Feasibility of Anti-Ethylene Treatments for Improving Quality and Longevity of Cut Leaves of *Aglaonema commutatum* 'Silver Queen', *Aglaonema commutatum* 'Pseudobracteatum' and *Cordyline terminalis* 'Red Edge'.

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ABSTRACT

Senescence which is a characteristic feature of actively metabolizing plant parts, is promoted by ethylene where it makes plant products unfit for sale. In order to fulfill export market requirements, it is necessary to increase the longevity and maintain the quality of cut leaves by reducing the effect of ethylene. A study was therefore carried out to enhance the quality and to prolong the longevity of *Aglaonema commutatum* 'Silver Queen', *Aglaonema commutatum* 'Pseudobracteatum' and *Cordyline terminalis* 'Red Edge' cut leaves. The cut leaves were treated with different anti-ethylene compounds such as 2mgl^{-1} potassium permanganate ($KMnO_4$), 4mgl^{-1} $KMnO_4$, 2% ethanol, 4% ethanol, 1000mgl^{-1} silver nitrate and silver thiosulphate. Distilled water was used as the control. A total of twenty five leaves were used for each treatment in two consecutive experiments. The best overall quality and longevity of *A. commutatum* 'Silver Queen' and *A. commutatum* 'Pseudobracteatum' cut leaves were recorded when they were dipped continuously in 4mgl^{-1} $KMnO_4$ solution. The cut leaves dipped in 2mgl^{-1} $KMnO_4$ solution continuously, recorded the second best performance while none of the other treatments had a significant impact on enhancing the quality and longevity compared to the control. None of the above anti-ethylene treatments improved the quality and longevity of *C. terminalis* cut leaves. However, dipping cut leaves in 4mgl^{-1} $KMnO_4$ continuously, could be selected as the best treatment to improve the quality and longevity of *A. commutatum* 'Silver Queen' and *A. commutatum* 'Pseudobracteatum' cut leaves along with its cost effectiveness.

KEYWORDS: ***Aglaonema commutatum* 'Silver Queen', *Aglaonema commutatum* 'Pseudobracteatum', Anti-ethylene treatments, *Cordyline terminalis* 'Red Edge', $AgNO_3$, Ethanol, $KMnO_4$, Longevity, STS, Vase life.**

INTRODUCTION

Sri Lankan floriculture industry basically comprises flowers and foliage. All types of foliage plants can be grown in the Wet and Intermediate Zones irrespective of elevation requirements (Anon, 2005a). Cut decorative leaves largely contribute to the foliage sector. Sri Lanka has established a good reputation as a high quality cut leaves producer in the region. The assortment comprises mainly tropical cut leaves and these are exported to the Netherlands, Germany, Japan, Switzerland, Italy and Middle East (Anon, 2005b).

Cut decorative leaves are living products with biological properties that make them highly perishable in the postharvest period from grower, shipper, retailer and finally the consumer. Due to the perishable nature, cut leaves are susceptible to mechanical damages, pest attacks and diseases which make them unfit for sale. These damages can be minimized by cold storage and proper postharvest handling methods.

Ethylene is an odorless, colourless gas produced by aging plant tissues which accelerates the deterioration of the harvested cut leaves and finally reduces the vase life. Ethylene is important in the horticulture industry, because it is estimated that 30-40 percent of cut flower and plant inventory dies prematurely, directly due to ethylene-induced disorders (Bledsoe *et al.*, 2005). There are some chemical treatments such as silver thiosulphate that can be used to prevent damages from ethylene. Preventive measures are extremely important, since the ethylene damage is irreversible (Bledsoe *et al.*, 2005).

Extending of shelf life of cut decorative leaves is very important in order to fulfill export market requirements. It will also facilitate long distance transportation of cut leaves (Wickramasinghe *et al.*, 2004). Therefore, the purpose of this study was to examine the benefits of some anti-ethylene treatments in extending the vase life of three demanded cut leaves, *Aglaonema commutatum* 'Silver Queen', *Aglaonema commutatum* 'Pseudobracteatum' and *Cordyline terminalis* 'Red Edge' while maintaining quality.

MATERIALS AND METHODS

This experiment was conducted at the Horticulture Laboratory, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila, Sri Lanka. The mean day time temperature and relative humidity of the laboratory during experimental period were 34.8^{0}C and 66.37% respectively.

Export quality cut leaves of *A. commutatum* 'Silver Queen', *A. commutatum* 'Pseudobracteatum' and *C. terminalis* 'Red Edge' were collected from Asian Cuttings (Pvt) Ltd, Katana. Cut leaves were brought to the laboratory within one hour and cut ends of leaf petioles were immersed in distilled water during transportation. Cut ends of leaf petioles were recut under distilled water in order to have the same length. Leaf petioles of fresh cut leaves were dipped in 200ml of different treatment solutions. All containers having treatment solutions were covered with black sheets from the beginning of the experiment.

The leaves were treated with distilled water as the control (T1), with 2mgl^{-1} $KMnO_4$ solution for one hour and transferred into distilled water (T2), with 2mgl^{-1} $KMnO_4$ solution for six hours and transferred

into distilled water (T3), continuously with $2mgl^{-1}$ $KMnO_4$ solution (T4), with $4mgl^{-1}$ $KMnO_4$ solution for one hour and transferred into distilled water (T5), continuously with $4mgl^{-1}$ $KMnO_4$ solution (T6), with 2% (v/v) ethanol solution for ten minutes and transferred into distilled water (T7), with 4% (v/v) ethanol solution for ten minutes and transferred into distilled water (T8), with $1000mgl^{-1}$ $AgNO_3$ solution for ten minutes and transferred into distilled water (T9), with STS solution for twenty minutes and transferred into distilled water (T10), with silver thiosulphate (STS) solution for forty minutes and transferred into distilled water (T11), with STS solution for one hour and transferred into distilled water (T12). [The STS solution was prepared by dissolving 0.1258g of $AgNO_3$ and 0.924g of sodium thiosulphate in 500ml of distilled water separately and pouring $AgNO_3$ solution slowly into sodium thiosulphate solution while stirring (Yapa *et al.*, 2000)].

Treatments were arranged in a Complete Randomized Design (CRD) with five replicates each. A set of five leaves was placed in a bottle as a replicate and exposed to a treatment. The experiment was repeated twice. Distilled water in bottles was replaced once in five days.

The quality of cut leaves was evaluated daily, by a panel of four people. Scores were given according to a pre determined scheme. Four parameters namely leaf colour, petiole condition, degree of glossiness and overall appearance of every leaf were used to evaluate the quality of leaves. Royal Horticultural Society (RHS) colour chart (Anon, 2001) was used to evaluate the colour of the leaf margin.

The self determined marking scheme used to assess the leaf quality and longevity of *Aglaonema commutatum* 'Silver Queen' and *A. commutatum* 'Pseudobracteatum' included original green colour (4), light green (3), slightly yellowing (2), moderately yellowing (1) and severe yellowing (0) for leaf colour; strong (4), slightly bending (3), moderately bending (2), severe bending (1) and petiole abscission (0) for petiole condition; high glossiness and fresh (3), slight loss of glossiness (2), severe loss of glossiness (1) and wilted (0) for degree of glossiness and very good (3), moderately good (2), slightly good (1) and poor quality (0) for overall appearance of leaf. The self determined marking scheme used to assess the leaf quality and longevity of *Cordyline terminalis* 'Red Edge' included original red colour (4), reddish purple (3), purple (2), dark purple (1) and brown (0) for leaf colour; strong (4), slightly bending (3), moderately bending (2), severe bending (1) and petiole abscission (0) for petiole condition; high glossiness and fresh (3), slight loss of glossiness (2), severe loss of glossiness (1) and wilted (0) for degree of glossiness and very good (3), moderately good (2), slightly good (1) and poor quality (0) for overall appearance of leaf.

According to the above marking scheme, longevity was set as the time taken (days) to reduce the percentage number of leaves of very good overall leaf appearance from initial percentage of 100 to 60. The total visual quality was then determined by the change of aggregate marks obtained for all four parameters (leaf colour, petiole condition, leaf glossiness and overall appearance) along with the time. The vase life of cut leaves according to the leaf colour was determined, as the number of days taken to reduce the scores given by the evaluators from 4 to 3. The vase life of cut leaves according to the petiole condition was determined, as the number of days taken to reduce the scores from 4 to 3. The vase life of cut leaves according to the degree of glossiness was determined, as the number of days taken to reduce the scores from 3 to 2. The vase life of cut leaves according to the overall appearance was determined, as the number of days taken to reduce the scores given by evaluators from 3 to 2. The experiment was repeated in the same procedure and the average of two trials was taken for the analysis. The data were statistically analyzed by means of CATMOD procedure using Statistical Analysis System (SAS) package (SAS, 1991).

RESULTS

Longevity

In *A. commutatum* 'Silver Queen' highest longevity of 21 days was observed when cut leaves were treated with $4mgl^{-1}$ $KMnO_4$ in a continuous dip (T6) while the lowest longevity of 9 days was resulted when the cut leaves were treated with $1000mgl^{-1}$ $AgNO_3$ (T9). Cut leaves treated with distilled water (T1) which was the control, recorded a longevity of 13 days. All the other treatments recorded an extension of longevity of cut leaves, but they were not significantly different from that of the control (Figure 1.1).

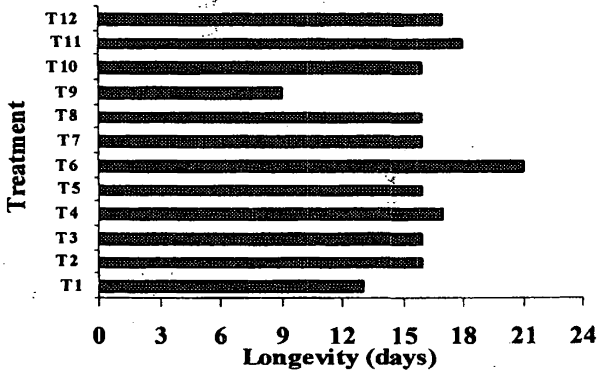

Figure 1.1. Longevity of *A. commutatum* 'Silver Queen' cut leaves

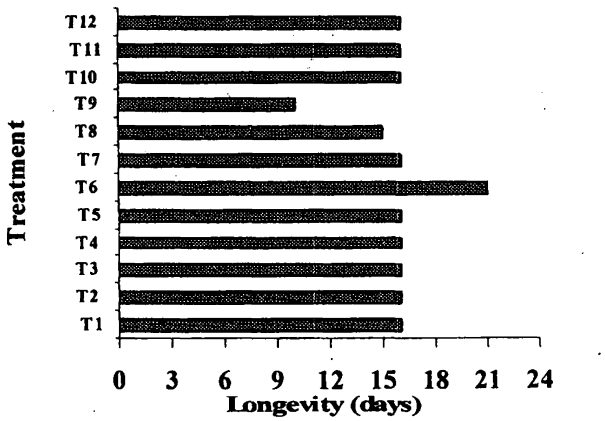

Figure 1.2 Longevity of *A. commutatum* 'Pseudobracteatum' cut leaves.

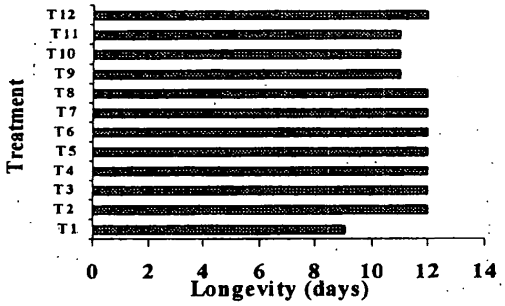

Figure 1.3 Longevity of *C. terminalis* cut leaves.

[Note: T1-control-distilled water, T2-2mgl^{-1} $KMnO_4$ dip for 1hr, T3- 2mgl^{-1} $KMnO_4$ dip for 6hrs, T4-2mgl^{-1} $KMnO_4$ continuous dip, T5-4mgl^{-1} $KMnO_4$ dip for 1hr, T6-4mgl^{-1} $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-1000mgl^{-1} $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

In *A. commutatum* 'Pseudobracteatum', the highest longevity of 21 days was observed when the cut leaves were treated with 4mgl^{-1} $KMnO_4$ in a continuous dip (T6) while the lowest longevity of 10 days was recorded when the cut leaves were treated with 1000mgl^{-1} $AgNO_3$ (T9). The second shortest longevity of 15 days was recorded when the cut leaves were treated with 4% ethanol for ten minutes (T8), while all other treatments including the control recorded a longevity of 16 days (Figure 1.2).

None of the treatments recorded a significant prolong in longevity of *C. terminalis* cut leaves. The shortest longevity of 9 days was recorded when the cut leaves were treated with distilled water (T1) which was the control. Many treatments (T2, T3, T4, T5, T6, T7, T8 and T12) recorded the highest longevity of 12 days (Figure 1.3).

Total visual quality

The study revealed that the total visual quality of all three types of cut leaves in all the treatments had been diminished during the period of study. Cut leaves of *A. commutatum* 'Silver Queen' treated with 1000mgl^{-1} $AgNO_3$ (T9) and STS solution for 20 minutes (T10) showed a reduction of total visual quality than that of control (distilled water), while all the other treatments enhanced the total visual quality of cut leaves compared to the control (Figure 2.1).

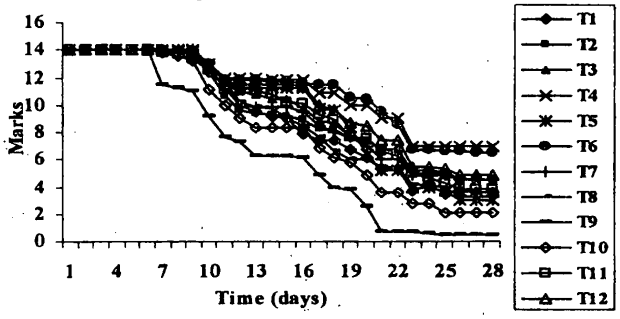

Figure 2.1 Changes of total visual quality of *A. commutatum* 'Silver Queen' cut leaves

[Note: T1-control-distilled water, T2-2mgl^{-1} $KMnO_4$ dip for 1hr, T3- 2mgl^{-1} $KMnO_4$ dip for 6hrs, T4-2mgl^{-1} $KMnO_4$ continuous dip, T5-4mgl^{-1} $KMnO_4$ dip for 1hr, T6-4mgl^{-1} $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-1000mgl^{-1} $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

Cut leaves of *A. commutatum* 'Pseudobracteatum' treated with 1000mgl^{-1} $AgNO_3$ (T9) was observed to be ineffective in enhancing the total visual quality compared to the control (T1). Cut leaves treated with STS solution for twenty minutes (T10) and 4mgl^{-1} $KMnO_4$ solution for one hour (T5) showed a reduction in total visual quality than that of the control at the latter part of the study. All the other treatments were able to maintain a higher total visual quality than that of cut leaves treated with distilled water which was the control (Figure 2.2).

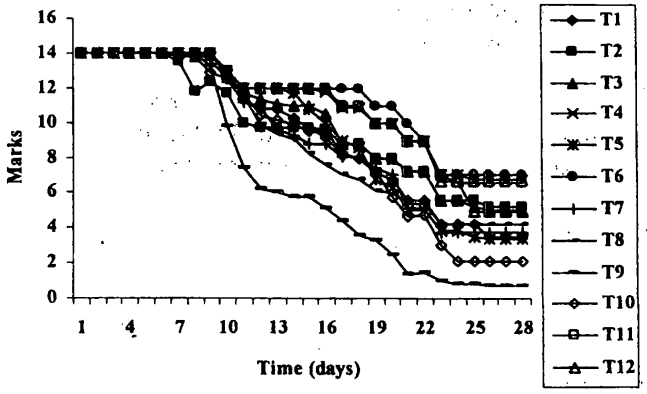

Figure 2.2 Changes of total visual quality of *A. commutatum* 'Pseudobracteatum' cut leaves

[Note: T1-control-distilled water, T2-2mgl^{-1} $KMnO_4$ dip for 1hr, T3- 2mgl^{-1} $KMnO_4$ dip for 6hrs, T4-2mgl^{-1} $KMnO_4$ continuous dip, T5-4mgl^{-1} $KMnO_4$ dip for 1hr, T6-4mgl^{-1} $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-1000mgl^{-1} $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

During the latter part of the study *C. terminalis* cut leaves treated with 1000mgl^{-1} $AgNO_3$ (T9) and 4mgl^{-1} $KMnO_4$ for one hour (T5) recorded a reduction in total visual quality than that of cut leaves treated with the control, while none of the other treatments showed a significant difference compared to the control (Figure 2.3).

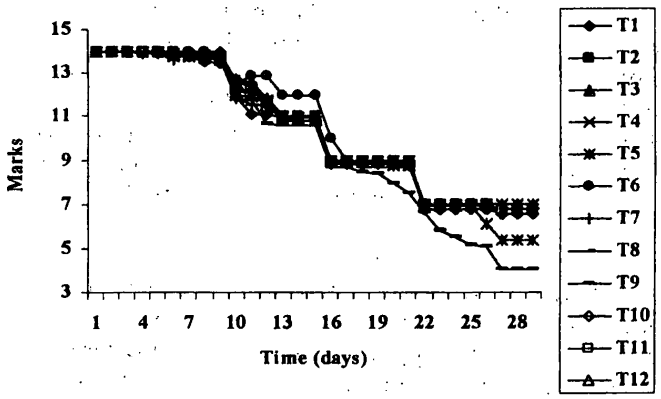

Figure 2.3 Changes of total visual quality of *C. terminalis* cut leaves

[Note: T1-control-distilled water, T2-2mgl^{-1} $KMnO_4$ dip for 1hr, T3- 2mgl^{-1} $KMnO_4$ dip for 6hrs, T4-2mgl^{-1} $KMnO_4$ continuous dip, T5-4mgl^{-1} $KMnO_4$ dip for 1hr, T6-4mgl^{-1} $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-1000mgl^{-1} $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

Vase life

Leaf colour was evaluated visually as well as using the RHS colour chart. The time (days) taken for the colour change in all three types of cut leaves was almost similar in both methods.

Initial colour of *A. commutatum* 'Silver Queen' cut leaves was recorded as 137A of green group in fan 3 of RHS colour chart where it was recorded as 137B when the colour change occurred. Cut leaves of *A. commutatum* 'Silver Queen' treated with $2mgl^{-1}$ $KMnO_4$ in a continuous dip (T4) recorded the longest vase life (22 days) according to the leaf colour, which was significantly higher ($p<0.003$) compared to the control (17.93 days). Cut leaves treated with $4mgl^{-1}$ $KMnO_4$ in a continuous dip (T6) recorded the second longest vase life (21.2 days) which was significantly ($p<0.006$) higher than that of control. Cut leaves treated with $1000mgl^{-1}$ $AgNO_3$ (T9) showed a significantly ($p<0.0001$) shorter vase life (12.5 days) while all the other treatments did not show a significant difference of vase life when compared to the control (Figure 3.1).

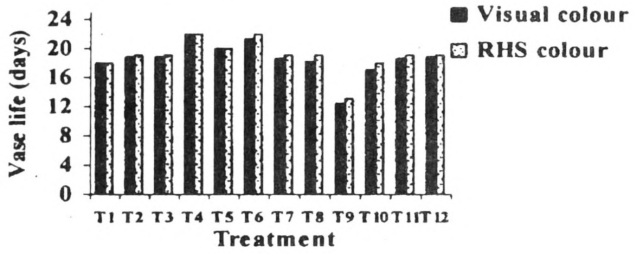

Figure 3.1 Vase life of *A. commutatum* 'Silver Queen' cut leaves according to leaf colour

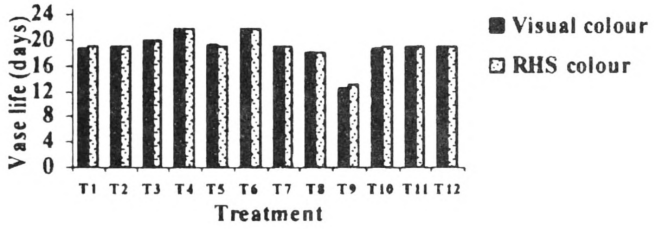

Figure 3.2 Vase life of *A. commutatum* 'Pseudobracteatum' cut leaves according to leaf colour

Figure 3.3 Vase life of *C. terminalis* cut leaves according to leaf colour

[Note:T1-control-distilled water, T2-$2mgl^{-1}$ $KMnO_4$ dip for 1hr, T3- $2mgl^{-1}$ $KMnO_4$ dip for 6hrs, T4-$2mgl^{-1}$ $KMnO_4$ continuous dip, T5-$4mgl^{-1}$ $KMnO_4$ dip for 1hr, T6-$4mgl^{-1}$ $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-$1000mgl^{-1}$ $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

Initial colour of *A. commutatum* 'Pseudobracteatum' cut leaves was recorded as 137A of green group in fan 3 of RHS colour chart where it was recorded as 137B when the colour change occurred. When *A. commutatum* 'Pseudobracteatum' cut leaves dipped continuously in $2mgl^{-1}$ $KMnO_4$ and $4mgl^{-1}$ $KMnO_4$ solutions (T4 and T6 respectively) showed significantly ($p<0.003$) longest vase life of 22 days according to the leaf colour while cut leaves treated with $1000mgl^{-1}AgNO_3$ (T9) recorded the significantly ($p<0.0001$) shortest vase life (12.53days) compared to the control (18.9 days). Other treatments did not show a significant difference with the leaf colour of the control (Figure 3.2).

Initial colour of *C. terminalis* cut leaves was recorded as 58A of red purple group in fan 2 of RHS colour chart where it was recorded as 59B when the colour change occurred at the latter part of the experiment. According to the leaf colour, *C. terminalis* cut leaves treated with $4mgl^{-1}$ $KMnO_4$ in a continuous dip (T6) showed a significantly ($p<0.003$) extended vase life of 14 days compared to the control (10.28 days). No other treatment was effective in extending the vase life where $1000mgl^{-1}$ $AgNO_3$ (T9) reduced the vase life (9 days) of cut leaves than that of the control. Moreover, $AgNO_3$ recorded a higher incidence of leaf discolouration than all the other treatments at the latter part of the study (Figure 3.3).

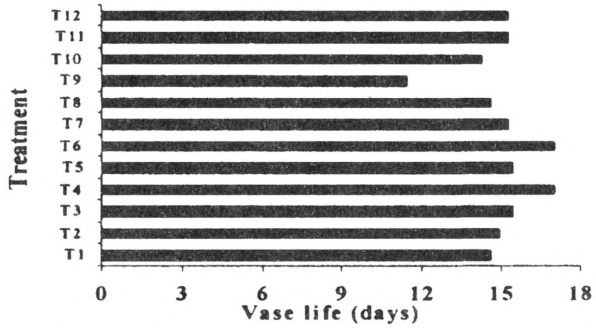

Figure 4.1 Vase life of *A. commutatum* 'Silver Queen' cut leaves according to petiole condition

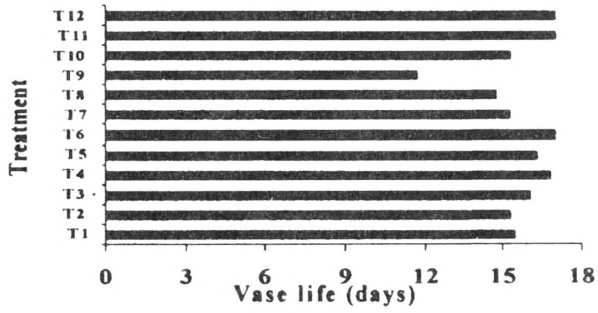

Figure 4.2 Vase life of *A. commutatum* 'Pseudobracteatum' cut leaves according to petiole condition

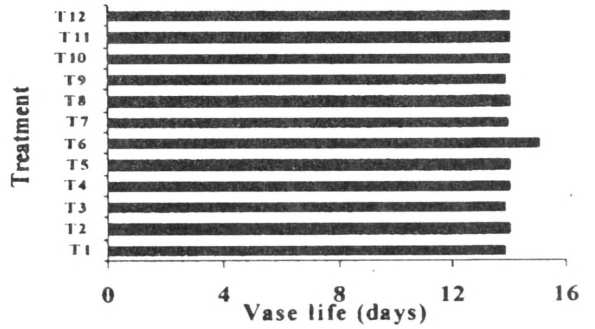

Figure 4.3 Vase life of *C. terminalis* cut leaves according to petiole condition

[Note: T1-control-distilled water, T2-2mgl^{-1} $KMnO_4$ dip for 1hr, T3- 2mgl^{-1} $KMnO_4$ dip for 6hrs, T4-2mgl^{-1} $KMnO_4$ continuous dip, T5-4mgl^{-1} $KMnO_4$ dip for 1hr, T6-4mgl^{-1} $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-1000mgl^{-1} $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

The vase life of *A. commutatum* 'Silver Queen' cut leaves according to the petiole condition is shown in figure 4.1. Cut leaves which were continuously dipped in 2mgl^{-1} $KMnO_4$ and 4mgl^{-1} $KMnO_4$ solutions showed a significantly ($p<0.008$) longer vase life (17 days) compared to the control (14.53 days). Cut leaves treated with 1000mgl^{-1} $AgNO_3$ (T9) showed a significant ($p<0.0007$) reduction in vase life (11.4 days) compared to the control.

Vase life of *A. commutatum* 'Pseudobracteatum' cut leaves according to the petiole condition is shown in figure 4.2. Cut leaves which were continuously dipped in 2mgl^{-1} $KMnO_4$ and 4mgl^{-1} $KMnO_4$ solutions showed a significantly ($p<0.008$) longer vase life (17 days) than that of the control (15.4 days). Cut leaves treated with 4mgl^{-1} $KMnO_4$ for one hour (T5) recorded the second longest vase life (16.3 days). Cut leaves treated with 1000mgl^{-1} $AgNO_3$ (T9) showed a significant ($p<0.0007$) reduction of vase life (11.67 days) while the other treatments did not affect the vase life of cut leaves significantly compared to the control.

A significant extension or a reduction of vase life according to the petiole condition of *C. terminalis* cut leaves was not observed under any treatment given in this experiment. However, cut leaves treated continuously with 4mgl^{-1} $KMnO_4$ (T6) showed the highest vase life (15 days) where the recorded vase life in the control was 13.8 days (Figure 4.3).

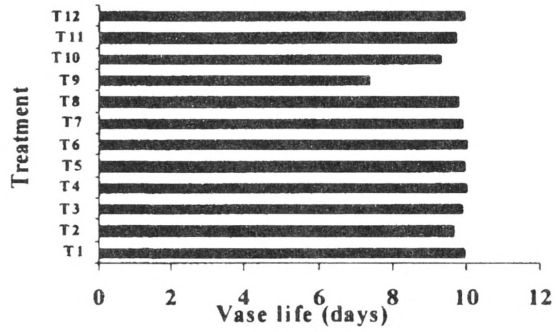

Figure 5.1 Vase life of *A. commutatum* 'Silver Queen' cut leaves according to leaf glossiness

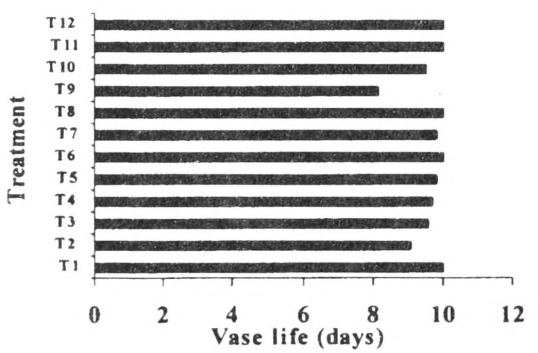

Figure 5.2 Vase life of *A. commutatum* 'Pseudobracteatum' cut leaves according to leaf glossiness

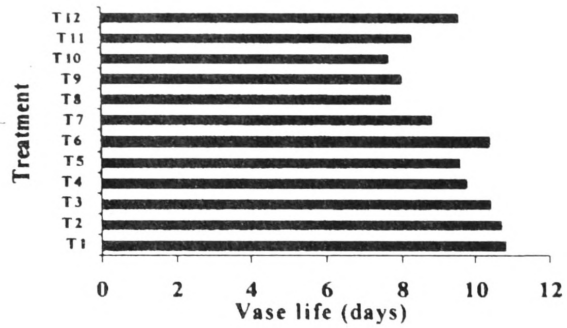

Figure 5.3 Vase life of *C. terminalis* cut leaves according to leaf glossiness

[Note: T1-control-distilled water, T2-2mgl^{-1} $KMnO_4$ dip for 1hr, T3- 2mgl^{-1} $KMnO_4$ dip for 6hrs, T4-2mgl^{-1} $KMnO_4$ continuous dip, T5-4mgl^{-1} $KMnO_4$ dip for 1hr, T6-4mgl^{-1} $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-1000mgl^{-1} $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

None of the treatments was effective in extending the vase life of *A. commutatum* 'Silver Queen' cut leaves, in relation to the leaf glossiness. 1000mgl^{-1} $AgNO_3$ (T9) significantly ($p<0.0001$) reduced the vase life of cut leaves (7.4 days) compared to the control (9.93 days). The longest vase life of 10 days could be observed from the cut leaves treated with 2mgl^{-1} $KMnO_4$ and 4mgl^{-1} $KMnO_4$ continuously (Figure 5.1).

Vase life of *A. commutatum* 'Pseudobracteatum' cut leaves according to leaf glossiness was significantly ($p<0.0001$) reduced by 1000mgl^{-1} $AgNO_3$ (8.13 days) compared to the control (10 days). Other treatments did not affect the vase life of cut leaves significantly compared to the control (Figure 5.2).

None of the treatments significantly affected the vase life of *C. terminalis* cut leaves according to leaf glossiness. The shortest vase life of 7.68 days was recorded from the cut leaves treated with STS for twenty minutes while the longest vase life (10.8 days) was recorded from the control (Figure 5.3).

Vase life of *A. commutatum* 'Silver Queen' cut leaves in relation to the overall appearance is shown in figure 6.1. Cut leaves treated continuously with 4mgl^{-1} $KMnO_4$ (T6) showed the significantly ($p<0.0006$) longer vase life (20.2 days) compared to the control (13.33 days). Cut leaves which were treated with 2mgl^{-1} $KMnO_4$ continuously (T4) (17 days), STS for forty minutes (T11) (16.2 days) and STS for one hour (T12) (17.33 days) also recorded significantly longer vase lives than that of the control. 1000mgl^{-1} $AgNO_3$ (T9) caused a significant ($p<0.0002$) reduction in overall appearance of cut leaves and recorded the shortest vase life (11.2 days).

Vase life of *A. commutatum* 'Pseudobracteatum' cut leaves in relation to the overall appearance is shown in figure 6.2. Cut leaves dipped continuously in 4mgl^{-1} $KMnO_4$ (T6) recorded the longest vase life (21 days) which was significantly ($p<0.0006$) longer than that of the control (14.9 days). Cut leaves treated with treatments T4 (15.9 days), T11 (16 days) and T12 (15.9 days) also showed

significantly longer vase lives than that of the control. 1000mgl^{-1} $AgNO_3$ (T9) detrimentally affected the overall appearance of cut leaves and reduced the vase life (11.6 days) significantly ($p<0.0002$) than the control.

Vase life of *C. terminalis* cut leaves according to the overall appearance was not significantly affected by anti-ethylene treatments as shown in figure 6.3. However, the longest vase life (12 days) was recorded when cut leaves were continuously dipped in 4mgl^{-1} $KMnO_4$ (T6) while the shortest vase life of 9.88 days was recorded when cut leaves were treated with STS solution for twenty minutes (T10) where the recorded vase life in the control was 10.56 days.

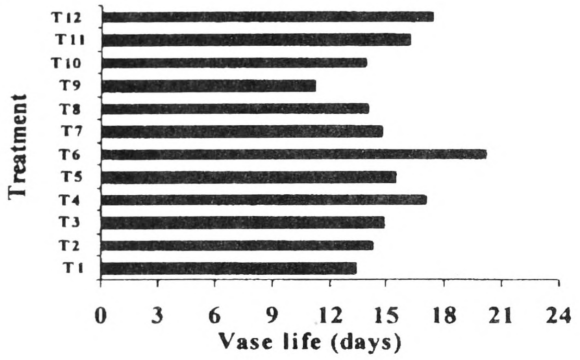

Figure 6.1 Vase life of *A. commutatum* 'Silver Queen' cut leaves according to overall appearance

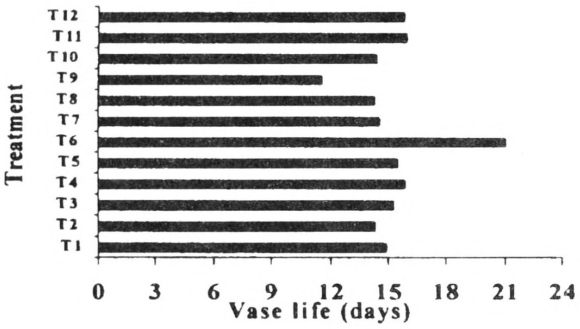

Figure 6.2 Vase life of *A. commutatum* 'Pseudobracteatum' cut leaves according to overall appearance

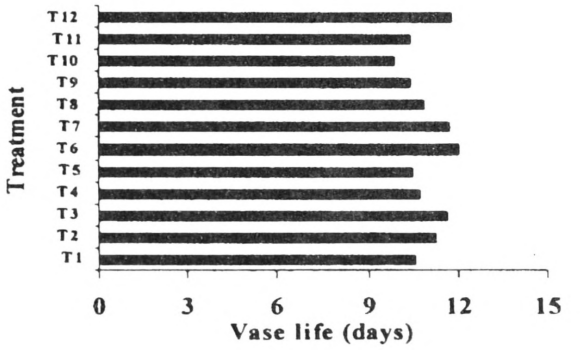

Figure 6.3 Vase life of *C. terminalis* cut leaves according to overall appearance

[Note:T1-control-distilled water, T2-2mgl^{-1} $KMnO_4$ dip for 1hr, T3- 2mgl^{-1} $KMnO_4$ dip for 6hrs, T4-2mgl^{-1} $KMnO_4$ continuous dip, T5-4mgl^{-1} $KMnO_4$ dip for 1hr, T6-4mgl^{-1} $KMnO_4$ continuous dip, T7-2% Ethanol dip for 10 min, T8-4% Ethanol dip for 10 min, T9-1000mgl^{-1} $AgNO_3$ dip for 10 min, T10- STS dip for 20 min, T11- STS dip for 40 min, T12- STS dip for 1hr.]

DISCUSSION

Stress conditions, pest and disease incidents and mechanical damages accelerate the ethylene production in plant tissues causing quick senescence that makes the product unfit for sale. Therefore, export quality, healthy cut leaves which were free from mechanical damages were selected and their petioles were immersed in distilled water during transportation to minimize the transport stress.

In this study distilled water was used as the control. It is not always possible to use distilled water in handling of cut leaves. However, several studies have shown that there is no real difference between the use of tap water and distilled water (Perry, 2002).

Both types of *A. commutatum* cut leaves were infected by bacterial rot during the period of study. The disease incidence was negligible among cut leaves which were continuously treated with 2mgl^{-1} and 4mgl^{-1} $KMnO_4$. Cut leaves treated with all other treatments were susceptible to the disease. $AgNO_3$ caused browning of petiole in all three types of cut leaves. Quality of *A. commutatum* cut leaves treated with $AgNO_3$ deteriorated within a short period of time compared to the other treatments. This detrimental effect may be due to the high concentration (1000mgl^{-1}) used. However, short pulses in solutions of silver nitrate have proved valuable for some crops as a biocide (Wilkins, 1999).

Performances of cut leaves of *A. commutatum* 'Silver Queen' and *A. commutatum* 'Pseudobracteatum' were almost similar under every treatment. It evidences that the relative sensitivity to ethylene of cultivars within a species does not differ considerably. Individual species vary widely in their relative sensitivity to ethylene and in general, cut flowers and flowering pot plants tend to be more ethylene sensitive than foliage lines (Wills *et al.*, 1998). In this study any anti-ethylene treatment except continuous dip in 2mgl^{-1} and 4mgl^{-1} $KMnO_4$, did not record a considerable increase in vase life of cut leaves of both species, *A. commutatum* and *C. terminalis*. This may be due to the poor sensitivity of these plants to ethylene gas.

$KMnO_4$ is quite effective in reducing ethylene levels by oxidizing ethylene into carbon dioxide and water. Silver ions provided as STS or $AgNO_3$ block the ethylene binding site, thereby preventing its action. Silver being toxic, sophisticated equipment is needed to handle the chemical (Yapa *et al.*, 2000). However, environmental pollution and high cost have reduced the popularity of silver based compounds as anti-ethylene treatments (Bledsoe *et al.*, 2005).

Other than these anti-ethylene compounds, sucrose also shows some impact on the bio synthesis of ethylene. The beneficial effect of sucrose on prolongation of flower vase life in several species has been attributed to the suppression of ethylene biosynthesis or sensitivity to ethylene (Kumar and Kazuo, 2003). At the same time, the addition of sucrose to the vase solution decreases the water potential of the tissue, thereby improves water uptake by the stem and finally lengthens their vase life

(Venkataryappa *et al.*, 1981). However, sucrose was not used as a treatment in this study. Therefore, further studies are recommended to find out the effect of sucrose on ethylene biosynthesis and vase life of cut leaves.

Pre harvest temperature, relative humidity, light and nutrition regimes can also affect the relative sensitivity of ornamentals to ethylene (Wills *et al.*, 1998). Environmental conditions such as temperature and relative humidity of the laboratory were not optimum (34.8^{0}C and 66.37% respectively) during the period of study. This may be another reason for lower vase life of *A. commutatum* and *C. terminalis* cut leaves.

CONCLUSIONS

The study revealed that 2mgl^{-1} and 4mgl^{-1} $KMnO_4$ solutions have the ability to enhance the vase life and longevity of *A. commutatum* 'Silver Queen' and *A. commutatum* 'Pseudobracteatum' cut leaves effectively when the petioles of the leaves were continuously immersed in the solutions while replacing them in every five days. The other treatments such as 2% ethanol, 4% ethanol, STS and $AgNO_3$ were not effective in prolonging the vase life. Therefore, considering the cost-effectiveness, continuous dip in 4mgl^{-1} $KMnO_4$ can be selected as the best treatment to prolong the vase life of *A. commutatum* 'Silver Queen' and *A. commutatum* 'Pseudobracteatum' cut leaves. To overcome difficulties during transportation, a cotton wool plug wetted with 4mgl^{-1} $KMnO_4$ solution can be used to cover the petiole ends of cut leaves.

None of the treatments tested was effective in enhancing the vase life and prolonging the longevity of *C. terminalis* 'Red Edge' cut leaves. Therefore, it can be inferred that *C. terminalis* 'Red Edge' has a comparatively poor response to ethylene gas.

The quality of all three types of cut leaves was adversely dropped down by 1000mgl^{-1} $AgNO_3$. Therefore, 1000mgl^{-1} $AgNO_3$ can be considered as an unsuitable treatment to improve the post harvest life of *A. commutatum* 'Silver Queen', *A. commutatum* 'Pseudobracteatum' and *C. terminalis* cut leaves. Further studies are needed to find out a suitable concentration of $AgNO_3$ to treat cut leaves.

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