Tropical Agricultural Research Vol. 15: 327-330 (2003)

Effects of Hydration Solutions on Postharvest Quality of Croton (*Codiaeum variegatum* (L.) A. Juss. 'Excellent') after Shipment

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ABSTRACT. *Hydration solutions make an important contribution to the postharvest quality of Croton (Codiaeum variegatum (L.) A. Juss. 'Excellent') after long-distance shipment. While the shortest vase life (18.90 days) produced in Chrysal vases, stems treated with 8-HQS showed the longest vase life (31.14 days). There were no significant differences for vase life of foliage stems placed in Biovin (30.26 days), tap water (30.01 days) and 8-HQS. Water transpiration and uptake continuously decreased in the vase period. Foliage stems placed in tap water indicated highest chlorophyll fluorescence yield at initial stage although, stems in 8-HQS and Biovin showed higher yield at senescence. Stems in tap water produced the lowest leaf lightness value (19.80) than other treatments (average 27.20) on 14 day post-treatment. It appears that hydration of C. variegatum stems with an appropriate holding solution after long-distance shipment positively influenced vase life, foliage colour and chlorophyll fluorescence yield. Results of the study indicate that 8-HQS (200 ppm) has the potential to be used as a commercial preservative solution for delaying foliage senescence, prolonging vase life and enhancing postharvest quality of C. variegatum cut foliage.*

INTRODUCTION

Croton (*Codiaeum variegatum* (L.) A. Juss. 'Excellent') is mainly exported to Europe as cut stems or rooted stems. The variety of colours and the ability to transport them in a dry state put crotons in remarkable demand from other countries. However, it takes usually 4 - 5 days to deliver packed boxes from the harvested point of Sri Lanka to final destination in Europe. Loss of quality of leaves or stems may result in rejection at the export market place. Floral preservatives may minimise the risk of physiological disorders (*e.g.* leaf chlorosis, leaf blackening) that occur in cut foliage after harvest (Eason, 2000). 8-Hydroxyquinoline Sulphate (8-HQS) is a germicide, which can be used as a vase solution with sucrose for some ornamental species, its effectiveness could be partially due to inhibition of bacterial proliferation however 8-HQS inhibits the occurrence of bent-neck in cut rose flowers (Burdett, 1970) and improves water relations by inhibiting both vascular blockage and transpiration (Halevy and Mayak, 1981). The aim of this work was to determine the effect of hydration solutions, introduced SVS (van Meeteren *et al.*, 1999), a commercial floral preservative (Chrysal), a biological fertilizer (Biovin) and a biocide (8-HQS) to maintain postharvest quality of cut croton stems after long-distance shipment.

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METHODS AND MATERIALS

Cut stems of *C. variegatum*, grown in shade houses in Sri Lanka, were obtained from a commercial grower to conduct laboratory experiments in Vienna, Austria. Upon arrival, stems were recut under water to maintain 20 cm in length and placed in hydration solutions of Chrysal® - Pokon & Chrysal, Holland (10 g l^{-1}), 8-HQS (200 ppm), Standard Vase Solution-SVS ($NaHCO_3$ 125 mg l^{-1}, $CaCl_2.2H_2O$ 99 mg l^{-1}, $CuSO_4.5H_2O$ 1.2 mg l^{-1}), Biovin® - Austria (1 ml l^{-1}) and control (tap water) vases. Vase life, fresh weight, water uptake, transpiration, °brix osmotic potential foliage colour and chlorophyll fluorescence were measured. Data were subjected to the general linear model procedure. and means separation was accomplished by Tukey HSD test (SPSS, USA, 1996).

RESULTS AND DISCUSSION

Stems placed in 8-HQS had the longest vase life (31.14 days) but the shortest vase life occurred in Chrysal vases due to rapid death of stems (Table 2). Hydration treatments had no effect on changes in fresh weight (Table 1) or dry weight and showed continuous decline in fresh weight remaining values below the initial weights over the vase period. Of all hydration treatments, Chrysal showed the lowest stems °brix and leaf osmotic potential compared to other treatments (Table 3). Chrysal like preservative solutions may contain carbohydrates, biocides, plant growth regulators, anti-ethylene compounds or chemicals known to reduce water tension and aid water uptake. However, addition of a biocide (8-HQS) was the effective solution for croton, preventing microbial growth during vase period.

Table 1. Effect of hydration solution on croton fresh weight (g) in vase period.

Hydration solution	Day 1	Day 7	Day 14	Day 21	End of vase
SVS	29.21 a	28.60 a	28.29 a	25.46 a	23.41 a
Chrysal	29.78 a	28.61 a	28.09 a	23.96 a	21.07 a
Biovin	29.64 a	28.23 a	27.59 a	24.76 a	23.49 a
Tap water	26.69 a	25.79 a	25.74 a	23.30 a	22.32 a
8-HQS	29.53 a	28.56 a	28.06 a	25.07 a	22.97 a

Note: Means within column with different letters are significantly different at $P<0.05$.

Table 2. Results of transpiration, water uptake and vase life in *Codiaeum* stems in hydration solutions.

Hydratio solution	Transpiration (g $d^{-1}stem^{-1}$)			Uptake (g $d^{-1}stem^{-1}$)			Vase life (d)
	Day 1	Day 15	End of vase	Day 1	Day 15	End of vase	
SVS	3.60 a	2.74 a	5.62 a	3.53 a	2.63 a	2.03 ab	26.36 b
Chrysal	3.81 a	2.28 a	4.54 a	2.65 a	2.11 a	1.90 a	18.90 a
Biovin	4.21 a	2.77 a	4.06 a	2.79 a	2.57 a	2.53 ab	30.26 c
Tap water	3.91 a	2.55 a	3.76 a	3.01 a	2.54 a	2.71 b	30.01 c
8-HQS	4.70 a	2.98 a	5.82 a	3.64 a	2.82 a	2.49 ab	31.14 c

Note : Means within column with different letters are significantly different at $P<0.05$.

Table 3. Changes of °brix value and osmotic potential of leaves and stems of croton at senescence.

Hydration solution	°brix (%)		Osmolality (mmol kg^{-1})	
	Leaf	Stem	Leaf base	Stem
SVS	6.35 a	5.35 a	-10.23 b	-10.06 b
Chrysal	6.55 ab	4.85 a	-10.97 ab	-10.46 ab
Biovin	6.97 ab	5.50 a	-10.90 ab	-10.16 b
Tap water	6.37 a	5.20 a	-11.99 a	-11.88 a
8-HQS	6.40 a	5.32 a	-10.81 ab	-10.78 ab

Means within column with different letters are significantly different at $P<0.05$.

Water uptake of croton cut stems decreased slowly over the vase period, and this pattern was observed for the other ornamental species (Halevy and Mayak, 1981). However, the decrease in transpiration rate does not equal to the decrease in water uptake, and therefore, the water deficit increases with time (Table 2). In many cut flowers and foliage stems, the length of vase life is limited by a drastic decrease in water uptake, which accompanied by a decrease in transpiration rate (van Doorn, 1999).

Colour components (a^*, b^*, chroma and hue angle) were not significantly affected by hydration solutions except leaf lightness (Table 4). However, variation of values during vase period showed the importance of nutrient solution than tap water. Chlorophyll fluorescence yield was significantly influenced by treatments (Table 4). van Kooten *et. al.* (1991) reported that chlorophyll fluorescence is a fast and non-invasive technique to determine the physiological status of plant tissue.

Table 4. Effect of hydration solution on leaf lightness (L^*) and chlorophyll fluorescence yield.

Hydration solution	Leaf lightness (L^*)			Chlorophyll yield		
	Day 1	Day 7	Day 14	Day 1	Day 7	End of vase
SVS	29.82 a	25.13 a	28.49 b	0.75 a	0.75 ab	0.67 a
Chrysal	29.41 a	22.24 a	26.94 ab	0.76 ab	0.76 ab	0.68 a
Biovin	29.96 a	29.24 a	27.45 ab	0.77 ab	0.77 ab	0.69 a
Tap water	30.91 a	28.17 a	19.80 a	0.78 b	0.77 b	0.67 a
8-HQS	29.26 a	27.49 a	24.70 ab	0.77 ab	0.76 ab	0.69 a

Note : Means within column with different letters are significantly different at $P<0.05$.

CONCLUSIONS

Hydration treatments for *C. variegatum* cut stems showed highest vase life in 8-HQS. It controlled microbial growth in the holding solution and prolonged vase life. It had no significant differences for vase life in 8-HQS, tap water and Biovin vases. Long-distance shipment affected the water relations of cut *C. variegatum*. Leaf colour lightness was significantly affected by hydration solutions, suggesting the necessity of use of appropriate vase solution after shipment. Results who indicate that 8-HQS (200 ppm) has the potential to be used as a commercial preservative solution for delaying foliage senescence, prolonging vase life and enhancing postharvest quality of *C. variegatum* cut foliage.

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