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Potential Low Cost Treatments for Extending the Vase-life of Anthurium (*Anthurium andreanum* Lind.) Flowers

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ABSTRACT. Flowers, being viable and actively metabolizing parts of plants, are subject to ageing processes and thus are perishable commodities. In order to meet the requirement for export market of cut-flowers it is necessary to prolong the vase-life while maintaining quality. Specific anti- ethylene compounds, which are expensive, are presently being used to break the ageing process. An investigation was therefore carried out to extend the vase-life of cut-flower Anthurium andreanum using inexpensive treatments in comparison with conventional methods. The flowers were treated with different concentrations of anti-ethylene compounds, such as $AgNO_3$ silver thiosulfate (STS), benzyl amino purine (BAP), $KMnO_4$, glycerine and hot water. Distilled water treatment was used as the control. The longest vase-life lasting 14 days was obtained with 2 mg l^{-1} $KMnO_4$. This was followed by STS (12.87 days), 10 mg l^{-1} BAP (12.43 days), 5 mg l^{-1} BAP(12.37 days) and 1000 mg l^{-1} $AgNO_3$ (12.25 days). Hot water and 15 mg l^{-1} BAP did not significantly affect the vase-life. Flowers treated with different glycerine concentrations showed the lowest vase-life compared to the control. The cost analysis revealed that the $KMnO_4$ treatment is the cheapest method. Moreover, amongst conventional treatments, $AgNO_3$, BAP and STS at tested concentrations were not found to be cost effective.

INTRODUCTION

Sri Lankan floriculture industry mainly consists of flowers and foliage mostly grown in the Western, Northwestern and Central provinces. Cut-flowers can be divided into 2 main categories based on the temperature requirement *i.e.*, temperate and tropical. The genus, anthurium has a tropical American origin and is now distributed to many tropical countries. The wide adaptability for floral decorations and the long vase-life of anthurium flowers have contributed to its success as a cut-flower (Hagen and Ekanayake, 1977). In Sri Lanka, export oriented cut-flower production began in an organized manner in the early 1990s. Dhanasekara (1998), reported that the highest demand is for red, orange and bicolour anthuriums.

Since flowers are viable and actively metabolizing plant parts, they are subject to ageing processes. In the ageing process, ethylene is found to be the main quality affecting factor on freshness of fruits and the vase-life of cut-flowers (Yun-Sang *et al.*, 1996 and Dutta *et al.*, 1991). To overcome this problem, people use many postharvest practices, which decrease ethylene production and increase the vase-life of anthurium. These include use of chemicals such as silver thiosulfate and silver nitrate which are expensive, and hence

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increase the cost of production. Therefore, methods with low cost of production and proper postharvest practices are of prime importance. The purpose of this study was to examine the benefit of various treatments to lengthen the vase-life of anthuriums while maintaining the flower quality.

MATERIALS AND METHODS

The experiment was conducted at the research laboratory of the Department of Crop Science, Faculty of Agriculture, Peradeniya. The mean daytime temperature and relative humidity during the experiment were 32°C and 70%, respectively. Anthurium flowers were collected from the Supreme Foliage at Himbutana, Kaduwela. Anthuriums were harvested when the spadix has past the sticky stage partially and were of same age. They were harvested in the morning and brought to the laboratory within 4 h after harvesting. Stems of the flowers were kept immersed in water during transportation.

The following treatments were used to observe the vase-life of anthurium flowers. Four flower stems were dipped in approximately 125 ml of different treatment solutions.

- T1 Stems were dipped in distilled water - Control
- T2 BAP 5 mg l^{-1} solution for 10 min and transferred into distilled water
- T3 BAP 10 mg l^{-1} solution for 10 min and transferred into distilled water
- T4 BAP 15 mg l^{-1} solution for 10 min and transferred into distilled water
- T5 $AgNO_3$ 1000 mg l^{-1} solution for 10 min and transferred into distilled water
- T6 Stems were dipped in Silver thiosulfate (STS) (solution was prepared by adding 0.462 g Sodium thiosulphate and 0.0629 g $AgNO_3$ and immediately volumarizing up to 500 ml) solution for 20 min and transferred into distilled water
- T7 Stems were continuously dipped in 100 ml of 25% glycerine
- T8 Stems were continuously dipped in 100 ml of 50% glycerine
- T9 Stems were continuously dipped in 100 ml of 75% glycerine
- T10 Stems were continuously dipped in 100 ml of 100% glycerine
- T11 Stems were continuously dipped in 150 ml of 2 mg l^{-1} $KMnO_4$
- T12 After wrapping the flower spathe using newspapers, stems were dipped in hot water (80°C) for 2 min and transferred into distilled water

Flowers stem ends were recut in water in order to have the same length. Four flowers per replicate in a bottle were exposed to different treatments. Distilled water in the containers was replaced every 5 day intervals. Treatments were arranged in a Complete Randomized Design (CRD) with 4 replicates. A panel including 5 persons evaluated the quality of anthurium flowers daily using nonparametric observations. Scores were given according to a pre- determinant scheme (Table 1). Parameters used to evaluate the quality of flower were spadix condition, stem or flower stem condition, colour of the spathe and the glossiness of the flower spathe. Vase-life was then determined by aggregate values obtained by all 4 conditions. The overall quality of flowers was considered without depending on one character. It was expected to obtain a maximum of 14 marks for each fresh flower for good condition. According to the above self determined marking scheme, vase-life was set as the day which the flowers could obtain an aggregate value of 10 marks.

Table 1. Nonparametric observations monitored to assess vase-life of anthurium flowers.

Characteristic of flower	Observation	Scale
Visual spadix condition	No blemish	4
	Tip slightly discoloured	3
	Tip definite browning	2
	Tip brown and dried	1
	Spadix dried	0
Spathe colour	Fresh cut appearance	3
	Slight bluing	2
	Moderate bluing	1
	Severe bluing	0
Degree of glossiness of spathe	High gloss-Fresh	3
	Slight loss of gloss	2
	Severe loss of gloss	1
	Wilted spathe	0
Stem condition	Good fresh stem	4
	Slightly browning and bending	3
	Moderate browning and bending	2
	Severe browning	1
	All dried	0

The vase-life of anthurium flowers according to spadix condition was determined, as the number of days taken to reduce the points give by the evaluators from 4 to 3. The spathe colour was determined, as the number of days taken to reduce the points 3 to 2. The glossiness of the spathe was determined, as the number of days taken to reduce the points from 3 to 2. The stem condition was determined, as the number of days taken to reduce the points from 4 to 3. The data were statistically analysed by using Excel and Statistical Analytical Software (SAS) packages for the analysis of variance procedure by Duncan's Multiple Range Test (DMRT) for the variables to determine the significance of treatment effects (Gomez and Gomez, 1976).

RESULTS AND DISCUSSION

Vase-life of Anthurium

The vase-life of anthurium flowers treated with various materials was determined qualitatively and points obtained by each flower on each day are shown in Fig. 1. The results revealed that the vase-life of anthurium flowers, irrespective of different treatments, was observed to diminish during the period of study. All treatments with glycerine (25%, 50%, 75% and 100%) were found to be ineffective in enhancing the vase-life of anthurium flowers at different concentrations. Also, anthuriums seemed to loose the visual quality when glycerine treatments were used. However, it was reported that glycerine could preserve certain types of flowers by removing moisture without any discolouration (Akamine and Goo, 1975).

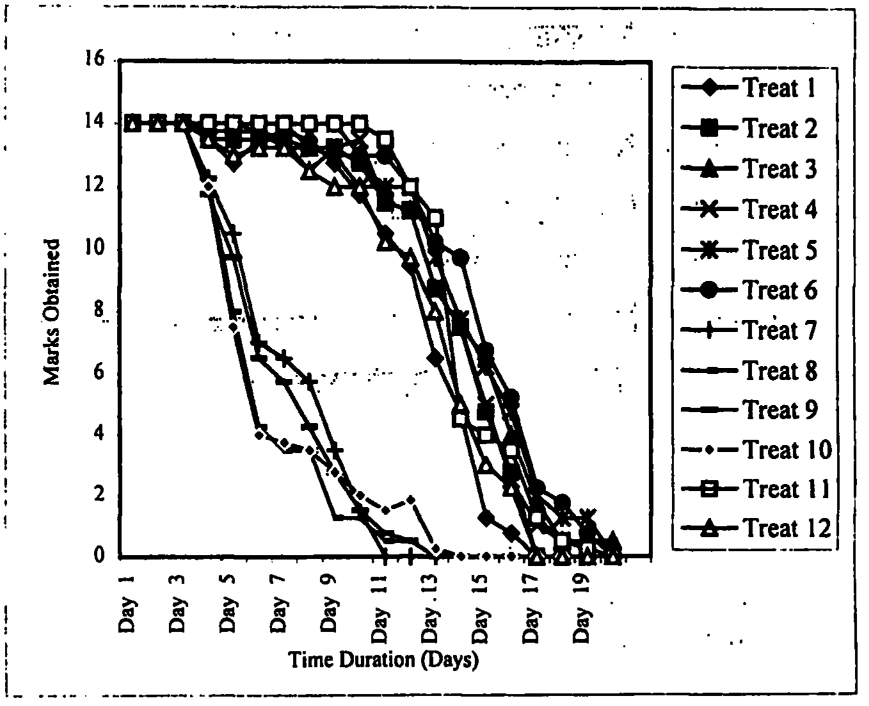

Fig. 1. Marks given to anthurium flowers under different treatment in each day according to self-determined marking scheme.
[Note: T_1 - Control– distilled water, T_2 - 5 mg l^{-1} BAP, T_3 - 10 mg l^{-1} BAP, T_4 - 15 mg l^{-1} BAP, T_5 - 1000 mg l^{-1} $AgNO_3$, T_6 - (STS), T_7 - 25% glycerine, T_8 - 50% glycerine, T_9 - 75% glycerine, T_{10} - 100% glycerine, T_{11} - 2 mg l^{-1} $KMnO_4$ and T_{12} - hot water].

Vase-life of anthurium flowers according to spadix condition under different treatments are given in Fig. 2. Flowers were detrimentally affected by all glycerine treatments and spadix condition deteriorated within the least number of days. The mean vase-life of anthurium flowers treated with 2 mg l^{-1} $KMnO_4$, 5 mg l^{-1} BAP, 10 mg l^{-1} BAP, 1000 mg l^{-1} $AgNO_3$ and STS was significantly (p=0.05) greater than that of glycerine treated flowers. The longest vase-life of 13 days was observed in 2 mg l^{-1} $KMnO_4$. In contrast, flowers treated with hot water had lower vase-life even than the control.

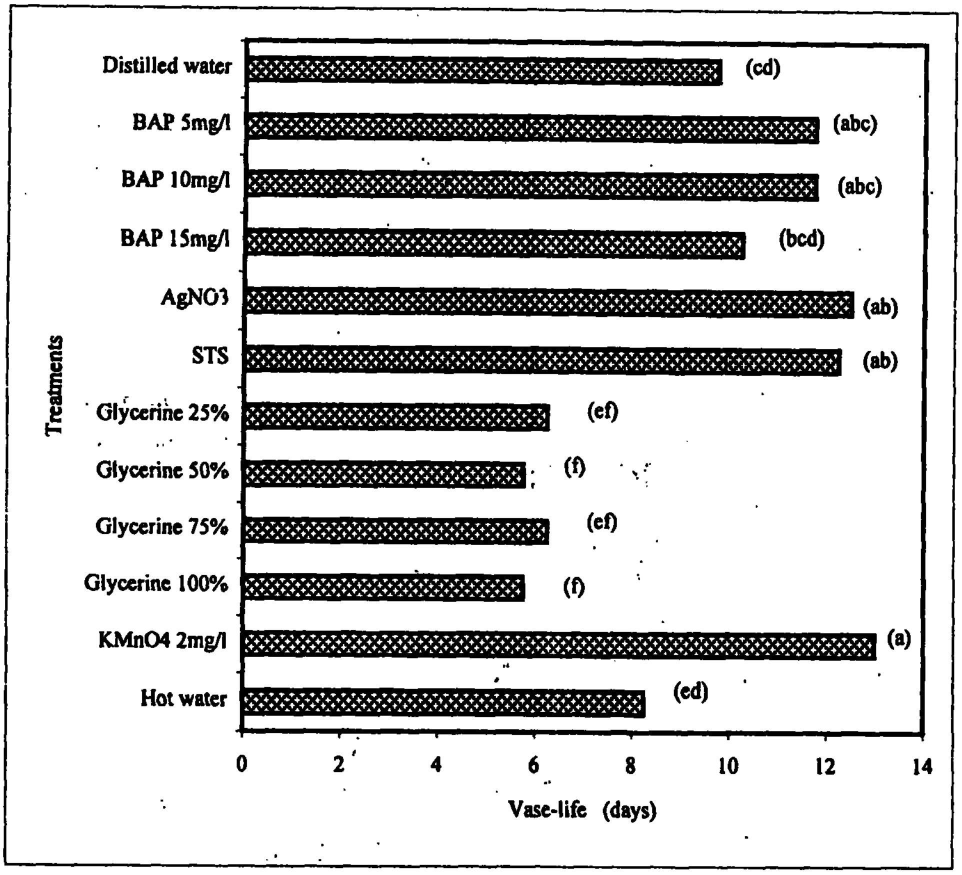

Fig. 2. Vase-life of anthurium according to spadix condition.

[Note: Means with the same letter are not significantly different at probability level ∝=0.05].

Vase-life of anthurium in relation to spathe colour are shown in Fig. 3. Glycerine treatments did not affect the vase-life significantly (p=0.05). According to the colour, $KMnO_4$ treated flowers had the longest vase-life of 13 days. Among BAP treatment concentrations 10 mg l^{-1} and 5 mg l^{-1} enhanced vase-life of anthurium compared to 15 mg l^{-1} BAP concentration. However, 15 mg l^{-1} BAP treatment gave better results than the control. Also, $AgNO_3$ and STS showed longer vase-life than that of control.

Changes of vase-life of anthuriums according to spathe colour show differences among glycerine treated flowers and also reduced the vase-life of anthuriums lower than the control (Fig. 4). Flowers under treatments of STS, 2 mg l^{-1} $KMnO_4$, 10 mg l^{-1} BAP, 5 mg l^{-1} BAP, 1000 mg l^{-1} $AgNO_3$ and 15 mg l^{-1} BAP significantly (p=0.05) achieved

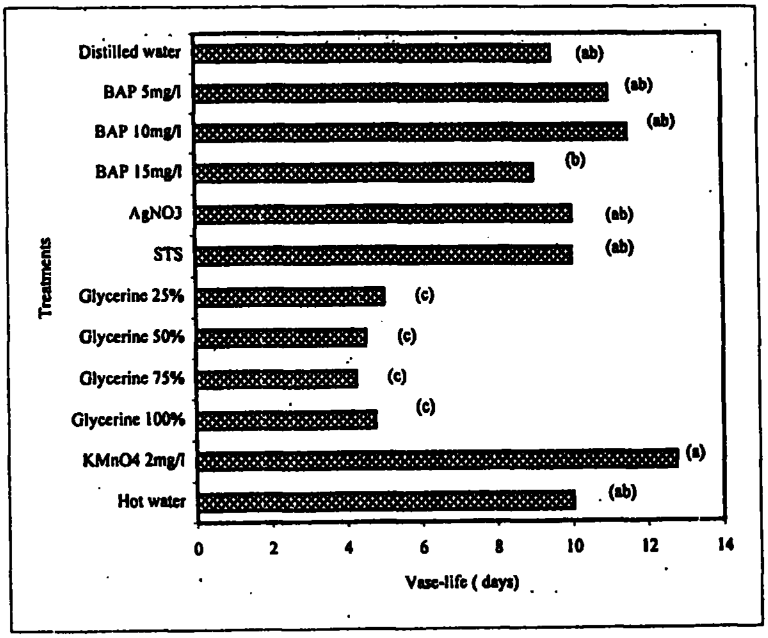

Fig. 3. **Vase-life of anthurium according to spathe colour.**
[Note: Means with the same letter are not significantly different at probability level ∝=0.05].

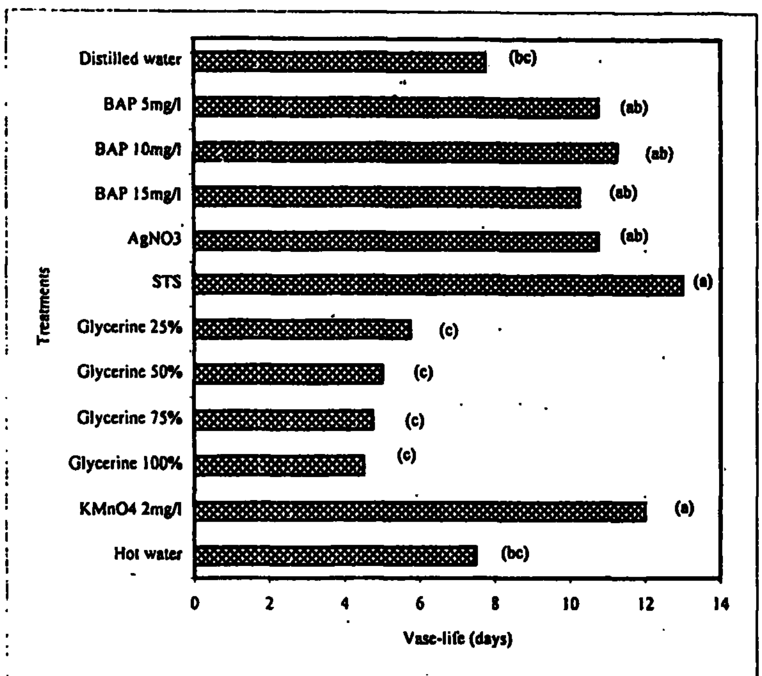

Fig. 4. **Vase-life of anthurium according to glossiness of the spathe.**
[Note: Means with the same letter are not significantly different at probability level ∝=0.05].

greater vase life. Though, BAP, silver nitrate and potassium permanganate gave better results than the control (vase-life of 7.75 days), hot water treatment was not effective in increasing vase-life of anthuriums in relation to glossiness on the flowers. According to Barnett and Egerick (1996), flowers such as roses and orchids retained their glossiness under hot water treatments.

Stems of the flowers treated with glycerine showed dehydrated and dried-up condition. While the flowers were in good condition, hot water treatment caused discolouration only in stem end of the flower.

Anthurium flowers impregnated with silver thiosulfate (STS) performed well until the 16th day following treatments. BAP at 5 mg l^{-1} level significantly (p=0.05) enhanced the vase-life of anthurium flowers.

Vase-life of anthuriums was affected by different treatments at all tested levels. 2 mg l^{-1} $KmnO_4$, STS, 10 mg l^{-1} BAP, 5 mg l^{-1} BAP $AgNO_3$, significantly (p=0.05) lengthened the vase life. Fig. 5 showed the best performance 2 mg l^{-1} $KMnO_4$ was found to be the best amongst the treatments.

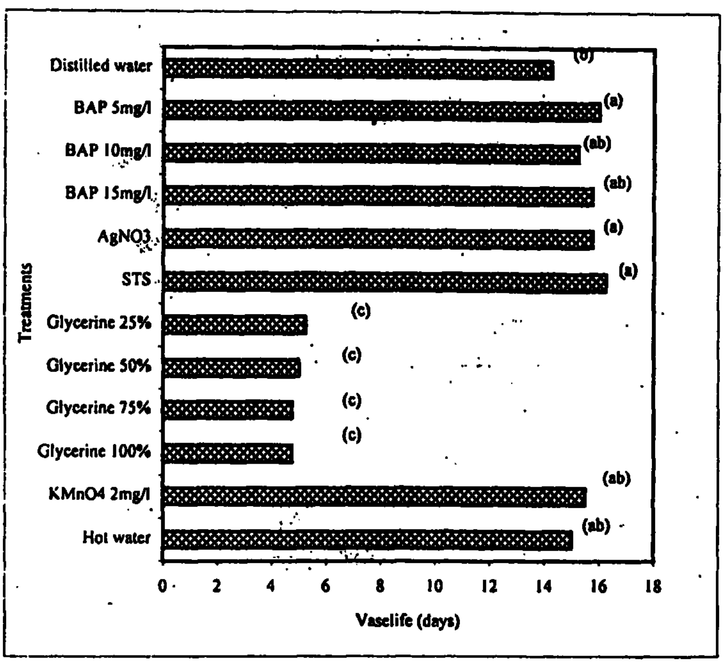

Fig. 5. Vase-life of anthurium according to stem condition.
[Note: Means with the same letter are not significantly different at probability level ∝=0.05].

Glycerine at all tested levels, caused detrimental effects on Anthurium stems and hence decreased vase-life significantly (p=0.05). However, it could be expected that, glycerine at very minute concentrations would not harm anthurium flowers, although not tested in this study.

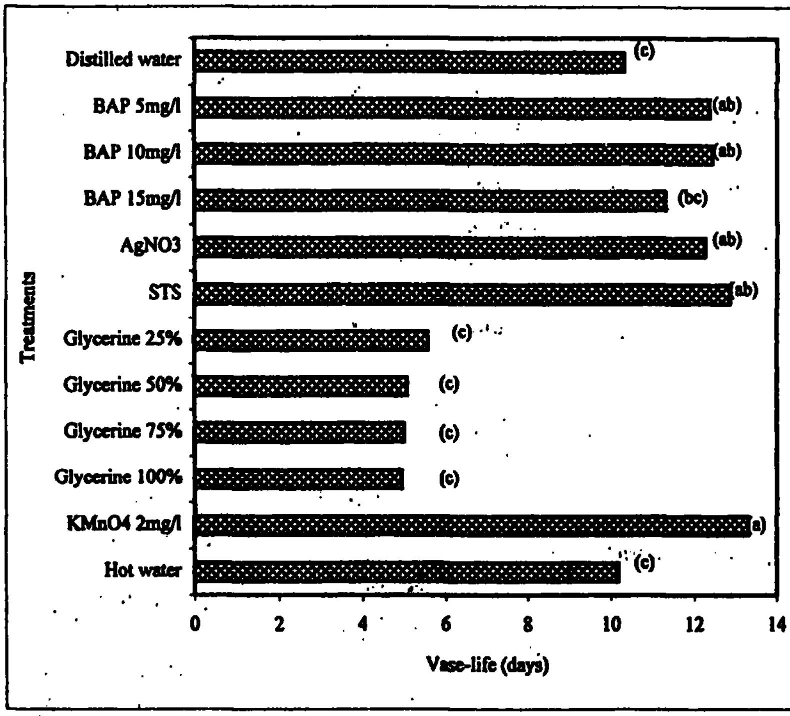

Fig. 6. Mean vase-life of anthurium flowers due to different treatments.
[Note: Means with the same letter are not significantly different at probability level ∝=0.05].

DISCUSSION

In order to meet the requirements for export market of cut-flowers, it is necessary to maintain their quality and improve the vase life, *i.e.*, the time period which the flowers could retain their fresh appearance without loss of market value. Another suggestion is to use materials such as silica gel or brick pieces that can be pre-treated with $KMnO_4$ and put in the package of flowers to absorb ethylene. Dutta *et al.* (1991), reported that the use of ethylene absorbent on shelf-life of fruits.

According to Yun-Sang *et al.* (1996) chemical removal of ethylene could be done by utilizing the ability of potassium permanganate, to oxidize ethylene to carbon dioxide and water. The requirements for the use of such materials are high surface area of inert material coated with $KMnO_4$ and readily permeability to gasses. However, this was not tested on anthuriums. Silver thiosulfate (STS) positively affected the vase- life of anthurium. Pre-prepared $AgNO_3$ and $Na_2S_2O_3$ should immediately be added together and treated as STS because STS is a photo degradable compound and it could not be stored for the future use. Silver being toxic, sophisticated equipment is needed to handle the chemical. Chemical cost may be around Rs. 270.00/1000 ml of commercially used STS solution. $AgNO_3$ also a fairly expensive treatment is not available in the market for the conventional farmers of Sri Lanka. Chemical cost per 1000 mg l^{-1} $AgNO_3$ be around Rs. 275.00.

Vase-life of anthurium was increased significantly ($p=0.05$) by BAP treatments. Chemical cost per 1000 ml of BAP, for the tested concentrations was Rs. 4.25 to 12.75. Also BAP is not available in the market for the conventional farmers. Distilled water was used as the control in the study and the vase-life was investigated as 10.5 days. However, people do not use distilled water in normal handling of anthurium flowers. To overcome this ageing problem, people used other post-harvest practices and methods such as treatment of Silver thiosulfate (STS), silver nitrate and benzyl amino purine (BAP). However, they are expensive and not available to the conventional anthurium growers.

CONCLUSIONS

Postharvest dip of anthurium in 0.2 mg l^{-1} $KMnO_4$, STS, 10 mg l^{-1} BAP, 5 mg l^{-1} BAP, and 1000 mg l^{-1} $AgNO_3$ could increase the vase-life effectively than the control with distilled water. Also the concentration of 2 mg l^{-1} $KMnO_4$ was the cost-effective treatment to prolong the vise life. The chemical cost for 1000 ml of 2 mg l^{-1} $KMnO_4$ was only 5 cents (Rs. 0.05). However, in the present investigation, $KMnO_4$ was used as a solution to treat the anthurium flowers. Practically it may be a problem to use a liquid treatment during the transportation of flowers. Therefore, the use of relatively high concentration of $KMnO_4$ could be used as a solution or cotton wool treated with $KMnO_4$ could also be used to wrap the cut surface of the anthurium flower stem. Hence, $KMnO_4$ could be used as a pretreatment to lengthen the vase-life. Glycerine in tested concentrations was not positively effective on vase-life of anthuriums. Though BAP, STS and $AgNO_3$ treatments could lengthen the vase-life of anthurium, they are expensive.

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