allometric Relationship among Leaf and Floral Parameters in *Anthurium andraeanum* Variety "Tropical Red": Simple Indication of Floral Display

T.M.R.S. Perera[1*], B.L.H.N. Balasooriya[1] and C.K. Benaragama[1]

[1] Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lnaka

Abstract

Anthurium is a popular tropical cut flower grown commercially both for export and local markets. Flower size plays a vital role in deciding the price of the finished product. Corner's rule in plant form indicated that, leaf size and inflorescence size are correlated. It is hypothesized that in Anthuriums, flowers and leaves that are produced alternatively in a bush should possess the above traits and would beneficial for growers, in determining aspects of floral display (inflorescence size) by observing allometry at the level of leaf size. This study mainly aimed to explore the simple allometric relationships in *Anthurium andraeanum* variety "Tropical red" considering leaf and floral morphological traits. Study was conducted in Kandy District, Sri Lanka. Relevant measurements were taken from ten Anthurium growing farms. Ten plants were measured at each location and size related parameters of both leaves and flowers were taken. Regression analysis was done using natural log in allometric analysis. Results showed significant relationships among most parameters measured. Leaf area, leaf length, leaf width, lobe length and petiole length showed significant positive correlations with pedicel length, spathe length and spathe width. However spadix length of Anthurium did not show significant relationships with leaf parameters. Reproductive effort of plants was also visible in tested Anthurium cultivar and without natural log values, graphs indicated, there should be a minimum leaf length of 5 - 10 cm to initiate flowers. Therefore, relationships between allocation and allometry are obvious. In conclusion, leaf sizes and flower sizes are allometically related traits (R^2 - 0.7072) in *Anthurium andraeanum* variety "Tropical red".

Key words: Anthurium andraeanum, Corner's rule, Plant allometry, Reproductive effort

Introduction

Corner (1949) has shown that, stoutness of twigs is inversely related to the degree of branching and leaf and inflorescence sizes are related to the branch thickness. These rules have tested for the vegetative structures at the inter-specific level but studies for the reproductive structures are scares (White, 1983). Thus, a logical argument can be developed using the Corner's rule that the leaf size and inflorescence size are correlated to each other since branch thickness correlates to both leaf and inflorescence size. This simple corollary has been tested for several species those contain leaves and reproductive structures on the same shoots.

Allometry can be further described in allocation point of view (partitioning) as a size dependent process. Allometry is the quantitative relationship between growth and allocation. Weiner (2004) has shown that many allocation patterns follow allometric trajectories, thus allocation is a function of plant size. When plants are grown in isolation, relationship between stem diameter, height and plant mass generally show simple allometry (linear relationship). However, when plants are competing, these relationships become curvilinear or discontinuous (Waite and Hutchings, 1982).

This study was implemented using *Anthurium andraeanum* variety "Tropical red" to test the simple allometric relationship of leaves and flowers. *Anthurium andraeanum* is a popular tropical cut flower which can be grown well in 21°C - 30°C temperature and at about 70 - 75% relative humidity. The rainfall should be more than 1500mm. Cultivation of Anthuriums is done under 75% shade nets since it is a

***Corresponding author:** ruchikasperera@gmail.com

shade loving flowering plant. High radiation and temperature results in sun scorching of the leaves and flowers (Wijesundara, 2005).Understanding the unexpected hidden links between vegetative and reproductive features of Anthuriums will help the growers to forecast the floral sizes by observing the leaf sizes using simple allometry of the leaves so that necessary management steps can be taken to adjust them since flower size is one of the key concerns in the grading and price determination in the global Anthurium market.

Materials and Methods

The selected site for the study was Kandy District which is located in the Central province, Sri Lanka. The agro ecological region is WM3. It receives annual rainfall of about 2066mm and the daily mean temperature is about 24.7 ^{0}C. Data were collected at different locations in Kandy District, namely Danthure, Katugasthota, Amunugama, Hanthana, Wattaranthanna, Minigamuwa, Ankumbura and Peradeniya where Anthuriums are grown under uniform conditions.

As leaf parameters: leaf area was calculated in cm^2 using the grid method. All the length measurements were taken in centimeters using a measuring tape. Leaf length was measured from the lobe end to the leaf tip. Leaf width was measured at the place where petiole connects to the leaf as it was the widest place in the leaf. Lobe lengths were taken from the lobe end to the place where petiole connects to the leaf. Finally petiole length was measured from the emerging point of the leaf from the rhizome to the place where petiole connects to the leaf.

As floral parameters: pedicel length was measured from the emerging point from the rhizome to the flower spathe. Spathe length was measured from the spathe tip to where pedicel joint to the spathe. Spathe width was measured from the place where the spadix of the flower emerged as it was widest place in the spathe. Spadix length was measured from the base of the spadix to the tip of it. Leaf sizes were regressed against the inflorescence sizes using the natural log values as usually used in the allometric analysis.

Results and Discussion

White (1983) argued that relationship between leaf size and inflorescence size is less general in different plant taxa due to the differences in the plant architecture. Accordingly the taxa which have separate vegetative and reproductive shoots will overcome the constraints of allometry by manipulating leaf size and inflorescence size.

Anthuriums which produce its flowers in the inflorescence called spadix follow the white's argument showing no significant allometric relationship between the sizes of spadix with the leaf parameters (Table 1).Thus, spadix is considered as a rigid character which shows no relationship with the leaf sizes. Since spadix contains the genetic information of the plant, it supports the reproductive mechanism of the flower independently from the other factors. Some allocation patterns show relatively fixed allometric trajectories, since allometry is related quantitatively to the growth and allocation in plants, proving the above relationship (Weiner, 2004).

In commercial point of view, Anthurium is a cut flower that consumers prefer the size of colorful spathe. The spathe shows simple allometric relationships with the leaves. Spathe length, spathe width and the pedicel length were positively correlated with the size related parameters of the leaves such as leaf area, leaf length, leaf width, lobe length and petiole length. Thus, it is evident that allometry can be seen between the leaves and spathe of Anthurium variety "Tropical red"

Table 1. Correlation matrix of leaf and flower parameters.

Parameter (cm)	Leaf area (cm^2)	Leaf length (cm)	Leaf width (cm)	Lobe length (cm)	Petiole length (cm)
edicel length	**0.789**	**0.753**	**0.833**	**0.856**	**0.881**
Spathe length	**0.861**	**0.814**	**0.866**	**0.927**	**0.833**
Spathe width	**0.88**	**0.856**	**0.845**	**0.896**	**0.662**
Spadix length	0.454	0.457	0.483	0.384	0.594

Corrlation coefficients shown in bold letters are significant at 5 %

Anthurium flowers are bisexual and born in the spadix. The flowers do not mature at the same time. Thus cross pollination through insects, wind or by artificial means needs to happen for seed set. The allometric patterns between leaf and floral parameters have implications to the insect pollination purpose, because the colorful spathe should be proportionately large enough parallel to the leaf size to visualize the spathe clearly to the insects to accomplish the pollination successfully. In order to do that, flower spathe should grow larger when the leaf enlarges. The results show clear indication of positive relationship between leaf size and floral size parameters supporting this idea (Figure 1).

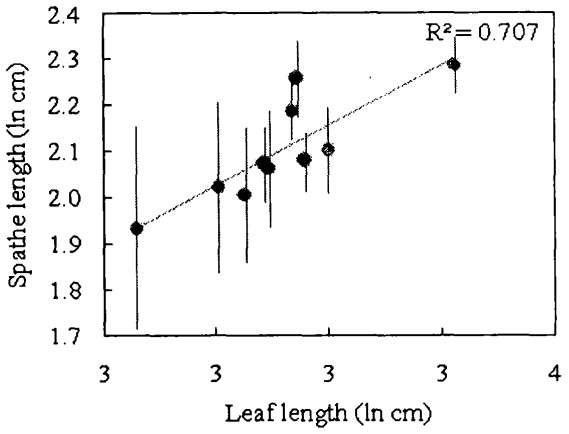

Figure 1. Relationship between leaf length and spathe length of Anthurim andraeanum variety "Tropical red"

Many studies have reported that plants change their reproductive allocation patterns in response to the competition. Plants grown in higher densities give priority to develop their vegetative structures (stems and leaves), but individually grown plants which do not have to compete with other plants give priority to produce their reproductive structures (flowers). This phenomenon can be explained much simply through allometry between reproductive and non-reproductive biomass (Waite and Hutchings, 1982). Since Anthuriums were grown in individual pots in commercial scale, competition between the plants are assumed to be less. Thus the simple allometry between the leaf and floral parameters exist unchanged.

According to the results, the average leaf length should be 5-10 cm to initiate flowers. This implies that, there should be a minimum leaf size for reproduction and the reproductive effort increases with time. These results on allometry may have practical applications in determining the time of flower initiation, potential flower size which can be used for the benefit of growers and plant taxonomists. Since the leaf and floral characteristics are correlated and determined the size of the spathe depending upon the leaf size, leaf size should be maintained according to the required spathe size. Proper shade level maintenance is quite important since the plant prefer 70-75% shade to flowering (Wijesundara, 2005). In large scale Anthurium farming, required quality and sizes of flowers can be achieved by practicing the recommended management and the fertilizer applications.

It can be concluded that, flower size and leaf size of *Anthurium andraeanum* variety "tropical red" are allometrically related and results support the Corner's rule. Further studies are required using different varieties grown in other Agro Ecological Regions to generalize this simple allometric relationship to

indicate floral display and reproductive effort to the whole species.

References

Corner, E.J.H. 1949. The duration theory and the origin of the modern tree. *Ann Bot*, 13: 367-414.

Waite, S. and Hutchings, M.J. 1982. Plastic energy allocation patterns in *Plantago coronopus. Okios*, 38: 333-342.

Weiner, J. 2004. Allocation, plasticity and allometry in plants. Elsevier, 6(4): 207-215.

White, P.S. 1983. Corner's rules in eastern deciduous trees: allometry and its implications for the adaptive architecture of trees. Bull Torrey Bot Club, 110: 203-212.

Wijesundara, D.S. 2005. *Anthurium cultivation*, Royal Botanical Garden, Peradeniya