The structural change of leaves in *Anthurium andraeanum* under intermittent mist

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Abstract. Photosynthesis is the fundamental basis in green plants, and the principal organ of photosynthesis is leaf. On the basis of water requirements or adaptations, as angiosperm leaves, Anthuriums require abundant soil water and relatively humid atmosphere. To identify the morphological characteristic of leaves in Anthurium, the transverses section was conducted. Two factors were tested in this experiment: 1) mist treatment (intermittent mist and control/without mist) and 2) the type of medium planting (bark and rockwool). For observation on microscopic differences, the leaves were put on the Auto Tissue Processor ROTEX and embedded the sample in a Hardener Resin (Technovit 7100), then the block-samples were sectioned in the Microtom machine at 5 μm. The results of transverses section showed that the leaves of Anthurium with intermittent mist treatment, under both rock wool and bark medium thicker than control. In this experiment, the intermittent mist treatment affected the leaf structure of *Anthurium andraeanum*. The intercellular space with connected to the outer atmosphere through the stomata was drastically increased by intermittent mist treatment which promoted transpiration, rapid gas exchange and photosynthesis.

Keywords: anthurium, leaves, transverses section, intermittent mist, bark, rockwool

Introduction

*Anthurium andraeanum* has achieved status as commercially propagated plants as a cut flower, with a vast array of colors, incredible vase life, and the most popular and long lasting of all tropical flowers. This plant generally has thick, cordate leaves and persistent reddish brown cataphylls (leaf sheaths). Currently numerous cultivars with different flower sizes, shapes, colors and some with delicate fragrances are available for the consumer (Kamemoto and Kuehnle, 2001). Anthurium is a native of Colombia and adjoining Ecuador in the tropical rain forest at elevation from 600 to 1,200 m (Croat, 1988). The many form of Anthurium represent terrestrial herbs, climbers, and epiphytes (Stanley, 1944). The structural unit of Anthurium plants is phytomer, which consist of leaf, inter-node, axis and root. The main axis of this plant produces from 3 to 8 leaves per year depending upon nutrition, environment, and cultivars (Higaki and Watson, 1972; Nakasone and Kamemoto, 1962; Rosario, 1981).

When plants advance from vegetative growth to the flowering, they go through several physiological stages. These different stages can require different environmental conditions for a successful flower development (Cristensen, 1971). Leaf cooling has been reported to improve flower production of *A. andraeanum* under condition of high light intensity (Leffring, 1975). Growth of *A. scherzerianum* can proceed at 15 °C although 20 to 22 °C are preferred for flowering (von Hentig and Heimann, 1975). Almost simultaneously the question arose if it possible to improve the yield and flower quality either by selection or by improving the environmental conditions such as temperature, light, insect, diseases, water, and nutrition. As a commercial cropping, flower yield is an important factor. Based on *A. andraeanum* needs high humidity, shade, constant warmth and moisture to growth and flowering, improvement of climate conditions seemed to be a better way for increasing the production. As an epiphyte, insufficient water absorption of aerial roots against the large leaves can give rise to the slow plant growth (Kamemoto and Kuehnle, 2001). We guess that the quantity of water absorbed in this way could significantly affect the plant moisture status because similarity in nature, so we done this study with intermittent mist.

Several media have been shown to be satisfactory for Anthurium growth and flower production, with availability and cost being important criteria for selection (Boerctje, 1978; Higaki and Poole, 1978). Organic matter wood shaving, coffee parchment, composted sugarcane, bagasse, tree fern, taro peel, macadamia nut shells, a slab of wood, bark, coconut husk, volcanic cinder, or an artificial medium (i.e., rock wool, polymer foam) can serve as a good medium to anchor roots for plant growth and flower production. Kamemoto and Nakasone (1957) emphasized nutrition and aeration as the two most important factors for the selection of an Anthurium medium. The purpose of this study was to identify the
morphological characteristic of leaves in Anthurium by the transverses section based on the combination of cultural modifications of water irrigation with intermittent mist and medium (rock wool and bark) to enhance the plant growth and cut flower of *Anthurium*.

**Materials and Methods**

**Growing condition**

Commercially-available young plants (ca. 10-cm height) of *Anthurium andraeanum* cv. Cancan with the red flower color were used for this experiment. The experiment conducted in the glasshouse. Tens plants (2 lines of 5 plants) per plot were planted at 35 cm interval between lines and 30 cm interval between plants. Two factors were tested in this experiment: 1). Mist treatment (1-minute intermittent mist treatment at 2-hour intervals 6 times a day and the control), 2). Media type (bark and granulous rock wool, Figures 1 and 2). A slow release coated fertilizer (Long 100, Asahi chemical industry) was given 10-gram as the basal fertilizer to each plant twice per year.

**Transverse section**

For observation of microscopic differences in the leaf structure treated with intermittent mist or without mist, the leaves and roots explants were fixed with FAA solution and after dehydration for one day. The samples washing in the water drip for one day, after that explants were cutting and put on the Auto Tissue Processor ROTEX for setting and through a graded ethanol series.

The ROTEX program were (1) 30 % ethanol for 1 hour agitation, (2) 50 % ethanol for 1 hour agitation, (3) 70 % ethanol for 1 hour agitation, (4) 80 % ethanol for 1 hour agitation, (5) 90 % ethanol for 1 hour agitation, (6) 95 % ethanol for 1 hour agitation, (7) 8 % ethanol for 2 hour agitation, (8) 100 % ethanol for 2 hour agitation, (9) 100 % ethanol for 2 hour agitation, (10) 50 % ethanol + 50% Hardener Resin for 2 hour agitation, (11) 100 % Hardener Resin for 15 hour agitation. After the agitation, the sample were taken and put on the plastic block and embedded the sample in a Hardener Resin (Technovit 7100) for one day, and waiting until the sample dry. The block-samples were sectioned in the Microtom machine at 5 um, and put directly on the water after cutting. By used the slide-glass, the samples were collected, waiting until the sample drying, and stained with toluidine blue a long 5 minutes.

**Results and Discussion**

*Anthurium andraeanum* growing under intermittent mist treatment have bigger leaves and growth faster than control in both rockwool and bark medium. From transverses section of the leaves we found that the leaves of Anthurium with intermittent mist treatment under both rock wool and bark medium (Figure 3 and 5) thicker than control bark (Figure 6). In this experiment, the intermittent mist treatment affected the leaf structure of *A. andraeanum*. The intercellular space with connected to the outer atmosphere through the stomata was drastically increased by mist treatment (Figure 3 and 5). Intermittent mist has similar effect with relative humidity as in the native of *A. andraeanum*. The intercellular space on the leaves of plants growing on rockwool medium in both mist treatment and control showed the palisade parenchyma has a lot of chloroplasts (Figures 3 and 4) compared with bark medium (Figures 5 and 6). The result of transverses section similar with the growth condition of the plants. Plants growing on the rock wool medium much better than the bark medium. Hopkins (1999) reported that chloroplasts is the site of photosynthesis in the leaf, contain a complete genome, including DNA, RNA, ribosoms, and the enzymes necessary for protein biosynthesis.

Anthurium leaves are characterized as mesophytes (plants that require abundant soil water and relatively humid atmosphere. In the mesophyll (the ground tissue of the leaf) commonly differentiated into palisade parenchyma and spongy parenchyma. The cells of palisade tissue are columnar, with their long axes oriented at right angles to the epidermis. The spongy parenchyma cells are irregular in shape. Chloroplasts are more numerous in palisade cells than in spongy cells. Although the palisade parenchyma appears more compact than the spongy parenchyma, most of the vertical walls of the palisade cells are exposed to intercellular space. The intercellular space is connected with outer atmosphere through the...
stomata, which facilitate rapid gas exchange, an important factor in photosynthetic efficiency (Raven et al., 1995).

In many leaves, the bundle sheaths are connected with either or both upper and lower epidermis by cells resembling the sheath cells. Besides offering mechanical support to the leaf, they apparently conduct water from the xylem to the epidermis. The vein contain xylem and phloem, the xylem occurs on the upper-side of the vein, and the phloem occurs on the lower side (Hopkins, 1999).

Figures 1 and 2. *Anthurium andraeanum* on the bark and rockwool medium in the cultural modifications of water irrigation.

Figure 2. Transverse sections of *A. andraeanum* leaves with intermittent mist treatment on rock wool medium.
Leaves provide an excellent demonstration of physiology and biochemical structure-function relationship. While some leaves may be modified for several purposes (for example, tendrils, spines, and floral parts), the primary function of leaves remains photosynthesis. The evolution of leaves as photosynthetic organs has revolved around three major themes: 1) The exploitation of light, 2) Efficient gas exchange, particularly with respect to CO$_2$ uptake, and 3) A well-organized transport system for the rapid export of product.

In the process of moving into terrestrial habitat, photosynthetic organisms have remained essentially aquatic. Their cells are comprised largely of water and most of their biochemistry is carried out in the aqueous milieu. Unfortunately, an efficient CO$_2$ exchanger is also an efficient evaporator. Leaves have evolved some unique structural and metabolic solutions to this problem of balancing CO$_2$ supply against excessive water loss. Finally, leaves are highly vascularized. An extensive network of interconnected veins serves to supply nutrients and other raw materials to the photosynthetic cells as well as to collect and export the products of photosynthesis to non-photosynthetic tissues and organs elsewhere in the plant (Raven et al., 1995).

**Conclusions**

From transverses section on the leaves of *A. andraeanum*, the plants below intermittent mist treatment in both rockwool and bark medium were produced thicker leaves, and the intercellular space with connected to the outer atmosphere through the stomata was
drastically increased by mist treatment which promoted transpiration, rapid gas exchange and photosynthesis. Plants growing on rockwool medium in mist treatment and control has a lot of chloroplasts in the palisade parenchyma.

References