Int. Agrophysics, 2003, 17, 77-84

INTERNATIONAL
Agrophysics
www.ipan.lublin.pl/int-agrophysics

Effect of waxing on the water balance and keeping qualities of cut anthuriums

S. Mujaffar and C.K. Sankat*

Department of Mechanical Engineering, University of the West Indies, St. Augustine, Trinidad, W.I.

Received December 16, 2002; accepted January 10, 2003

A b s t r a c t. Improving the shelf life of cut anthuriums through the application of a fruit wax was investigated. The transpiration rate of cut flowers held under ambient (28°C, rh 60–80%) and refrigerated conditions (18 and 13°C, rh 80–90%) were shown to decrease when the wax was applied to the spadix tissue. Waxing of the spadix maintained the fresh weight and extended the shelf life of the flowers under ambient conditions for to up to 20 days. The shelf life of waxed flowers stored at 18°C was extended from 20 to 25–30 days with a corresponding improvement in water relations, while waxed flowers stored at 13°C were comparable in appearance to the control (untreated) flowers. Waxing of the spathe tissue resulted in discolouration of the spathe.

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

INTRODUCTION

The most common reason for the termination of the life of cut flowers 'in the vase' is their wilting, not their natural senescence [4]. Wilting occurs as a result of water stress, which occurs when the rate of transpiration exceeds the rate of water uptake. Symptoms of water stress in anthuriums include loss of weight, loss of spathe gloss, spathe blueing, spadix necrosis and abscission. Sankat and Mujaffar [11] showed that these symptoms appear in cut 'Trinidad Pink' anthuriums when the ratio between the rates of transpiration and the water uptake (transpiration : uptake ratio) exceeds 1.5.

Water loss in anthuriums occurs primarily through the numerous tiny flowers on the pencil-like spadix. There are relatively few stomatal openings on the colourful, petal-like spathe, and both the spathe and stem are covered with an abundant layer of waxy cuticle [12,14]. Because of this, anthuriums can maintain a positive water balance for an extended period compared with other flowers. The shelf life of the anthurium varies greatly from cultivar to cultivar, even when grown under identical conditions [9]. Anthurium flowers are also quite easily mechanically damaged, are susceptible to water loss, attack by microorganisms and the detrimental effects of ethylene gas. The actual vase life of 'Trinidad Pink' anthuriums in tropical ambient temperatures can vary from 1 to 2 weeks.

One approach to reducing the transpiration rate of cut anthuriums with a view to extending shelf life is the application of a commercial wax commonly used for maintaining fruit and vegetable quality. Waxes or coatings are commonly applied to fruit and vegetables to reduce water loss during storage. These coatings can be formulated from different materials, including lipids, resins, polysaccharides, proteins and synthetic polymers [1]. Post-harvest coatings are available for use on citrus fruits, tomatoes, cucumbers, apples, yams, melons, mangoes and papayas. According to Baldwin [1], coatings are a simple, environmentally friendly, and relatively inexpensive technology that can be used to extend the shelf life of tropical fruits and vegetables provided that there is good storage and temperature control. Baldwin however recommended that prior to use, coatings should be tested and tailored for each commodity.

Little published data is available on the use of commercially available wax solutions to reduce transpiration in cut anthuriums. Watson and Shirakawa [14] investigated the morphology of 'Ozaki Red' anthuriums as it related to water evaporative ability and shelf life. They compared the amount of water lost by untreated anthuriums with those in which the spadices were dipped in paraffin heated at 70°C, before storing with their stems in water under ambient conditions. The weight loss was consistently greater from spadices that were not dipped in paraffin.

*Corresponding author's e-mail: saheeda@tstt.net.tt

© 2003 Institute of Agrophysics, Polish Academy of Sciences

Paull and Goo [8] investigated the effect of a range of commercial lipid-based coatings on the water uptake rate and vase life of 'Ozaki Red' anthuriums. In simulated shipping trials, flowers were dipped in coatings such as polyethylene, paraffin, vegetable oil and carnauba, held in water for 24 h then packed in commercial flower boxes for 3 days at 22–25°C. Stems were then recut and flowers placed in deionized water. Waxes were assessed based on the reduction in flower water loss, high gloss appearance when dry and vase life extension. Results showed considerable variation in the effectiveness of the waxes to extend shelf life. Waxing of the whole or parts of the anthurium with carnauba-based FMC-819 was found to decrease water uptake (g day^{-1}) by 10 to 20% and to double vase life with or without 3 day packing. Polyethylene-based FMC-715 increased vase life from 17.9 to 26.5 days, while another polyethylene-based wax, FMC-700, had no effect on vase life.

The object of this study was to investigate the effect of a simple wax treatment using Fresh Wax 51V (a liquid paraffin-based wax) on the water balance and keeping qualities of cut 'Trinidad Pink' anthuriums stored under ambient and refrigerated conditions. Previous studies showed that this wax effectively reduces weight loss due to transpiration in papayas, breadfruit and breadnuts [10].

MATERIALS AND METHODS

Anthurium flowers c.v. 'Trinidad Pink', were obtained from a commercial, cut anthurium producer in Lalaja, Trinidad. Undamaged flowers that were at least three-fourths matured, based on the percentage of open flowers on the spadix, [6] were selected for storage. Flowers were treated with a commercially available wax, Fresh Wax 51V (Fresh Mark Corporation, Florida), which is commonly used for maintaining fruit quality. A small paintbrush was used to apply a thin coat of the liquid wax to both the spathe and spadix in some flowers, and only to the spadix tissue in others. Flowers were then cut to a length of 30 cm and placed singly in plastic bottles containing distilled water. The mouth of each bottle was sealed with parafilm to ensure that water loss occurred only via the flower [2,3,5,13,15]. 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 a maximum of 30 days and the water was changed every 5 days. Twenty flowers were used for each treatment. Previous work [11] showed that 'chill' injury to anthuriums occurred at 8°C, so flowers were not stored at this temperature. Paull [7] noted that if anthuriums are kept much cooler than 14–17°C, the flowers become unsaleable as they develop necrosis of the spadix as well as various spathe discolorations such as blueing, browning and blackening.

Based on a procedure used by Paull and Goo [8], transpiration and water uptake rates of the flowers were measured as in a previous study [11]. Rates were expressed in g H_2O cm^{-2} spathe h^{-1}. Moisture content was expressed on a dry weight basis (g H_2O g^{-1}DM), which was determined after a 48 h oven drying of a composite tissue sample (spathe, spadix and stem) at 65°C [8]. The vase life and keeping quality of the flowers were determined through spathe colour, spathe gloss and spadix senescence [6]. Marketability (based on overall appearance) was also assessed. The data was analysed using the MINITAB (Release 7.2, Minitab Inc., 1989) statistical package.

RESULTS AND DISCUSSION

Figure 1 shows the changes that occur during the ambient storage of untreated and waxed anthuriums. Untreated (control) anthuriums stored under ambient conditions experienced changes in weight, transpiration rate and the transpiration : uptake ratio as previously recorded [11]. Waxing of the entire flower head (that is, both the spathe and spadix tissue) prior to storage under ambient conditions significantly reduced water loss by as much as 20% (p 0.05) during the first 5 days of storage. These flowers maintained higher fresh weights and a positive water balance (transpiration : water uptake ratio of less than 1.5) for up to 14 days. However, the presence of wax on the spathe tissue resulted in the development of brown unattractive spots after 10 days. By comparison, waxing of the spadix tissue alone was also found to decrease water loss due to transpiration and maintain a positive water balance for up to 14 days without adversely affecting the appearance of the bloom. Beyond this time, waxed flowers deteriorated as the loss in weight exceeded 5% of the initial weight and the transpiration : uptake ratios exceeded 1.5. Waxing of the spadix tissue alone was therefore found to significantly (p 0.001) extend the shelf life of anthuriums and this treatment was repeated at refrigerated temperatures 18 and 13°C.

Changes in fresh weight, transpiration rates and transpiration : uptake ratios for control and waxed anthuriums stored at ambient and refrigerated temperatures (28, 18 and 13°C) are given in Figs 2–4, respectively. Waxed flowers stored at 18°C maintained higher fresh weights and lower transpiration rates than control flowers, and after 26 days of storage the transpiration : uptake ratio averaged 1.31. Control flowers at 18°C deteriorated after 19 days. The weight loss and transpiration rates of waxed flowers stored at 13°C were slightly lower than for the control flowers, however, both the control and the waxed flowers maintained a positive water balance (ratio of 0.86–1.24) for the duration of the storage trial. As shown in Fig. 5, the waxed flowers showed the typical change in moisture content as previously reported [11], but these changes were more gradual. Waxed flowers held under ambient conditions maintained high moisture contents for 15 days, beyond which the moisture content

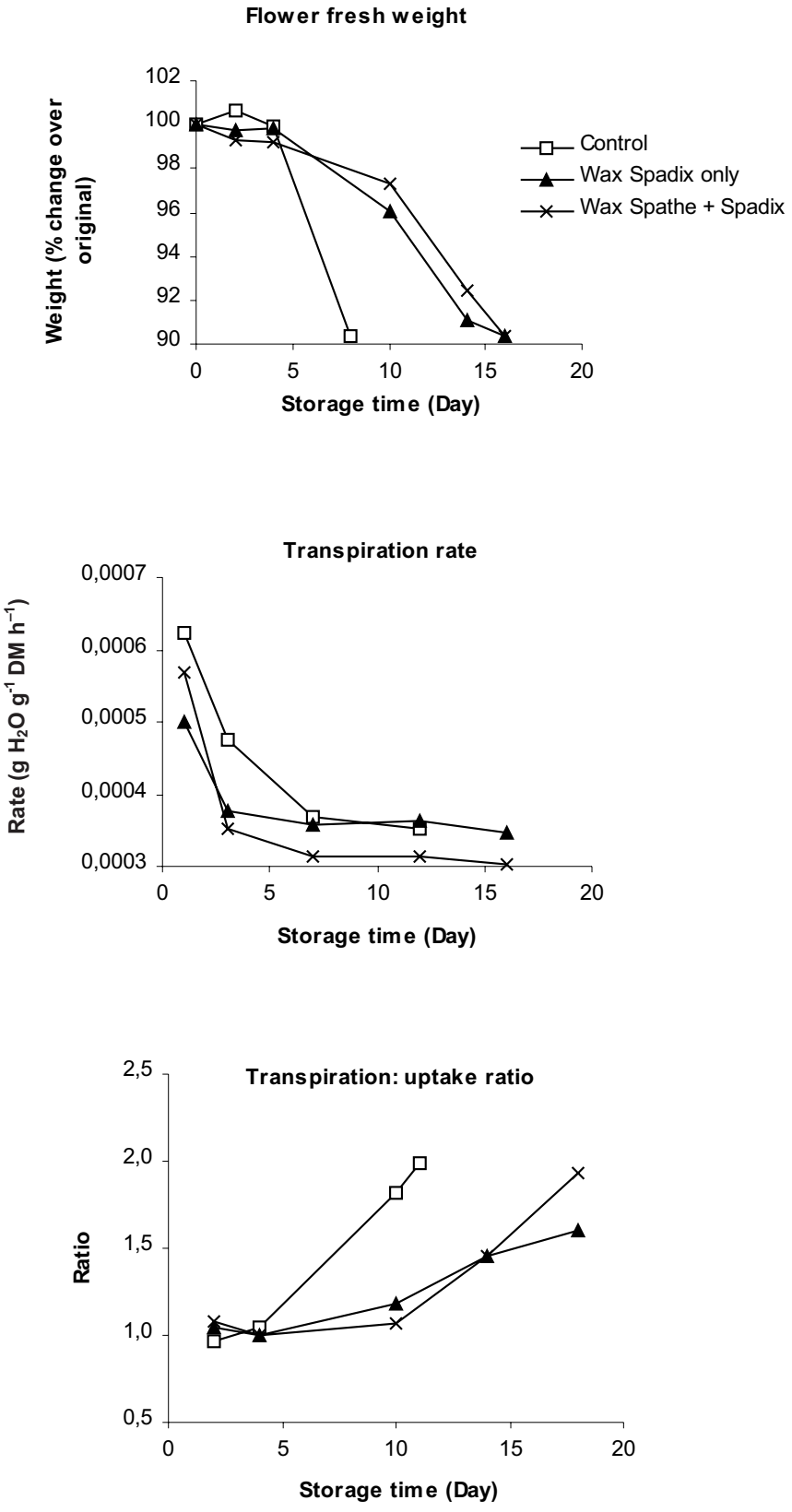

Fig. 1. The effect of waxing on the water relations of cut anthuriums during ambient storage.

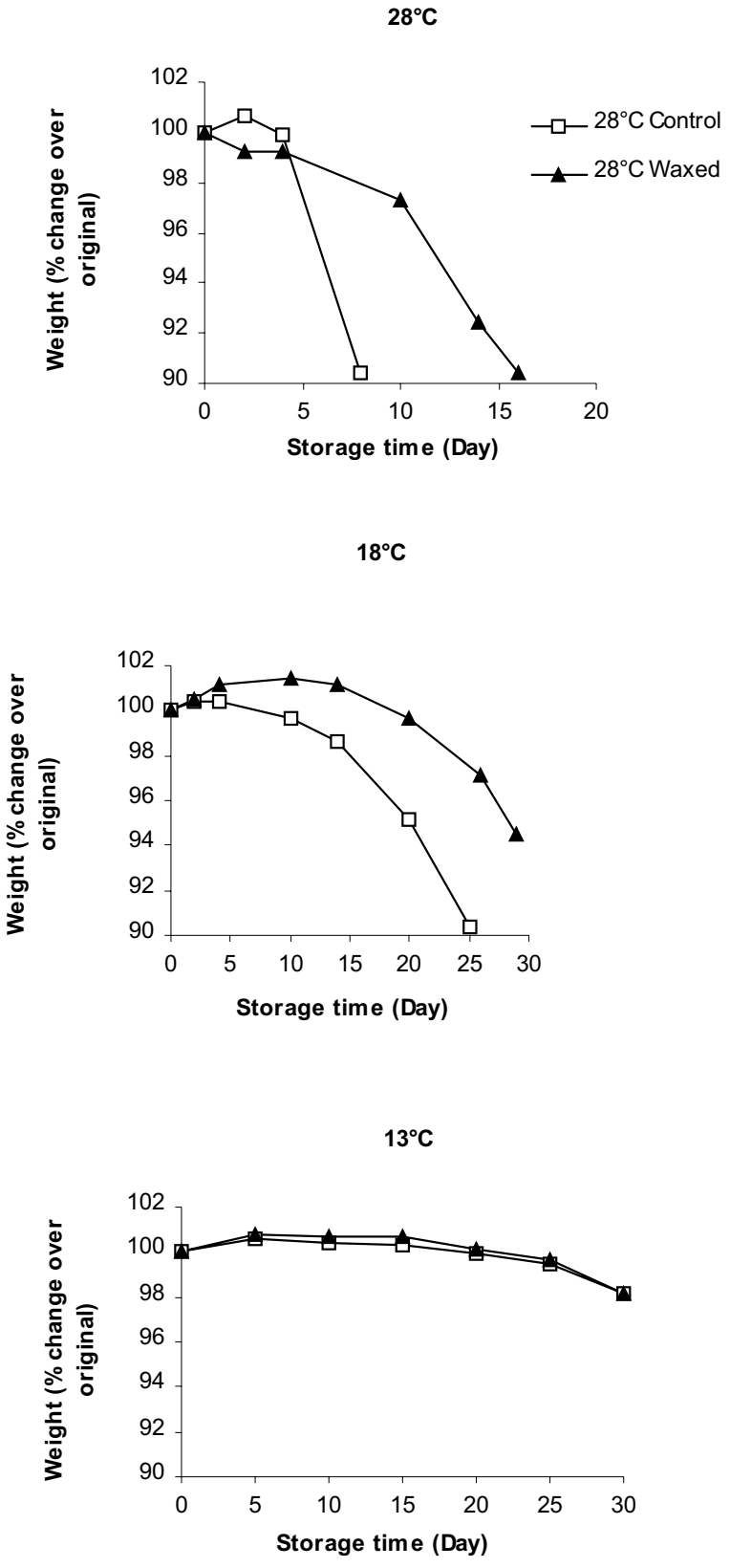

Fig. 2. The effect of spadix-waxing on the fresh weight changes in cut anthuriums during ambient and refrigerated storage.

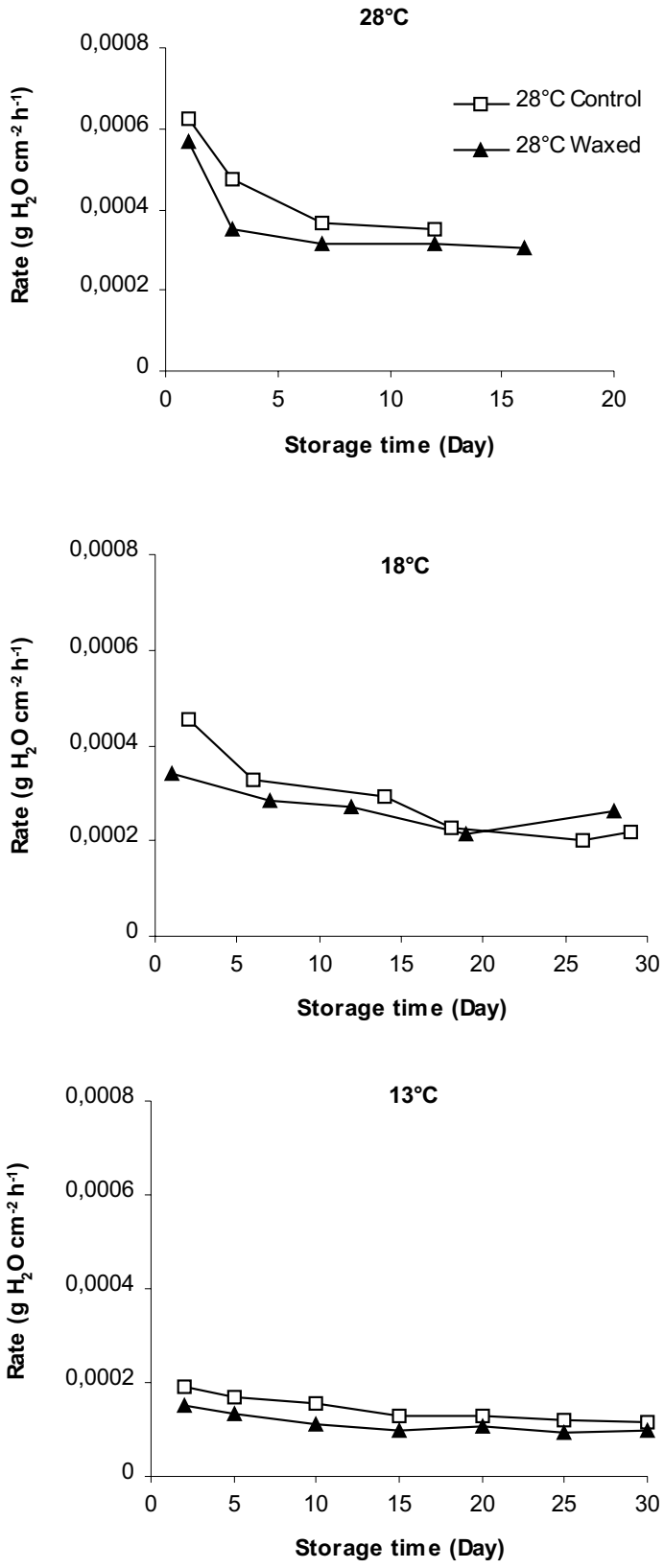

Fig. 3. The effect of spadix-waxing on the transpiration rates of cut anthuriums during ambient and refrigerated storage.

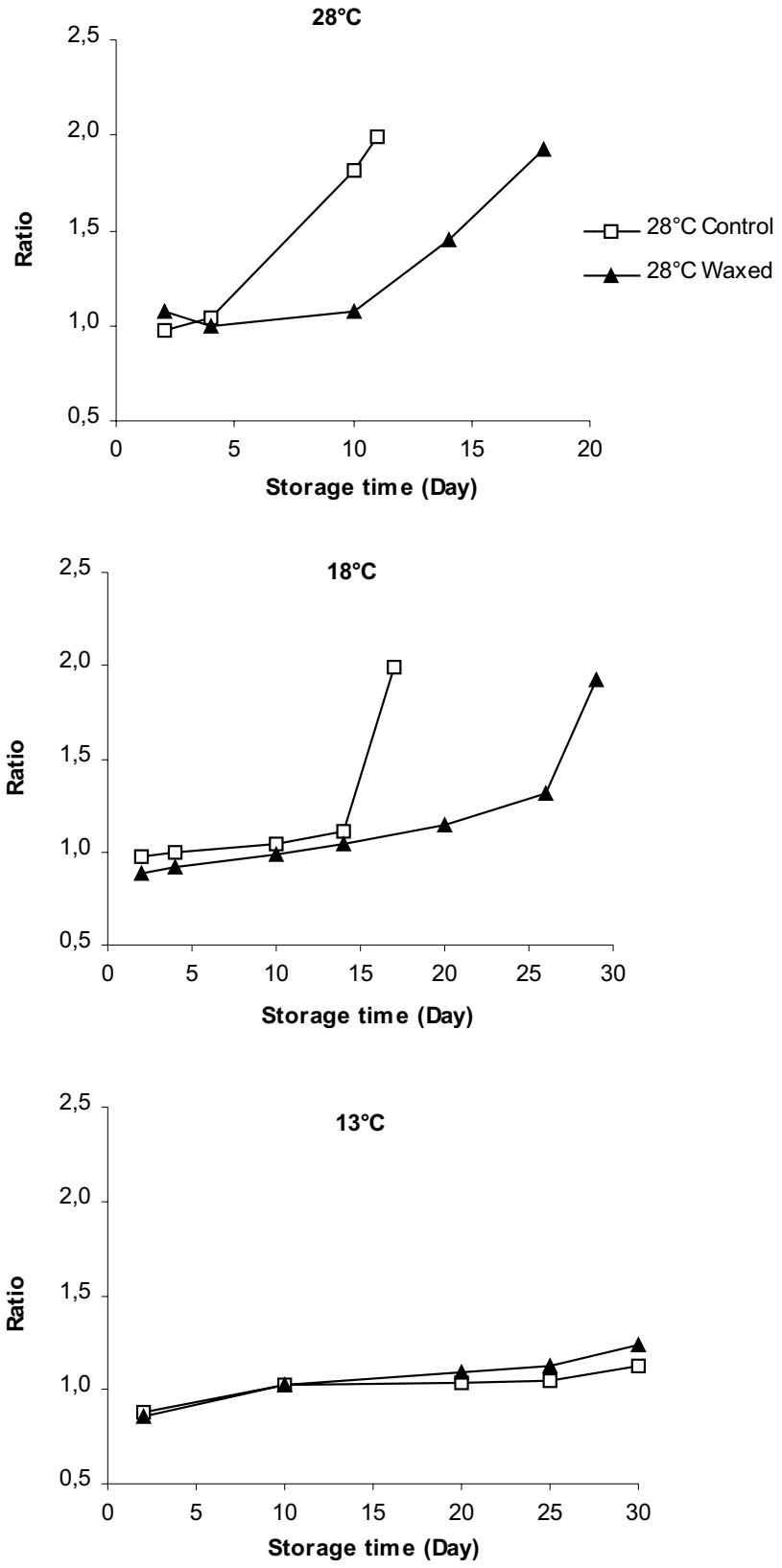

Fig. 4. The effect of spadix-waxing on the water balance (transpiration : uptake ratio) of cut anthuriums during ambient and refrigerated storage.

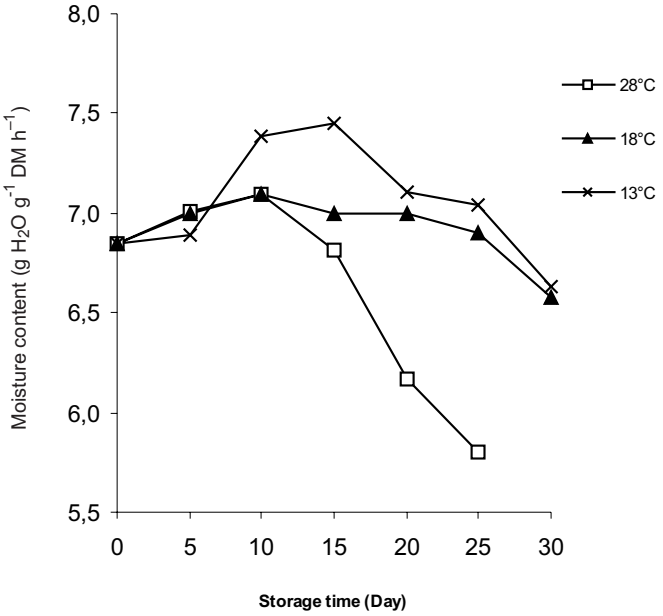

Fig. 5. The effect of spadix-waxing on the moisture content changes in cut anthuriums during ambient and refrigerated storage.

rapidly declined. Waxed flowers held at 18 and 13°C maintained high moisture contents for the duration of the trial.

A separate set of 10 waxed flowers was stored at storage temperature to assess marketability. Separate flowers were used in order to avoid any disturbance in water flow, which occurs when flowers are moved for weight measurements. Flowers were considered marketable if they showed less than 5% spathe blueing, less than 10% spadix necrosis and minimum loss in spathe gloss. Figure 6 shows the percentage of marketable flowers under ambient and refrigerated storage. Compared with the previous trial [11] waxing resulted in an increase in the percentage of

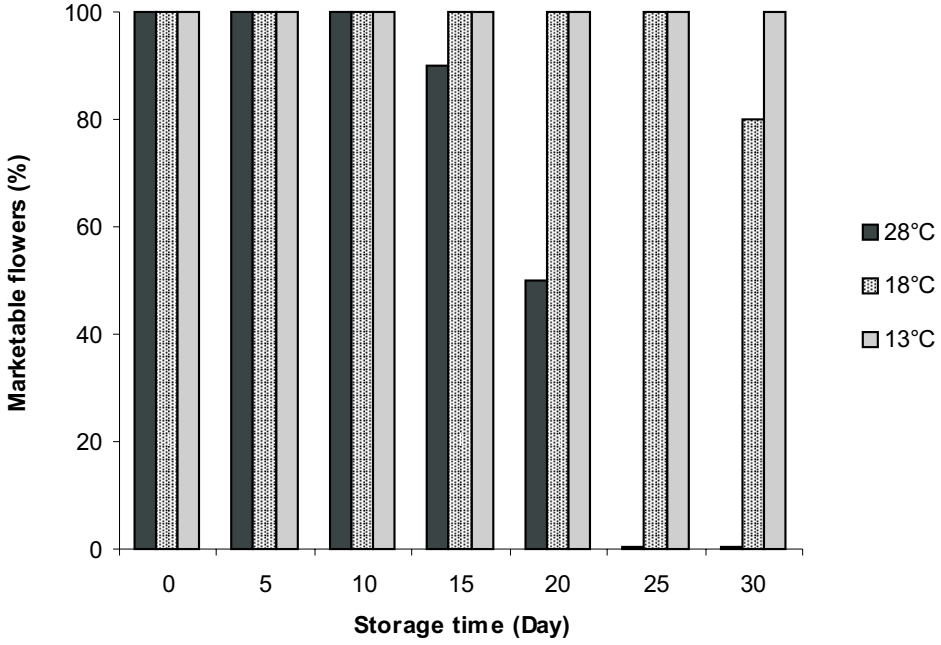

Fig. 6. The effect of spadix-waxing on the marketability of cut anthuriums during ambient and refrigerated storage.

marketable flowers under ambient conditions from 75 to 90% after 15 days. There was also an increase in marketable flowers at 18°C from 40 to 80% after 30 days.

Paul and Goo [8] reported that the spadix of the 'Ozaki Red' anthurium is the pathway for up to 60% of water loss, the spathe about 20% and the stem 10–20%. Waxing of the spadix tissue was shown to reduce water uptake by 10–20% and extend flower shelf life. Paul and Goo [8] also noted that results obtained using wax on anthuriums can vary from trial to trial due to the differing amounts of wax covering the spathe. Variation in the shelf life of anthuriums from trial to trial can also result from various pre-harvest factors beyond experimental control.

CONCLUSIONS

Coatings such as Fresh Wax 51V are a simple, environmentally friendly, and relatively inexpensive technology that can be used to extend the shelf life of cut 'Trinidad Pink' anthuriums. Waxing of both the spathe and spadix tissue significantly reduces water loss, but results in the development of unattractive brown spots on the spathe tissue. Waxing of the spadix also reduces water loss, maintains fresh weight and extends the shelf life of flowers stored under ambient conditions to 14–20 days. The shelf life of waxed flowers stored at 18°C is extended to 25–30 days with the corresponding improvement in water relations, while waxed flowers stored at 13°C are comparable in appearance to control (untreated) flowers.

REFERENCES

1. **Baldwin E., 2001.** New coating formulations for the conservation of tropical fruits. Abstract, In Fruit Conservation and Processing: New Issues, New Techniques. Cirad-flhor Professional Meeting, Montpellier, France, 5 Sept., Cirad-flhor, France.
2. **Dai J. and Paull R.E., 1991.** Effect of water status on Dendrobium flower spray postharvest life. J. Amer. Soc. Hort. Sci., 116(3), 491–496.
3. **Fujino D.W., Reid M.S., and Kohl H.C., 1983.** The water relations of maidenhair fronds treated with silver nitrate. Scientia Hort., 19, 349–355.
4. **Halevy A.H., 1976.** Treatments to improve water balance of cut flowers. Acta Hort., 64, 223–230.
5. **Mayak S. and Halevy A.H., 1974.** The action of kinetin in improving the water balance and delaying senescence processes of cut rose flowers. Physiol. Plant., 32, 330–336.
6. **Paull R.E., 1982.** Anthurium (*Anthurium andraeanum* Andre) vase life evaluation criteria. Hort. Sci., 17(4), 606–607.
7. **Paull R.E., 1987.** Effect of storage duration and temperature on cut anthurium flowers. Hort. Sci., 22(3), 459–460.
8. **Paull R.E. and Goo T., 1985.** Ethylene and water stress in the senescence of cut anthurium flowers. J. Amer. Soc. Hort. Sci., 110(1), 84–88.
9. **Planella I., 1992.** Anthurium. Proceedings on Technical Assistance and Training Programme - Part 1: Technical Appraisal of Ornamental Horticulture Projects. Sevilla Club, Brechin Castle, Couva, Trinidad and Tobago, Sept. 25-Oct. 19. Port of Spain: Inter-American Institute on Tropical Agriculture.
10. **Sankat C.K., 1998.** Postharvest Management of Perishable Crops. UWI/IDB Postharvest Workshop, April 14–15, 1998, Rudranath Capildeo Learning Resource Centre, Trinidad and Tobago.
11. **Sankat C.K. and Mujaffar S., 1994.** Water balance in cut anthurium flowers in storage and its effect on quality. Acta Hort., 368, 723–732.
12. **Smith M.R. and Haron bin M.S., 1974.** Moisture loss from packaged anthurium flowers. ASAE Paper, 74–3530.
13. **Stamps R.H., 1987.** Harvest time and postharvest immersion affect water uptake and postharvest decline of leatherleaf fern. Proc. Inter-Amer. Soc. Hort. Sci., 31, 42–50.
14. **Watson D. and Shirakawa T., 1967.** Gross morphology related to shelf life of anthurium flowers. Hawaii Farm Science 16(3), 1–3.
15. **Zieslin N., Kohl H.C. jr., Kofranek A.M., and Halevy A.H., 1978.** Changes in the water status of cut roses and its relationship to bent-neck phenomenon. J. Amer. Soc. Hort. Sci., 103(2), 176–179.