*Int. Agrophysics, 2000, 14, 307-310*

# TRANSPIRATION RATE OF CUT ANTHURIUMS BY A HYGROMETRIC METHOD

*S. Mujaffar, C.K. Sankat*

Agricultural Engineering Programme, Faculty of Engineering, University of the West Indies
St. Augustine, Trinidad, West India

*Accepted March 6, 2000*

A b s t r a c t. Interest in determining transpiration rate of cut anthuriums led to the development of a method employing the use of a hygrometer (a humidity sensor). Transpiration rates of cut flowers held under ambient (28 °C, rh 60-80%) and refrigerated storage conditions (18 and 13 °C, rh 80-90%) obtained by hygrometry were found to be similar to those obtained by the traditional, direct weighing method. These rates also declined logarithmically with storage time. Hygrometry can be successfully used to directly measure the quantity of water vapour released as a result of the transpiration process.

K e y w o r d s: anthuriums, hygrometry, shelf-life, transpiration

## INTRODUCTION

Moisture loss during storage and shipment is a major factor affecting quality and marketability of perishable commodities [2]. Previous work by Sankat and Mujaffar [9] revealed that the transpiration rate of anthurium cut flowers declines logarithmically with storage time, and that the relationship between the rate of transpiration and the rate of water uptake directly affects flower turgidity and shelf life. Understanding of the transpiration process is therefore an important consideration in cut flower post-harvest technology.

A number of different techniques have been used to determine the transpiration rate of cut flowers while they are in water. The most commonly used method involves monitoring weight changes of a system consisting of the flower in a sealed bottle containing water, where any loss in weight is attributed to water loss as a result of transpiration [3-5,7,8,10,11].

Alternatively, a hygrometer (a humidity sensor) can be used to directly measure the quantity of water vapour released during transpiration. Butchbaker [1] described a simple method to determine moisture loss in potatoes, adding that the procedure could be adapted for other biological products. This technique is based upon measuring the rate of change in the moisture content of the air in a closed system containing the product.

The objectives of this study were to determine whether the hygrometric method described by Butchbaker [1] could be used to measure transpiration rates of cut anthuriums, and to compare rates obtained by hygrometry with those obtained by weight measurements.

## MATERIALS AND METHODS

In this method, a hygrometer is used to measure the relative humidity and the dry-bulb temperature of the air in a closed system containing the flower. Since all the principal hygrometric values are interrelated, a measurement in one term can be converted to another if one or two other parameters are known. Thus, from the values of relative humidity and dry-bulb temperature the change in the moisture content of the air in the sealed environment containing the flower was calculated.

Anthurium flowers (cv. Trinidad Pink) were individually placed singly in plastic bottles containing distilled water and the mouth of each bottle was sealed with waterproof parafilm to ensure that water loss occurred only via the flower. The bottles were placed in refrigerated storage chambers set at 13 and 18 °C (rh 80-90%), as well as under ambient conditions (28 °C, rh 60-80%) for the maximum of 30 days. Ten flowers were used for each treatment, and the entire experiment was repeated twice.

Components of the basic hygrometric measuring system are illustrated in Fig. 1. The system consists of a sealed 20-litre bucket to which the probe of the hygrometer is attached. The probe of the hygrometer was sealed, using silicone sealant, into a hole cut in the lid of the bucket. The relative humidity and the dry-bulb temperature of the air in the closed system could be read from the digital display on the Humitemp Model B hygrometer (Phys-Chemical Research Corp.). The bottle with the flower was placed in the bucket, and the lid with the probe positioned. Vacuum grease was applied to the rim of the bucket and lid before sealing. Values of the relative humidity, temperature and time were recorded from the observations of the hygrometer. A great deal of pretesting was done to ensure a proper seal in the system, to determine the frequency of sampling, and the maximum time required to obtain sufficient readings without altering the storage environment of the flower significantly.

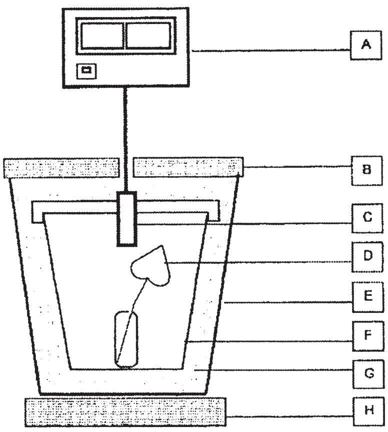


**Fig. 1.** Diagram of the components of the measuring system for determining the transpiration rates of cut anthuriums. A - hygrometer, B, G, H - styrofoam insulation, C - hygrometer probe, D - anthurium, E - large outer bin, F - sealed bucket.

Various properties of air-vapour mixtures are interrelated, thus the values of relative humidity, dry bulb temperature, time, volume of bucket, initial ambient temperature and ambient pressure were used to calculate the humidity ratio of the air in the bucket, and then the actual mass of water vapour in the bucket. This was done using appropriate mathematical expressions which are used to describe a psychrometric chart [1,6].

This increase in the mass of water vapour of the air was attributed to the weight loss by the flower due to the water loss by transpiration, and a plot of this water loss versus time over a limited time range indicated a linear relationship. The slope of this graph represents the weight loss of the flower as a function of time, that is, the transpiration rate of the flower.

For the direct weighing method, the weight of the complete system consisting of the flower and the sealed bottle containing water was measured at the start of the experiment and at 5-day intervals. The transpiration rate was calculated from the change in the weight between the two consecutive weighings, divided by the number of hours during that interval.

## RESULTS AND DISCUSSION

Transpiration rates of anthuriums stored under ambient and refrigerated conditions determined via weight measurements and via the use of a hygrometer are shown in Fig. 2. Comparisons made using the Comparison of Linear Regressions Statistical Program (COLR Program #11, Version 1 - December 1974, CARDI, St. Augustine) revealed no significant differences in the transpiration rates determined via weight measurements and via the use of a hygrometer.

Transpiration rates of anthuriums held under both ambient and refrigerated conditions determined by the two methods were also found to be consistent with the results obtained in a

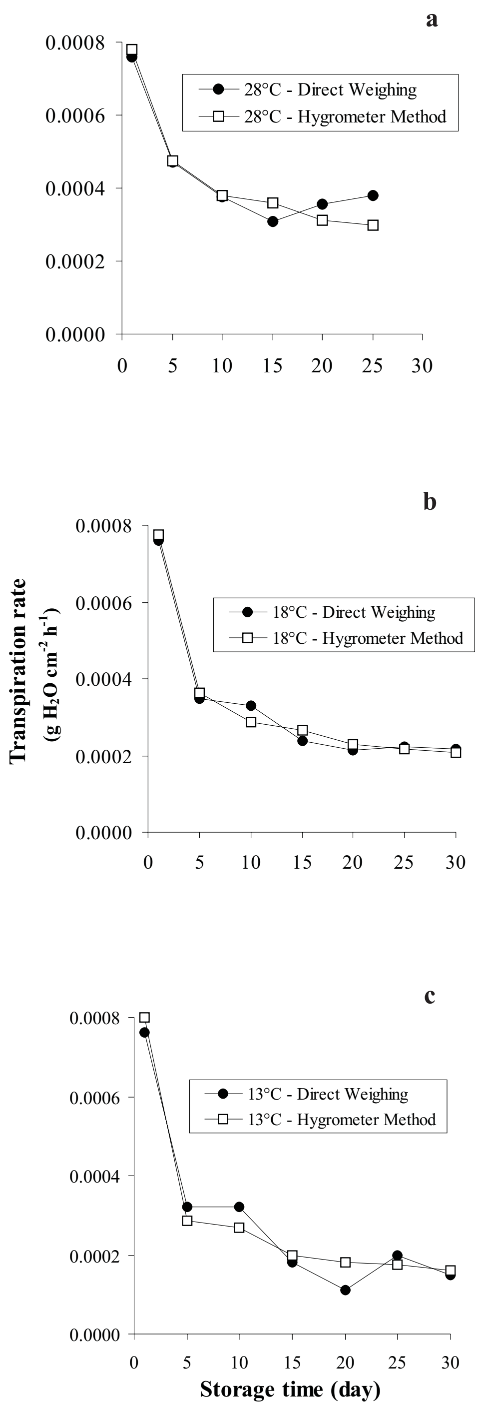


**Fig. 2.** Transpiration rates of cut anthuriums stored under ambient and refrigerated conditions (28°C (a), 18°C (b), 13°C (c)) determined by direct weighing and by hygrometry.

previous study [9]. Rates declined logarithmically with storage time ($p \leq 0.001$) were attributed to an impairment in the water uptake capacity, and lowering of the temperature reduced transpiration rate ($p \leq 0.01$) due to the reduction in the evaporative demand of the environment. A sharp decrease in transpiration following harvest and the subsequent levelling off has been reported by Mayak *et al*. [8].

Neither the hygrometric method nor the direct weighing method differentiates between the moisture loss due to the diffusion process as a result of vapour pressure differences and that from the respiration process. However, by including gas analysis equipment into the hygrometric method, the rate of moisture production due to respiratory activity can be calculated. Butchbaker [1] noted that the buildup of carbon dioxide in time may possibly alter respiration and the resulting moisture loss. However, because of the short sampling times employed in this study (40 min) it is not envisioned that there would be any appreciable $CO_2$ buildup.

## CONCLUSION

There have not been any prior studies on the comparison of direct weight measurements and hygrometry in the cut flower water relations. This study has revealed that transpiration rates measured by hygrometry are similar to those obtained by direct weight measurements. Hygrometry is therefore a useful alternative method of determining the transpiration rate of cut anthuriums. Additionally, hygrometry is a rapid technique and transpiration rates can be obtained in one hour as opposed to the weighing method where rates are normally obtained after 24 h.

## REFERENCES

1. **Butchbaker A.F.:** A method for determining the moisture loss from biological products. Trans. ASAE, 110-115, 1972.
2. **Chan K.V., Gaffney J.J., Romero R.A.:** A mathematical model for the transpiration from fruits and vegetables. ASAE Paper No. 85-6005. Michigan State University, East Lansing, 1985.
3. **Dai J., Paull R.E.:** Effect of water status on Dendrobium flower spray postharvest life. J. Amer. Soc. Hort. Sci., 116(3), 491-496, 1991.

4. **Fujino D.W., Reid M.S., Kohl H.C.:** The water relations of maidenhair fronds treated with silver nitrate. Scientia Hort., 19, 349-355, 1983.
5. **Halevy A.H., Mayak S., Tirosh T., Spiegelstein H., Kofranek A.M.:** Opposing effects of abscisic acid on senescence of rose flowers. Plant & Cell Physiol., 15, 813-821, 1974.
6. **Lerew L.E.:** A. Fortran Psychrometric Model. Master of Science Thesis, Agricultural Engineering Department, Michigan State University, East Lansing, Michigan, 1972.
7. **Mayak S., Halevy A.H.:** The action of kinetin in improving the water balance and delaying senescence processes of cut rose flowers. Physiol. Plant., 32, 330-336, 1974.
8. **Mayak S., Halevy A.H., Sagie S., Bar-Yosef A., Bravdo B.:** The water balance of cut rose flowers. Physiol. Plant., 32, 15-22, 1974.
9. **Sankat C.K., Mujaffar S.:** Water balance in cut anthurium flowers in storage and its effect on quality. Acta Hort., 368, 723-732, 1994.
10. **Stamps R.H.:** Harvest time and postharvest immersion affect water uptake and postharvest decline of leatherleaf fern. Proc. Inter-Amer. Soc. Hort. Sci., 31, 42-50, 1987.
11. **Zieslin N., Kohl H.C. JR., Kofranek A.M., Halevy A.H.:** Changes in the water status of cut roses and its relationship to bent-neck phenomenon. J. Amer. Soc. Hort. Sci., 103(2), 176-179, 1978.