CO_2 Evolution Rate Decrease of Anthuriums as Affected in Storage[1]

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ABSTRACT

An investigation of the comparative carbon dioxide evolution rates of cut anthuriums was conducted with the Infra-Red Gas Analyzer. Only one major commercial variety, Kaumana, was used with the test flowers classified into four commercial sizes: large, medium, small, and miniature. The rate of carbon dioxide evolution from all flowers decreased logarithmically during the 16 days in storage.

INTRODUCTION

The anthurium (*Anthurium andreanum* L.) is grown chiefly in tropical or near tropical climates for its attractive, long lasting flowers. A large majority of these in the United States are grown in Hawaii and southern California, and to a much lesser extent in Puerto Rico. The anthurium industry is one of the elements of diversified agriculture in Hawaii, which contributes significantly to its economic stability. As an example, the number of flowers sold increased from 796,000 dozen in 1970 to 1,130,000 dozen in 1974, a 42% increase. The wholesale value of these flowers increased 79% during the same period, from $0.94 million to $1.69 million (8). The cultivation of anthurium for a cut-flower enterpise has a great potential in Puerto Rico. The Agricultural Experiment Stations in Adjuntas and Gurabo presently cultivate anthuriums on an experimental basis (12).

Numerous studies have been made in the past whereby the respiration rates of various biological materials have been measured to detect bruises (1, 2, 4, 6, 7, 9, 11). Respiration is a complex combination of coupled metabolic processes in which organic substrates such as sugars or starches are combined with oxygen to yield carbon dioxide, water and energy. With a depletion of such substrates the respiration rate decreases. This information could offer a potential method for the evaluation of cut-flower freshness in vase-life in bulk handling, provided that the respiratory response is not affected by temperature changes or other factors.

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MATERIALS AND METHODS

The anthurium flower consists of a modified leaf (spathe) with a single finger-like projection (spadix) from the base of the spathe. All flowers received for experimentation were sized into the four commercial categories: large, medium, small, and miniature as shown below (5).

Size	Spathe length (tip to base, cm)
Large	> 11.4
Medium	9.5–11.4
Small	7.6– 9.5
Miniature	< 7.6

The flowers were harvested when anthesis was 60–70% complete, and then shipped by air from Hilo, Hawaii, to the Agricultural Engineering Department at the University of Hawaii, Honolulu. Only one variety, Kaumana, was studied for these tests. Upon arrival, the flowers were placed in jars containing 15–20 cm of water. The temperature of the storage room was maintained at 21° C. With this procedure, the flowers lasted approximately 3 weeks. Stems were cut 5 cm after every 5 days as a recommended practice to prolong the vase life (10). All tests on the measurement of respiration (carbon dioxide evolution) from the flowers in storage were conducted in a laboratory where the temperature was maintained at 24 ± 1° C to rule out any significant effect on respiration rate due to temperature variations.

An airtight flower holding chamber was constructed from acrylic plastic sheet 0.5 cm thick with inner dimensions 28.2 cm × 23 cm × 7.5 cm, with an inlet and an outlet for the flow of circulating air. Two 0.2 HP diaphragm pumps were used, one to maintain a continuous circulation of air through the flower chamber and the other to circulate air through an Infra-Red Gas Analyzer (IRGA) via a flowmeter and a cotton filter to trap any dust particles. The entire experimental circuit was a closed loop system and all units of the experimental system were interconnected by means of 0.25 cm and 0.95 cm flexible plastic tubings (fig. 1).

PROCEDURE

Four groups, each consisting of 10 good flowers, and sorted according to size classification: large, medium, small, and miniature were tested daily for carbon dioxide evolution rate at a temperature of 24 ± 1° C. Measurements of evolved carbon dioxide were made daily for 16 consecutive days at a constant air flow (650 ml/min) through the IRGA unit. The air flow rate was maintained by means of a control valve and a flow meter provided at the outlet of the second pump. The evolution of carbon dioxide was studied for all tests between two selected concentration levels, namely from an initial concentration of 100 p/m to a final

concentration of 170 p/m. The IRGA unit was connected to a Leeds & Northrup[3] recorder which gave a continuous record of carbon dioxide concentrations.

The IRGA unit was calibrated with pure nitrogen in the reference cell, which determined the zero on the measurement scale, and a span gas comprising 510 p/m carbon dioxide in nitrogen by volume in the sample

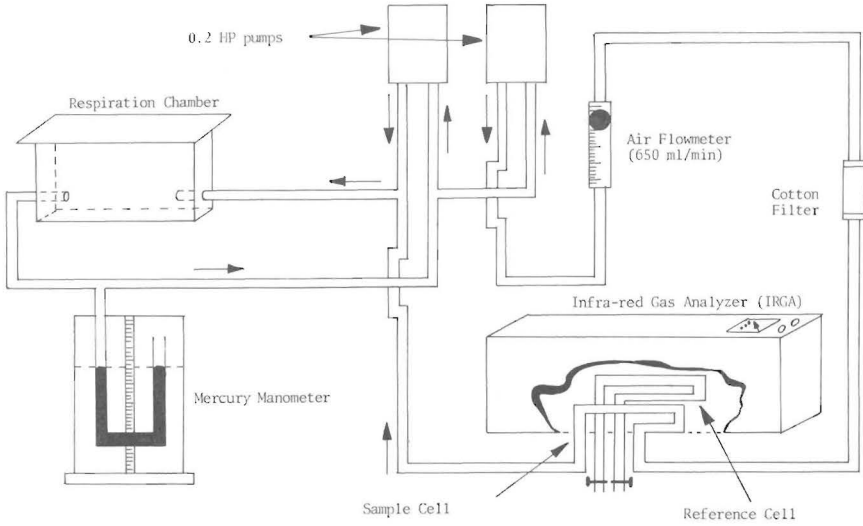

FIG. 1.—Closed-loop experimental station.

cell. With reference to the analyzer calibration curve, a carbon dioxide concentration of 510 p/m corresponded to a deflection of 90 D.C. microamperes on the IRGA unit. This established the upper limit of the measurement scale.

After the completion of a test, it was essential to purge the system to reduce the carbon dioxide and water vapor concentrations to the initial level, prior to beginning the next test. This was accomplished with two acrylic plastic tubes containing calcium hydroxide (soda lime) and silica gel respectively (fig. 2).

RESULTS AND DISCUSSION

The plotted curves including observations (fig. 3), and the resulting logarithmic equations and correlation coefficients (table 1) clearly indi-

[3] Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

cate that the rate of evolution of carbon dioxide by flowers of all sizes gradually decreased when stored for a long period of time under constant temperature conditions. This decrease could be attributed to the depletion of substrates such as sugars and starches for respiration. On the first day when the flowers were at the peak of their freshness, carbon dioxide evolved from large flowers at a rate approximately two and a half times that of miniature flowers. At the end of the 16-day period, the carbon dioxide evolution rate for large flowers was observed to be twice that of miniature flowers.

Temperature plays an important role in the evolution of carbon dioxide. It has been established that a rise of temperature within the biological range is likely to cause an acceleration of respiration rate (3). It has also been found, although not always, that at excessively high temperatures,

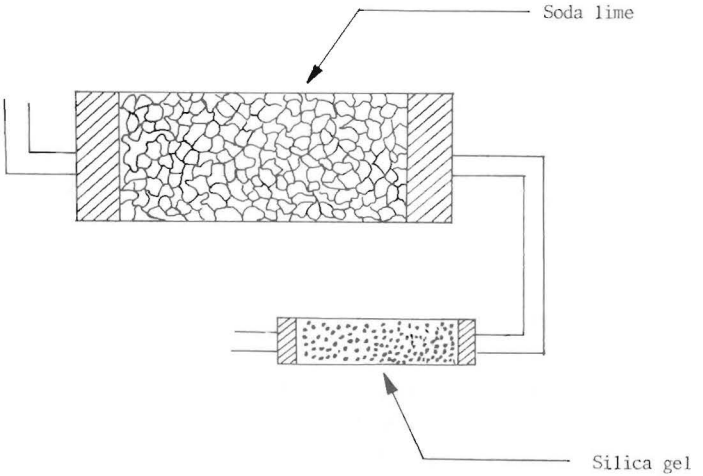

FIG. 2.—The carbon dioxide and water-vapor purging unit.

the respiration rate declines, and various estimates have been made of the point at which the inflexion from acceleration to deceleration took place. This so-called critical temperature is usually estimated to lie between 35° C and 40° C. However, if ambient conditions are maintained constant, then significant comparisons, leading to possible applications in the cut-flower industry, can be made in sorting and in the determination of cut-flower freshness.

RESUMEN

Un trabajo de investigación se llevó a cabo para estudiar la tasa comparativa de cambio del anhidrido carbónico de la flor del anturio cortada

usando un analizador de gases que usa luz infrarroja. Solamente la variedad comercial Kaumana se usó con muestras de flores de cuatro tamaños: grandes, medianas, pequeñas y miniaturas. La tasa comparativa de cambio del anhidrido carbónico de todas las flores disminuyó logarítmicamente en un período de 16 días.

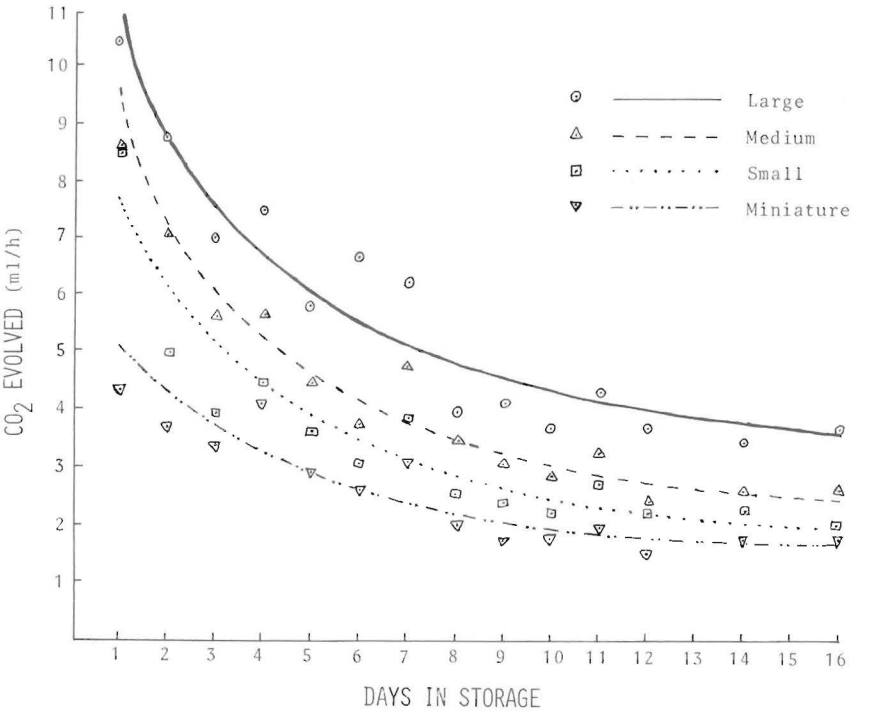

FIG. 3.—Respiration-rate decrease of flowers in storage at 24 ± 1° C.

TABLE 1.—*Regression equations for the carbon dioxide evolution rate (ml/h) of undamaged cut anthuriums versus the number of days in storage at 24 ± 1° C*

Flower classification	Regression equation	Correlation coefficient (R^2)
Large	$\hat{Y} = 11.46\ X^{-0.41}$	0.853
Medium	$\hat{Y} = 9.74\ X^{-0.49}$	.925
Small	$\hat{Y} = 7.79\ X^{-0.49}$	.916
Miniature	$\hat{Y} = 5.21\ X^{-0.41}$	.792

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