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The effect of inclination bench and intermittent mist on the growth and production of Anthurium plant (*Anthurium andraeanum*)

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Abstract. *Anthurium andraeanum* is an epiphyte with a habit of growth climbing. This plant has long duration of seed development and juvenile growth phase before flowering. *A. andraeanum* has 5 flowers per plant per year, with a variation from 0 to 7 flowers. The aims of this study are to determine the effect of intermittent mist and inclination bench on the growth and production of *Anthurium* in rock wool medium. This study uses cluster randomized design (RAK) 3 x 3 factorial pattern with 3 repetitions. There are three factors were tested in this experiment: 1) mist treatment (mist and control), 2) media type (bark and granulous rock wool), 3) inclination angle of bench (0, 30 and 60 degrees). The investigations were leaf area, the number of inflorescence harvested, the spathe area, the fresh and dry weights. The results showed the plants with intermittent mist have bigger leaves and growth faster than control. Intermittent mist has similar effect with relative humidity as in the native of *A. andraeanum*. The root of plants on the inclination bench 0° with intermittent mist contact a substrate, and attached or penetrate to the rock wool medium and grown down wards the medium and bench. All flowers from plants grown under intermittent mist classified as large flowers, with the average around 14.19 cm. Intermittent mist and medium influenced the fresh and dry weight of *Anthurium*. Plants with intermittent mist have the average 18.17gram fresh weight and control just 12.96 gram per plant. The structure, length, branching pattern and thickness of aerial roots varied depend on intermittent mist, medium and inclination bench have an effect to the growth and flowering of plants.

Key words: Anthurium, inclination bench, intermittent mist, rockwool

Introduction

Recently growing of *Anthurium* flowers in commercial production have become more important for cut flower and flowering pot plants. *Anthurium andraeanum* has a vast array of colors, incredible vase life and large heart-shaped leaves, native at tropical rain forests of Central and South America (Neal, 1963). *A. andraeanum* is an epiphyte with a habit of growth climbing or anchoring on large trees entangled with other vines, and has numerous aerial roots (Madison, 1980) covered with velamen for absorption water and nutrient.

This plant has long duration of both seed development and juvenile growth phase before flowering due to the low growth rate of plant. The main axis just produces from 3 to 8 leaves per year (Higaki and Watson, 1972; Nakasone and Kamemoto, 1962; Rosario, 1981) depending upon nutrition, environment, and cultivar. *A. andraeanum* need high humidity, shade and constant warm to growth and flowering, and the circle of leaf and flower emergence varies with season (Klapwijk and van der Spek, 1988).

Under commercial conditions the average number of flowers produced is 5 per plant per year, with a variation from 0 to 7 flowers (Leffring, 1975). A single growing axis usually produces only about five to six flowers (spadix and spathe) per year, so a difference in yield of one flower per plant per year may translate into large economic differences (Kamemoto and Kuehnle, 2001). By the selection, the flower production can increase till 7 flowers per

plant. As breeding work always takes a long time, especially for *Anthurium,* caused by the long lasting vegetative period of two and a half years.

Almost simultaneously the question arose if it possible to improve the yield and flower quality either by selection or by improving the environmental conditions. As a commercial cropping, flower yield is an important factor. It was influenced by a number of environmental factors such as temperature, light, insect, diseases, water, and nutrition.

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. We guess that the quantity of water absorbed in this way could significantly affect the plant moisture status, because similarity in nature.

In the traditional culture method, *Anthurium* was grown in bed culture under the shade with tree fern or cheese-cloths. This method require a rotation 4 years for larger cultivars with long internodes, and 5 years for smaller cultivars to keep beds manageable and productive (Kamemoto and Kuehnle, 2001).

Based on the above information, the purpose of this study was to determine the combination of cultural modifications of water irrigation with intermittent mist and inclination bench as a new culture system, to enhance the plant growth and production of *Anthurium* in rock wool medium.

Materials and Methods

a. 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. Angle-adjustable inclination benches (length 100 cm x width 120 cm) made of the stainless-steel mesh was used for growing plants. Tens plants (2 lines of 5 plants) per plot were planted at 35-cm interval between lines and 30-cm interval between plants.

Three 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), 3) inclination angle of the bench (0, 30 and 60 degrees). A slow release coated fertilizer (Long 100, ASAHI CHEMICAL INDUSTRY) was given 10-gram as the basal fertilizer to each plant twice per year.

b. Plant growth and flowering measurements

The investigations were leaf area every 4 weeks, start from 1 week after the planting; the spathe area; the fresh and dry weights of inflorescence.

Results and Discussion

a. Leaf area

When grown under intermittent mist and on the inclination bench, leaf area became significantly larger compare with control (Figure 1).

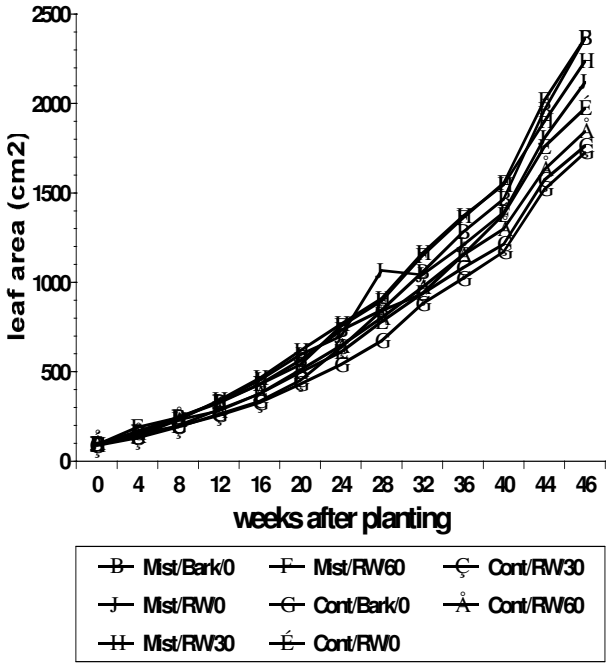

Fig. 1 The effect of intermittent mist and inclination bench on leaf area of *A. andraeanum*.

On 38 weeks after planting, plants under intermittent mist on the inclination bench 60˚have 2367 cm^2 leaf area; and control plant with the same inclination bench on 60˚ have 1844 cm^2 leaf area, the different of leaf area between two treatments was 623 cm^2, respectively. Plants with intermittent mist have bigger leaves and growth faster than control. Intermittent mist has similar effect with relative humidity as in the native of *A. andraeanum*. Madison (1977) reported that *A. andraeanum* is an epiphyte and native in the tropical rain forest, and most epiphytes reside in cloud forests (Sugden and Robins, 1979).

b. Flower production

The licenses from supplier that the plants would have a flower 6 months after planting, but only 3 month after planting (12 weeks) the plants start to flowering. In Figure 2, the maximum flower production was observed on week's 44-56 (May-August) with average cut flower production 5.3 stem per month.

The number of inflorescence tended to increase by the combination of intermittent mist and inclination bench. Plants with intermittent mist on the inclination bench 30˚ and 60˚ have 6.5 and 7.1 stems of cut flowers, respectively; and control plants with inclination bench 30˚ and 60˚ have 5.8 and 6.1 stems of cut flowers. Plants in bark medium in control, start to flowering 36 weeks after planting with the number of cut flower just 4.5 stems.

Plants with intermittent mist and inclination bench produced more stem cut flowers, compare with the plants without intermittent mist. On the other hand, bark medium showed good performance by combining with mist treatment (Figure 1 and 2) and have similar effect with rock wool medium in the growth and flowering. This experiment showed that *A. andraeanum* requires well-aerated media to provide sufficient moisture. When grown in media with many gaps, the capability of water absorbing of the roots becomes low, because total contact area between the surfaces of aerial roots and culture medium is small.

The maximum flower production was observed with intermittent mist treatment on the inclination bench 30° and 60°(on 44-56 weeks), flower production increases considerably from spring to summer. The seasonal influences mainly were found on plant growth, growth period and flower bud abortion. Variation in flower yield is significantly influenced by temperature and solar radiation (Leffring, 1975; Kamemoto and Kuehnle, 2001; Klapwijk and van der Spek, 1988).

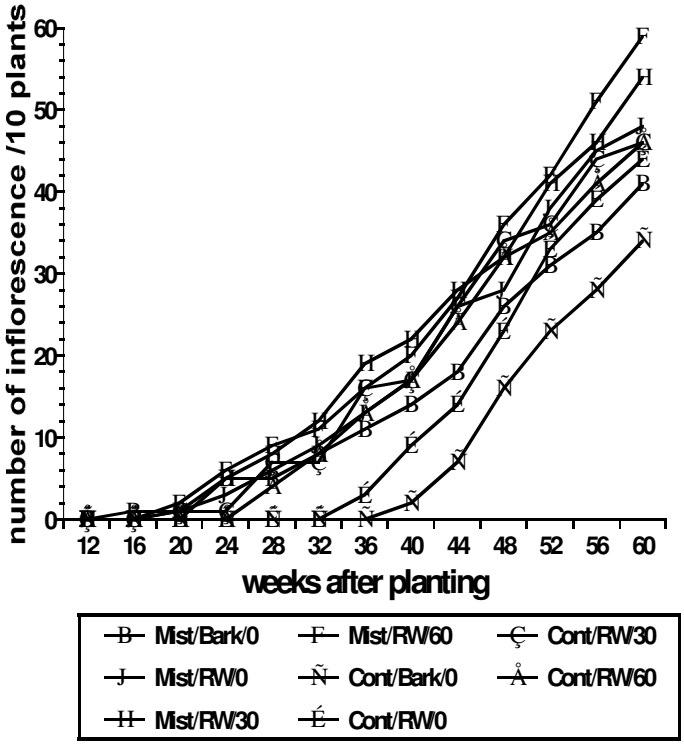

Fig. 2 The effect of combination intermittent mist on the number of inflorescence, with weekly interval

c. Flower size (spathe area)

Plants under intermittent mist produced larger spathe area in both rockwool and bark medium than control plants, with the average around 14.19 cm, respectively (Figure 3). In control, the inclination bench influenced the flower size; plants on the inclination bench 60° with rockwool medium have 12.18 cm of spathe area, respectively. Plants in bark medium on the inclination bench 0° just have 10.19 cm. In this experiment, all flowers from plants grown under intermittent mist classified as large flowers by the Hawaii Grades and Standards of *Anthurium* flowers, to be considered 'large', the size of flower must be 12.7cm

to 15.2cm (Hawaii Dept. of Agriculture, 1972). Size is determined by averaging the length and width of the spathe.

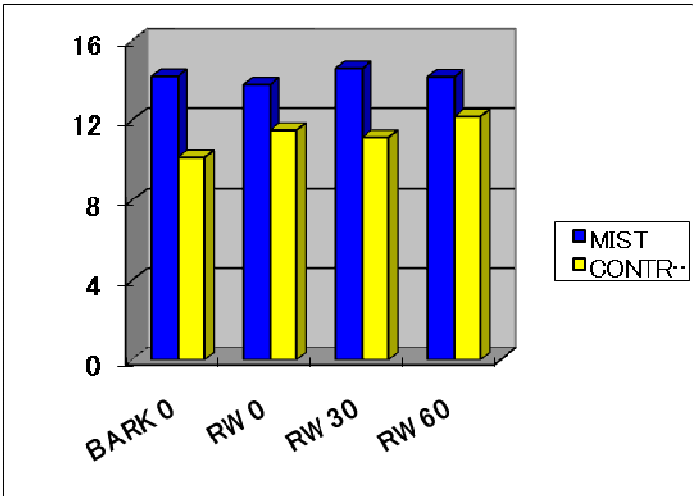

Figure 3.The effect of intermittent mist and inclination bench to the spathe area of *A. andraeanum* (cm)

e. The fresh and dry weight

Intermittent mist and medium influenced the fresh and dry weight of *Anthurium* cut flower. Plants with intermittent mist have the average 18.17gram fresh weight and control just 12.96 gram per plant (Figure 4). In dry weight, plants with intermittent mist have around 2.0 gram per plants compare with control just 1.0 gram per plants (Figure 5). In this experiment rock wool as a medium showed a good result when combine with inclination bench, to provide a holding place for water and nutrient. When *A. andraeanum* grow on the inclination bench, the root exposure to air is not restricted like in the pot. Using the sloping benches admitted the development of aerial root, and the shape of the root system directly and/or indirectly affected the growth and flowering

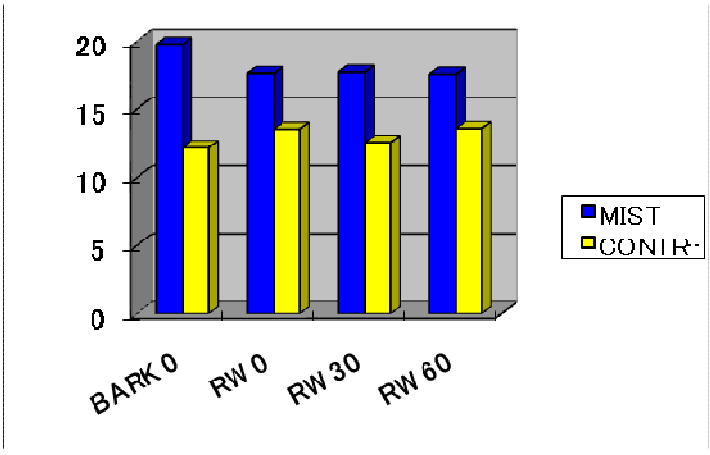

Figure 4.The fresh weight of *A. andraeanum* in the new culture system based on the growth habit, with intermittent mist and inclination bench (g).

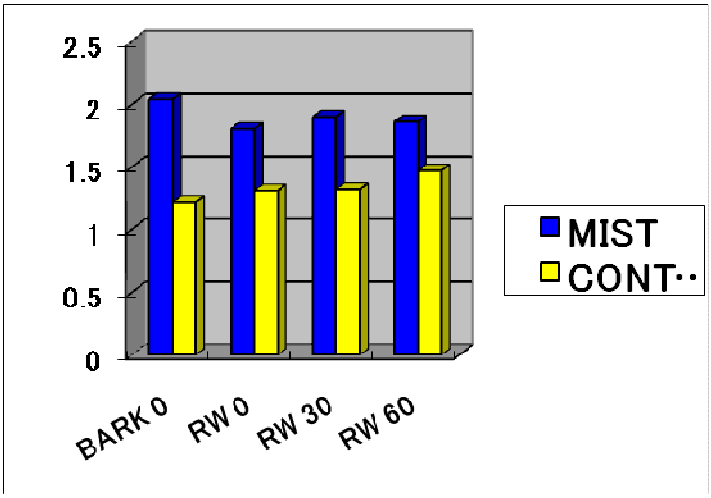

Figure 5.The dry weight of *A. andraeanum* in the new culture system based on the growth habit, with intermittent mist and inclination bench (g).

Conclusions

Intermittent mist enhances the time of flowering more early in rock wool medium (12 weeks), than rock wool medium without mist (32 weeks). Higher-quality of flower was produced under this system. The number of inflorescences tended to increase on the inclination bench, plants on the angle 30° and 60° with intermittent mist were produced 6.5 and 7.1 cut flowers per plant per year; root and shoot of the plants on this angle were better than those plants.

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