Extending the Postharvest Life of *Calathea lancifolia* (Rattle snake Plant) Cut Leaves Using 1-Methylcyclopropene (1-MCP)

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Abstract

Calathea lancifolia is a cut foliage species that is regularly exported from Sri Lanka. However, early wilting and rolling of leaves are the prominent postharvest problems that are associated with *Calathea* which lead to shorten the vase life. These problems limit the export potential of this attractive species grown in Sri Lanka. 1-Methylcyclopropene (1-MCP) can be used to extend the shelf life of ornamentals by blocking the ethylene action. Thus present study was conducted to identify the effective concentration of 1-MCP on extending the postharvest life of *C. lancifolia* cut leaves. The experiment was arranged in a completely randomized design (CRD), composed of two factors with three replicates; 1- MCP concentration at four levels (50, 100, 150 and 200 ppb) and period of exposing at two levels (6 and 12 hours) in a hermetically sealed plastic buckets (20 L) at 28 °C. Afterwards, the treated and untreated cut leaves were dipped in a glass filled with distilled water and stored in ambient temperature (28 °C, 70% RH). Each treatment consisted of 3 replicates, five leaves per replication. Cut leaves of C. *lancifolia* treated with 50, 100, 150 and 200 ppb of 1- MCP gas in 12 hours extended the vase life compared to 6 hours and untreated control. Leaf wilting, leaf yellowing and leaf rolling were recorded to assess the quality of the leaves. The cut leaves treated with 1- MCP at a concentration of 200 ppb in 12 hours showed 10 days of vase life with acceptable export quality. However there was no significant difference between 200 ppb and 150 ppb of 1-MCP concentrations when qualitative traits are considered. Therefore, 150 ppb of 1-MCP concentration can be considered the cost effective among the concentrations that were experimented.

Key words: Calathea lancifolia, Vase life, 1-Methylcyclopropene

Introduction

Calathea lancifolia (Rattle snake Plant / Prayer Plant; Marantaceae) is one of the most attractive indoor ornamental tropical house plants. This plant has narrow leaves up to 50 cm long, medium green leaves with olive green dark decorative spots and fluted edge foliage. *Calathea* produces color even under extremely low light and therefore very popular and has a good demand as cut foliage exported from Sri Lanka. *C. lancifolia* has also become popular among the growers due to its characteristic leaves that attract the export market. But wilting and rolling of leaves leading to reduced shelf life are the prominent postharvest problems encountered with *Calathea* which limit the export potential of this foliage. Manipulation of the regulating mechanism of senescence is necessary to extend the vase life of cut foliage. Thus, use of post-harvest treatments is important. Ethylene plays a major role in reducing vase life of cut foliage. 1-Methylcyclopropene (1-MCP) as an inhibitor of ethylene action, over 100 studies have conducted to examine of its action, application and effect on ethylene inhibition.1-MCP prevents ethylene effects in a broad range of fruits, vegetables and floricultural crops. Depending on the species being treated, 1-MCP may have variety of effects on respiration, ethylene production, volatile production, chlorophyll degradation and other color changes (Blankenship and Dole, 2003). Generally, treatment durations of 12-24 h were sufficient to achieve full response (Blankenship and Dole, 2003). 1- MCP has not been tested for cut foliage in Sri Lanka. Therefore this study was conducted to identify effective

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concentration of 1-MCP in extending the postharvest life of *C. lancifolia* cut leaves.

Materials and Methods

The experiment was carried out at the tissue culture laboratory of Ministry of Agriculture (NWP), Kurunegala. The cut leaves were collected early in the morning and the cut ends of the leaves were put into a bucket filled with tap water. The leaves were transported to the laboratory on the same day. Healthy, disease free *C. lancifolia* cut leaves (50 leaves) with similar characteristics (Same colour, shape and size of the leaves) were selected for the experiment. All the selected leaves were cleaned using distilled water and Teepole™. Leaves were recut in the water in order to have same petiole length. Following treatments were applied 1-MCP 50 ppb, 100 ppb, 150 ppb, 200 ppb concentrations with two exposure times of 6 hours and 12 hours at 28±2° C. Distilled water was used as the control. Plastic bins were labeled according to the levels of treatments and beakers which were having 5 ml of distilled water with 5 leaves were placed in each bin with three replicates. To release the 1- MCP gas, drops of distilled water at 40 ° C was added to the small bottle of 1- MCP powder. Bottle was placed inside the plastic bin and the bottle cap was opened. The bin lid was immediately sealed with Selotape. All the levels of treatments were made by this way and kept at 28±2 ° C for relevant time duration as 6 hours and 12 hours. After 6 hours and 12 hours plastic bins were opened, and beakers were taken out. Quality of the cut leaves was determined according to the self-determined marking scheme. Leaf wilting, leaf yellowing and leaf rolling were recorded at two day intervals to assess the quality of the leaves. Distilled water in the beakers was replaced at 7 day intervals. Percentage of weight losses were recorded at two day intervals by using electrical balance. The weight difference was recorded as the percentage weight losses. The experimental design was CRD with three replicates. Data were analyzed using Statistical Analysis Software (SAS) package and the means were separated using Duncan multiple range test. Data on leaf wilting, yellowing, rolling were analyzed by Kruscal Wallis test.

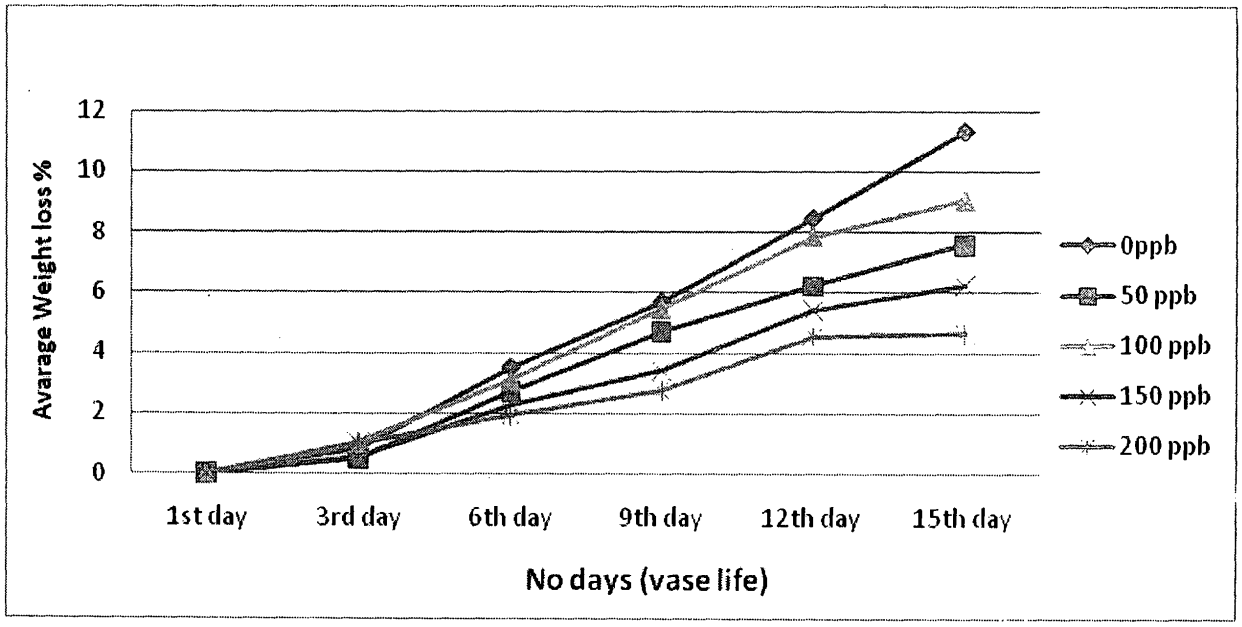

Figure 1. Average weight loss percentage of *C. lancifolia cut* leaves at three day intervals after treated with 1-MCP at various concentrations.

Results and Discussion

Exposure time of 1-MCP gas affected the weight loss of *C. lancifolia* cut leaves. The weight loss percentage of cut leaves treated with 1-MCP for 12 hours was significantly lower ($p<0.0001$) compared to those treated with 1-MCP for 6 hours. At the end of 14 days, 100 ppb of 1-MCP showed highest mean weight loss percentage (13.7). The lowest mean weight loss percentage (2.01) was found in 200 ppb of 1-MCP treated for 12 hours period. 1-MCP treated cut leaves had lower weight loss than untreated leaves (control - 0 ppb). There was a significant difference in weight loss percentage among 50 ppb, 100 ppb, 150 ppb and 200 ppb stared at 9th day. The leaves treated with 200 ppb for 12 hours showed the lowest weight loss percentage (Figure 1).

Table 1. Mean value of wilting of C. lancifolia cut leaves after exposing to the different concentrations of 1-MCP gas.

Concentration (ppb)	Mean Score
0	38.5^{d}
50	65.37^{c}
100	78.03^{b}
150	96.53^{a}
200	99.07^{a}

Values having different superscripts are significantly different at $p<0.0001$.

In 12 hours 1-MCP treated cut leaves showed a longer vase life of 10 days than 6 hours treated cut leaves. There was no significant difference in wilting between 150 ppb and 200 ppb concentrations of 1- MCP. The cut leaves treated with 150 ppb and 200 ppb of 1-MCP did not show a significant difference up to 7 days of storage period. 200 ppb concentrations of 1-MCP treated cut leaves showed 10 days vase life and 150 ppb concentrations of 1- MCP treated cut leaves showed 9 days vase life.

Yellowing of *C. lancifolia* cut leaves that treated with of 1-MCP was significantly different ($p<0.0001$) at the end of 14 days. The cut leaves treated with 200 ppb of 1-MCP showed the highest mean score value (104.0) and control showed the lowest mean score value (37.9). There was significant difference in yellowing between the control (0 ppb) and the various concentration of 1-MCP. There was no significant difference in leaf yellowing between 6 hours 1-MCP treated cut leaves and 12 hours treated cut leaves up to 11 days of storage period. 6 hours 1-MCP treated cut leaves started leaf yellowing at 11th day but 12 hours 1-MCP treated cut leaves did not show leaf yellowing until end of the experimental period of 14 days.

Rolling of *C. lancifolia* cut leaves that treated with various concentrations of 1-MCP was significantly different ($p<0.0001$) at the end of 14 days. The cut leaves treated with 200 ppb of 1-MCP showed the highest mean value of 104.0 and the control showed the lowest mean value of 21.4. There was no significant difference in leaf rolling between 6 hours treated cut leaves and 12 hours treated leaves up to 13 days of storage period. 6 hours 1-MCP treated cut leaves started leaf rolling at 13th day but 12 hours 1-MCP treated cut leaves did not show leaf rolling until end of the experimental period of 14 days. There was no significant difference among the various concentrations of 1- MCP up to 13 days. 150 ppb and 200 ppb 1-MCP treated cut leaves did not show leaf rolling and showed more than 14 days vase life.

In many plant species ethylene has a detrimental effect on the vase life of sensitive cut stems and it particularly important in inducing undesirable abscission, senescence and physiological disorders of vegetative and generative organs (Ludovica *et al.*, 2006). It also damages the product quality, causing loss of cellular turgor, chlorophyll and pigment degradation. In the early 1990s 1-MCP was shown to be an effective and environmentally safe blocker of ethylene binding sites.

This gaseous compound acts at low concentrations even after a single application of few hours (Ludovica *et al.*, 2006).

The results showed that exposing of cut leaves to 1-MCP gas at 12 hours had better performance showing longer vase life than the 6 hours. In overall effect among various 1- MCP concentrations on *C. lancifolia* cut leaves, 200 ppb showed the best performance. 1- MCP at a concentration 200 ppb for 12 hours can be used to extend the vase life of *C. lancifolia* cut leaves up to 10 days with acceptable export quality. There was no significant difference between 200 ppb and 150 ppb of 1-MCP. Therefore 1- MCP at a concentration of 150 ppb for 12 hours also can be used to extend the vase life of *C. lancifolia* up to 9 days with acceptable export quality.

Exposing the *C. lancifolia* cut leaves to 1- MCP at ambient temperature can extend the vase life successfully. 1- MCP at a concentration of 200 ppb and 1- MCP at a concentration of 150 ppb in 12 hours can be used to extend the vase life of *C. lancifolia* cut leaves by maintaining the freshness of the leaves. However, 150 ppb of 1-MCP concentration may be the cost effective among the concentrations that were experimented.

References

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