

EFFECT OF SOME SELECTED VASE WATER ADDITIVES ON VASE LIFE OF *Cordyline terminalis* 'red' FOLIAGE

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INTRODUCTION

Cordyline terminalis (L.) Kunth, commonly known as Ti plant is a member of family *Asperagaceae* (APG III), and a popular decorative plant owing to its vivid and variable leaf coloration. *C. terminalis* has a high demand in the export market as cut decorative foliage. However, the short vase life in many *Cordyline* varieties limits their potential demand for exportation as foliage in spite of the high demand. The short vase life of cut foliage of *Cordyline* varieties is indicated by initiation of yellowing at the leaf tips, which progressively spread to the margins. A number of factors contributing to the short vase life of cut foliage in general. Among these factors, blockage of water conducting xylem vessels is the major factor which contribute for the short vase life of most cut flowers (Van Doorn, 1997). The blockage of water conducting tissues may be microbial and /or physiological in origin. Further, bacteria in the vase water may reduce flower longevity, by plugging the vessels in the stems subsequently result the wilting and indication of other symptoms of water stress (Van Doorn *et al.*, 1989). The addition of certain antimicrobial compounds into the vase water reduces the number of bacteria in the flower stems of roses increasing the longevity (Van Doorn *et al.*, 1990). The sugar pulsing with 100 g L⁻¹ sucrose in combination with the biocide, 8-Hydroxyquinoline sulfate(8-HQS) for 16 h has significant effect on extending the vase life of cut Sweet Pea flowers and cut Roses (Ichimura and Suto, 1999). From these findings it is suggested that sucrose might be required as an osmolyte for flower opening and a substrate for cell wall synthesis and respiration. The incorporation of plant hormones in to the vase water is another method to improve vase life of cut flowers and foliages. It has been recorded that the vase life and leaf damage of cut *Eustoma grandiflorum* flowers has been extended by pulsing with sucrose and 10 µmol of ABA (Yomoto and Ichimura, 2009). This study was conducted with the objective of finding out a suitable treatment for extending vase life of cut foliage of *C. terminalis*.

METHODOLOGY

Foliage of *C. terminalis* at the commercially mature stage (length 20 cm) was harvested in the morning (8.00 a.m. - 9.00 a.m.) from a nursery at Rajagiriya. Harvested foliage was immediately kept in an upright position in the buckets partially filled with distilled water and was kept in the shade during transportation to the laboratory. Further, to minimize moisture loss during transport, the foliage- containing buckets were covered with a plastic film shroud. Once the materials were brought to the laboratory, the foliage ends were re-cut under distilled water to avoid the embolism of xylem vessels. A set of *Cordyline terminalis* Leaves (06 leaves per each treatment) was treated as follows and the vase life and Relative Fresh Weight (RFW) of the leaves were determined

1. Effect of re-cutting of foliage petiole ends or recutting plus treatment with Citric acid

Effect of re-cutting the foliage petiole segments was tested by removing of 1cm length from the base of petioles in every 2-day intervals or recut petiole ends were then dipped separately in solutions of Citric acid 1.0 mM or 1.5 mM.

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2. Effect of sugar pulsing

Effect of sugar pulsing was determined by the separately dipping foliage petioles (24 h) in different concentrations of sucrose (5 gL^{-1} or 10 gL^{-1} or 20 gL^{-1}). This treatment is known as sucrose pulsing. From this treatment, the optimum concentration of sucrose needed for 'pulsing' was determined.

3. Effect of 8-Hydroxyquinoline sulfate (8-HQS) alone or 8-HQS plus Sugar or 8-HQS plus Sugar and citric acid

C. terminalis petioles were dipped in the 8-HQS solution alone (200 mgL^{-1}) separately or petiole ends that were already treated with HQS were dipped separately in Sucrose (10 gL^{-1}) and/or Citric acid (1.5 mM).

4. Effect of pulsing of BAP (5 mg/L or 10 mg/L) alone or BAP plus citric or BAP plus sucrose or BAP plus both sucrose and citric acid

(i) The first set of cut *Cordyline terminalis* foliage ends were pulsed with BAP by dipping 30 min separately in BAP (5 mgL^{-1}) concentration (ii) The second set of *C. terminalis* leaves that were pulsed in BAP (5 mgL^{-1}) for 30 min were again dipped in Citric acid solution (iii) Third set of foliages were initially pulsed with BAP (5 mgL^{-1}) for 30 min were again given Sucrose pulsing (10 gL^{-1}) treatment (iv) Fourth set of leaves were initially pulsed with BAP (5 mgL^{-1}) for 30 min were again given Sugar pulsing treatment and Citric acid treatment. (v) Fifth set of leaves were dipped in distilled water and maintained as controls

The similar experiment was performed using five other sets of leaves (each set contains 06 leaves) using the 10 mgL^{-1} BAP

The quality of leaves was rated using a scale of 4 to 1 on the basis of freshness and color of leaves, where, 4 = Fresh appearance/ No blemish; 3 = Slight loss in freshness/ Slight yellowing; 2 = Moderate loss of freshness/ moderate yellowing; 1 = Severe loss of freshness/ Severe yellowing. The vase life of the foliage was determined as the number of days taken to reach the value 03 in the quality scale.

The fresh weights (FW) of the cut foliage were recorded daily during the vase period. Relative Fresh Weight (RFW) of foliage was calculated using formula $\text{RFW (\%)} = (W_t/W_{t=0}) \times 100$, where W_t is the weight of the foliage (g) at $t = 1, 2$ etc, $W_{t=0}$ is the weight of the same foliage (g) at $t = \text{day } 0$.

The experiments were conducted in a room maintaining the temperature at $20 \pm 1^\circ \text{C}$, Relative Humidity (R.H) at $60 \pm 10\%$ and light intensity at $12 \mu \text{ mol m}^{-2} \text{ s}^{-1}$ (cool white fluorescent tubes) under a daily light period of 12 h. In each experiment, all foliage was placed individually in 300 ml capacity plastic vases containing 250 ml of distilled water.

RESULTS

1) Effect of re-cutting of foliage petiole ends and treatment with Citric acid 1 and 1.5 mM

There was discernible difference between the foliage treated with Citric acid (1.5 mM) without re-cutting the petioles (vase life of 26 days) and foliages treated with Citric acid (1.0 mM) without recutting the petiole (22 days). The vase life of the petioles re-cut foliages treated with Citric acid (1.0 mM) and those with re-cut petioles and treated with Citric acid (1.5 mM) were 22.5 and 20 days respectively. The comparatively higher vase life was observed for the foliages treated with 1.5 mM of Citric acid. The results indicated that re-cutting of petiole ends has no significant contribution to extend the vase life of foliages. Further, there was perceivable difference in % Relative Fresh Weight in foliages treated with non-cutting and treated with Citric acid (1.0 mM) (non-cutting plus Citric acid (1.5 mM)).

2) Effect of sugar pulsing on vase life and Relative Fresh Weight of foliages

Foliage stems treated with 24h pulsing with 20 gL⁻¹ Sucrose showed lesser vase life (12days) compared to the foliages provided with 24h pulsing with 5 gL⁻¹, 10 gL⁻¹ sucrose and non-treated controls. Meanwhile the vase life of foliages treated with 24h pulsing with 5 gL⁻¹ and 10 gL⁻¹ Sucrose were 24- and 26 days respectively. The Relative Fresh Weight (RFW) of foliages which were treated with 24h pulsing with 10 gL⁻¹ Sucrose solution showed longest value of the vase life. The Shortest vase life was observed in foliages pulsed with 20 gL⁻¹ Sucrose solution.

3) Effect 8-Hydroxyquinoline sulfate (8-HQS 200 mgL⁻¹) and combined treatment

There was no noticeable difference in vase life of foliages treated with sucrose pulsing plus 8-HQS, Sucrose pulsing plus 8-HQS plus Citric acid (1.5 mMol) compared to control foliages. However, vase life of foliages was considerably increased in sugar pulsing plus Citric acid treatment (1.5 mMol) (28 days). The lowest vase life was observed in foliages treated with 8-HQS alone. The percentage Relative Fresh Weight of foliages which were subjected to Sucrose pulsing and Citric acid treatment remained at a higher level throughout the vase life period.

4) Effect of pulsing of 6-Benzyl Amino Purine (BAP) alone (5 mgL⁻¹ or 10 mgL⁻¹) or BAP plus Citric acid or BAP plus Sucrose or BAP plus both Sucrose and Citric acid

Treatment	Vase life(days)
BAP (5mg/L)	36±(0) [#] a
BAP (10mg/L)	36±(0)a
BAP (5mg/L)plus Citric acid	35±(2.445)a
BAP (10mg/L)plus Citric acid	33±(3.27)ba
BAP (5mg/L)plus Sucrose	28.6±(9.633)bc
BAP (10mg/L)plus Sucrose	32.3±(6.47)ba
BAP (5mg/L)plus Sucrose plus Citric acid	35±(2.445)a
BAP (10mg/L)plus Sucrose plus Citric acid	33.3±(6.53)ba
Sucrose(100mg/L)	33±(3.32)a
Citric acid	28.3±(7.84)c
Sucrose(100mg/L) plus Citric acid	31.5±(4.15)ba
Control	23.16±(4.47)c

[#]Mean followed by Standard Deviation (SD) of the mean within parenthesis

Table 01 Pulsing of BAP alone and in combination with citric and sucrose on vase life.

Mean values followed by similar letters were not significant at $P \leq 0.05$ from LSD test *C. terminalis* leaves subjected to treatment with BAP either 5 mgL⁻¹ or 10 mgL⁻¹ or BAP (5mgL⁻¹) plus Citric acid had longer vase life than foliages treated with the other treatment and the controls. There was a significant difference between the foliages treated with BAP alone and BAP in combination with either BAP plus Citric acid or BAP plus Sucrose plus Citric acid treatment compared to Citric acid alone or BAP (5 mgL⁻¹) plus Sucrose or controls

DISCUSSION

The post harvest vase life is often ended in many types of foliage due to the microbial plugging of vessels at the stem ends. In the present study, the addition of the biocide, 8- HQS (200 mg L⁻¹) into the vase water and the re-cutting of stem ends at 2- day intervals were tried out as a measure to reduce bacterial activity. However, recutting and application of 8-HQS had no considerable effect on extending vase life of *C.terminalis* 'red' foliages. However, it has been reported that

vase life of *C. terminalis*, 'mike silver' was extended by the addition of 8-HQS and some of floral preservatives ('Flora' and 'Flower fresh') (Hettiarachchi and Balas, 2003).

Foliages treated with Citric acid (1.5 mMol) indicated vase life and percentage Relative Fresh Weight compared to other treatments (recutting alone and re-cutting plus Citric acid (1.0 mMol). This may indicate a role of Citric acid in increasing stem conductance and it may also be probably retarding the bacterial activity in vase water.

Pulsing of foliages with Sucrose solution (10gL⁻¹) improved vase life compared to the other treatments tested and higher Relative Fresh Weight indicated that quality of foliages remained better up to 28 days of vase life. However, yellowing of leaves was observed after 12 day of vase period in leaves pulsed with 20gL⁻¹ Sucrose solution which indicates that higher Sucrose supply exerts a negative effect on the vase life of *C. terminalis* cut foliage. It has been reported that low levels of Sucrose was beneficial to vase life of two flowering *Eucalyptus* sp. although levels of 10% caused leaf browning and damage (Jones *et al*, 1994). Foliages treated with sugar pulsing in combination with Citric acid treatment showed the highest vase life among the other treatment combinations. The positive effects of Sucrose with Citric acid may be due to the synergistic effect of both compounds on extending the vase life of cut *Cordyline terminalis* 'red' foliages. It is well-known that Sucrose reduces ethylene sensitivity and replaces the carbohydrate depletion of *Cordyline* during vase life period. Low pH levels in the vase solution created by the addition of Citric acid may be beneficial for the stem conductance and retarding the bacterial activity in vase water. Foliages subjected to the treatment with BAP 5mgL⁻¹ or 10mgL⁻¹ had highest vase life compared to the BAP plus Citric acid or BAP plus sucrose or BAP plus Citric acid or Sucrose. This indicated that BAP alone would be beneficial in extending vase life of *Cordyline* leaves compared to the controls. There was no significant difference in vase life of foliages, when BAP provided alone and incombined treatment with Sucrose or Citric acid. Similar results were recorded by Hara *et al.*, 1999 for extending vase life of green Ti leaves with 200ppm dip in BAP for 5 min after hot water treatment at 49°C. ABA and Sucrose plus ABA treatments showed marked delays in leaf wilting. These findings indicate that a pulse treatment with Sucrose plus ABA suppresses leaf damage and improves the quality of cut *Eustoma* flowers (Yumoto-Shimizu and Ichimiura 2009).

CONCLUSIONS/RECOMMENDATIONS

Based on this study it can be concluded that the optimum treatment for extending vase life *Cordyline* foliages is BAP either 5mgL⁻¹ or 10mgL⁻¹

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