

Effect of Chemical Treatments and Sucrose on Vase Life of Three Cut Rose Cultivars

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ABSTRACT

A study was carried out to investigate the effect of chemical treatments and sucrose on vase life of three new rose cultivars, 'Bouing', 'Creamly' and 'Sena'. Treatments were included distilled water (control), 10 g l⁻¹ sucrose, 10 g l⁻¹ sucrose + 100 mg l⁻¹ citric acid, 10 g l⁻¹ sucrose + 100 mg l⁻¹ aluminium sulphate, 10 g l⁻¹ sucrose + 0.5 mM silver thiosulphate for 2 h. Results showed that the best treatment for 'Sena' was silver thiosulphate + sucrose that increased fresh weight, water uptake, flower diameter and flower vase life. On the other hand, this treatment caused petal burning in 'Creamly' in spite of its other improved traits. Best treatment for other cultivars was citric acid + sucrose that had significant effect on all investigated factors. Aluminium sulphate just had a positive effect on 'Sena'. This treatment did not have positive effect in 'Creamly' and even decreased vase life of 'Bouing' in comparison with control.

Keywords: Aluminium sulphate, Silver thiosulphate, Citric acid, Cut flowers, Rose

INTRODUCTION

Rose (*Rosa hybrid* L.) flower is one of the most important ornamental plants in the world and cut rose flowers industry is also the most important aspect of rose culture industry (Bleeksma and Van Doorn, 2003; Mortazavi *et al.*, 2007). Vase life of cut rose flowers are comparatively short (Al-Humaid, 2004; Ichimura *et al.*, 2006; Ichimura *et al.*, 2003). Depending on the species flower longevity is varied and the functional life of petals is ended by flower closure, wilting or abscission or changing color of petals prior to wilting or

abscission (Van Doorn and Schroder, 1995). Many researches showed that one of the most important causes of shortening of vase life in roses is blockage of xylem vessels which, constricts water supply to flowers. Occlusions are thought to develop due to various factors such as bacteria, air emboli and physiological responses of stem to cutting (Al-Humaid, 2004; Bleeksma and Van Doorn, 2003; Ichimura *et al.*, 2006; Nowak *et al.*, 1990; Van Doorn, 1997). Also it is reported that antimicrobial compounds increase flower longevity (Bleeksma and Van Doorn, 2003; Nowak *et al.*, 1990). Adding citric

acid improves flower longevity by decreasing pH of solution and controlling microbial function in vase solution of rose cut flowers (Nowak *et al.*, 1990).

It is reported that aluminum sulfate extended vase life and improved water relation and postharvest quality of cut rose flowers by antimicrobial effect (Edrisi, 2003; Ichimura and Ueyama, 1998). But aluminum sulfate was ineffective in a rise in stem resistance to water flow or solution uptake (Knee, 2000). Also, aluminum sulfate with sugar had lowest weight loss and highest enhancing flower diameter of cut 'super star' rose flowers, however other antimicrobial compounds such as CoSO_4 or 8-HQC extended flower longevity more than aluminum sulfate (Tiwari and Singh, 2002). But in many researches application of silver thiosulphate (STS) is preferred to other chemical compounds. A pulse treatment of STS extended vase life of cut 'Diana' roses and 'First Red' rose flowers (Chamani *et al.*, 2005; Liao *et al.*, 2000). STS extends vase life, improves post harvest quality and reduces bacterial count in the basal parts of gladiolus and rose stems (Al-Humaid, 2004). On the other hand, cut rose flowers are often harvested in commercial maturity or bud stage and so flowers need large amount of soluble carbohydrates for opening. Treatment with sugars, such as sucrose and glucose in combination with some germicides was shown to extend the vase life of many cut flowers and can affect ethylene production and regulation of sugars accumulation in floral organs (Ichimura *et al.*, 2006; Liao *et al.*, 2000). Treatment with sucrose promoted unfolding of petals, suppressed the decrease in fresh weight of cut flowers and inhibition the occurrence of petals (Ichimura *et al.*, 1999; Ichimura *et al.*, 2003).

The objective of this study was to determine different effects of citric acid, aluminium sulphate, silver thiosulphate and sucrose on vase life and post harvest quality of three new cultivars of rose, 'Bouing', 'Creamly' and 'Sena'.

MATERIALS AND METHODS

Plant materials

This study was carried out in Institute of Scientific-Applied higher education of Jihad-Agriculture, Besat Educational Center, Fars, Iran. Three *Rosa hybrida* L. cultivars ('Bouing', 'Creamly' and 'Sena'), were harvested at commercial maturity stage. Stems of transported cut flowers to laboratory were trimmed to 50 cm.

Chemical treatments

Cut flowers were placed in vases with preservative solutions for 24 h at a room with $24\pm 2^\circ\text{C}$ temperature, $65\% \pm 5$ relative humidity and illumination 700 Lux for 10 h day^{-1} . Preservative solutions included: distilled water (control), 10 g L^{-1} sucrose (S), 10 g L^{-1} sucrose + 100 mg L^{-1} citric acid (S + CA), 10 g L^{-1} sucrose + 100 mg L^{-1} aluminum sulphate (S + $\text{Al}_2(\text{SO}_4)_3$), 10 g L^{-1} sucrose + 0.5 mM silver thiosulphate for 2 h (S + STS). For fifth treatment, first cut flowers were treated with STS for 2 h followed by sucrose for 24 h and transferred to distilled water. A factorial experiment with a completely randomized design carried out for 3 cultivars with 5 chemical treatments and 3 replicates. Each replicate included 4 cut flowers.

Flower longevity

Vase life was recorded by the number of days between the time of harvest and end of longevity that occurs in ways such

as bending the floral axis just below the flower head (bent-neck), flower closure, wilting or abscission, changing color of petals prior to wilting or abscission.

Fresh weight

Relative fresh weight of cut flowers was calculated using the formula:

RFW (%) = $(W_t/W_{t=1}) \times 100$; where W_t = weight of cut flowers (g) at t = days 1, 4, 7, 10, etc. and $W_{t=1}$ = weight of the same cut flower (g) on day 1.

Water uptake

Vase water uptake was determined using the formula:

Water uptake ($\text{ml day}^{-1} \text{ g}^{-1}$ fresh weight) = $(S_{t-1}-S_t)/W_t$

Where, S_t = solution weight (g) at t = days 1, 4, 7, etc. S_{t-1} = solution weight (g) on the preceding day, and W_t = fresh weight of the cut flower (g) on t days.

Flower head diameter

The maximum head diameter of the flowers was measured at post harvest days (1, 4, 7, etc) using a micrometer.

RESULTS

Flower longevity

There was significant differences between cultivars vase life ($P < 0.05$). Flower vase life of 'Creamly' was more than 'Sena' and 'Bouing' (Table 1). The longest vase life in 'Sena' observed when it was treated with STS + sucrose and in two other cultivars when they were treated with CA + sucrose (Table 1). Some solution had harmful effect on flowers. Flower vase life of 'Bouing' became short when it was treated with $\text{Al}_2(\text{SO}_4)_3$ + sucrose and treatment with STS + sucrose caused petal burning in 'Creamly'.

Fresh weight

Relative fresh weight changes had significant differences among three cultivars ($P < 0.05$). In 'Bouing' and 'Creamly', maximum fresh weight was related to STS + sucrose till 10th day but after that it replaced with CA + sucrose. In 'Sena', maximum flower fresh weight was related to STS+sucrose in all days (Figure 1).

Table 1. Vase life days of three cultivars of Rosa hybrid flowers as influenced by treatments

Cultivar	Vase life (day)				
	Chemical treatments				
	Control	S	S+CA	S+ $\text{Al}_2(\text{SO}_4)_3$	S+STS
Bouing	10.90 ± 0.21g	10.77 ± 0.43g	13.27 ± 0.39f	9.83 ± 0.44g	12.60 ± 0.31f
Sena	15.91 ± 0.52e	17.80 ± 0.46cd	19.17 ± 0.44ab	19.36 ± 0.70ab	20.36 ± 0.57a
Creamly	16.59 ± 0.48de	18.87 ± 0.45bc	20.38 ± 0.47a	19.25 ± 0.26ab	19.75 ± 0.45ab

Data (means±SE, n = 3) within table followed by different letters are significantly different at $P < 0.05$.

distilled water (control), sucrose (S), sucrose + Citric acid (S + CA), sucrose + Aluminum sulphate (S + $\text{Al}_2(\text{SO}_4)_3$), sucrose + Silver thiosulphate (S + STS)

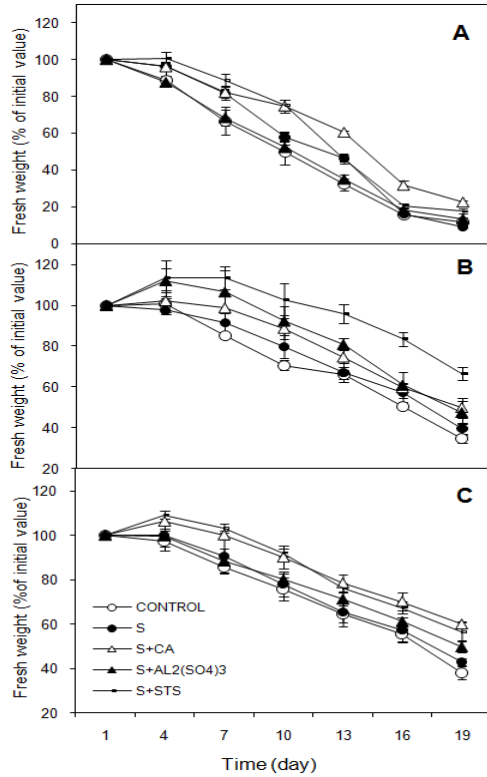


Figure 1. Changes in fresh weight of three cut rose flowers, Bouing (A), Sena (B) and Creamly (C), treated by distilled water (control), sucrose (S), sucrose + Citric acid (S + CA), sucrose + Aluminum sulphate (S + $Al_2(SO_4)_3$), sucrose + Silver thiosulphate (S + STS). Values are the means of 3 replications, \pm S.E

Water uptake

Water uptake changes had significant differences among three cultivars ($P < 0.05$). In all cultivars water uptake of control and then sucrose were less than all the other treatments, but $Al_2(SO_4)_3$ + sucrose caused less water uptake even than control in ‘Bouing’. Maximum water uptake in all treatments related to STS + sucrose and after that CA + sucrose in cultivars ‘Bouing’ and ‘Creamly’ and $Al_2(SO_4)_3$ + sucrose in ‘Sena’ (Figure 2).

Flower diameter

Significant differences were obtained for flower diameter ($P < 0.05$). In general, ‘Bouing’ had shortest flower diameter than ‘Sena’ and ‘Creamly’. Maximum flower diameter in ‘Bouing’ (6.95 cm) and ‘Creamly’ (9.83 cm) was observed when they treated with CA + sucrose. In ‘Sena’ Maximum flower diameter (9.88 cm) was obtained by treating with STS + sucrose. Also in ‘Bouing’, control flowers had larger diameter than $Al_2(SO_4)_3$ + sucrose (Figure 3).

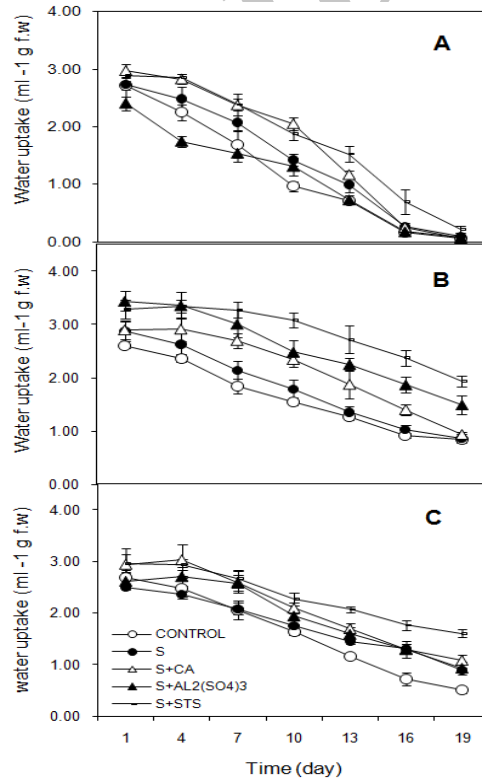


Figure 2. Changes in vase water uptake of three cut rose flowers, Bouing (A), Sena (B) and Creamly (C), treated by distilled water (control), sucrose (S), sucrose + Citric acid (S + CA), sucrose + Aluminum sulphate (S + $Al_2(SO_4)_3$), sucrose + Silver thiosulphate (S + STS). Values are the means of 3 replications, \pm S.E

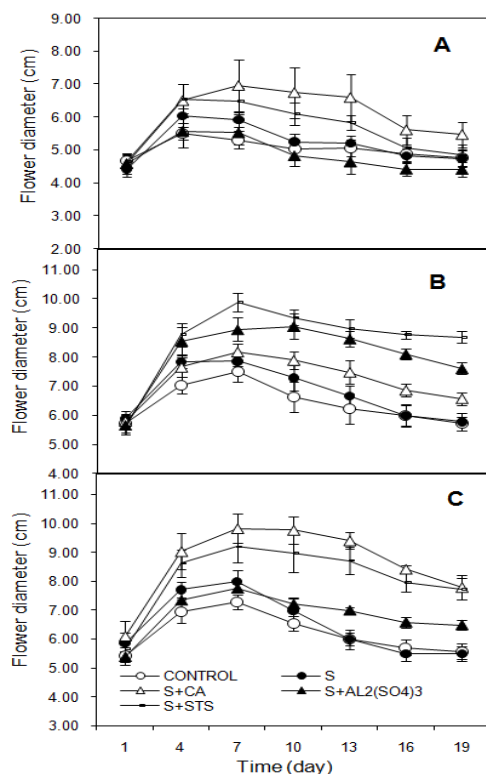


Figure 3. Changes in flower diameter of three cut rose flowers, Bouing (A), Sena (B) and Creamly (C), treated by distilled water (control), sucrose (S), sucrose + Citric acid (S + CA), sucrose + Aluminum sulphate (S + $Al_2(SO_4)_3$), sucrose + Silver thiosulphate (S + STS). Values are the means of 3 replications, \pm S.E

DISCUSSION

In this study, flower vase life was ended by wilting of petals and in none of cultivars abscission was observed. 'Bouing' showed bent neck in all treatments, but it was not seen in two other cultivars except control and a little in sucrose treatment. Results of this study showed that adding sucrose to distilled water significantly increased flower longevity of 'Sena' and 'Creamly' (Table 1). Many researchers have shown that

shortage of soluble carbohydrates in petals is one of the most important causes for shortening cut flowers vase life and applying sucrose in vase solutions increases flower longevity (Ichimura *et al.*, 1999; Ichimura *et al.*, 2006; Ichimura *et al.*, 2003; Liao *et al.*, 2000). As results showed, Sucrose supplementation delayed the onset of visual senescence symptoms at least in some cultivars. It is reported that treating with sugars can increase carbohydrates supplement in floral tissue for metabolism and nutrition. In this way, soluble carbohydrates are consumed in respiration, wall synthesis and as osmolyte. As sugars sources are consumed gradually in rose cut flowers, vase life will be short (Ichimura *et al.*, 1999; Ichimura *et al.*, 2006; O'Donoghue *et al.*, 2002). Delaying protein degradation, regulating water rate due to controlling respiration, higher water uptake, inhibition ethylene producing and decreasing ethylene sensitivity of cut flowers are the other advantages of sugars (Bleeksma and Van Doorn, 2003; Chanasut *et al.*, 2003; Ichimura *et al.*, 1999; Ichimura *et al.*, 2006). However, in this study other investigated factors had no more changes when just sucrose added to distilled water. In 'Bouing', it had no effect even on vase life. These results may suggest that 1% sucrose in the vase solution was insufficient to induce measurable responses in some cut rose flowers.

Higher concentrations of sucrose will be investigated for 'Bouing'. Aluminum sulphate, silver thiosulphate and citric acid are among the most common bactericides. Silver thiosulphate competes with ethylene for the same site of action and therefore reduces the negative effect of ethylene (Figuroa *et al.*, 2005). In this study, all measured factors had significant improvement by adding chemical compounds to sucrose treatment. But

effects of chemical compounds were varied between three cultivars. In 'Sena', flowers treated by STS had higher water uptake, fresh weight, flower diameter and longevity. Also applying STS as an antimicrobial and anti-ethylene compound in preservative solutions seems more useful than two other chemical compounds. It corresponds with results of many previous researches (Chanasut *et al.*, 2003; Chamani *et al.*, 2005; Liao *et al.*, Nowak *et al.*, 1990; Serek *et al.*, 2006). In 'Creamly', STS decreased visual flower quality due to burning of petals and leaves, however it increased fresh weight and flower diameter. So for this cultivar, it is better to use STS in lower concentrations or in shorter times. Citric acid had best effects on all investigated factors on 'Creamly' and 'Bouing'. However in most of the time, it had no significant difference with STS treatment. Most effectiveness of citric acid is due to decreasing pH of solution that prevents bacterial and fungal growth. Also, it improves water uptake of stem (Nowak *et al.*, 1990). The best effect of aluminum sulphate was observed in 'Sena'. But not only it had less effect than citric acid in cultivar 'Creamly', but even decreased vase life than control in 'Bouing'. The most likely, this concentration of aluminum sulphate had toxic effect on this cultivar, however in other researches on cut roses, it was observed that aluminum sulphate in higher concentrations had no toxic effect and even had low antimicrobial effects (Ichimura *et al.*, 2006; Knee, 2000). Extending vase life

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in two other cultivars after treating with aluminum sulphate maybe attribute to its antimicrobial action and inhibition of vascular blockage (Edrisi, 2003; Ichimura and Ueyama, 1998).

Genetic variations between rose cultivars cause in different responses to chemical compounds (Ichimura *et al.* 2002). These results suggest that 'Bouing' is more sensitive to aluminum sulphate compared with 'Sena' and 'Creamly'. On the other hand, in this study citric acid + sucrose had positive effect on all tested cultivars and no visible symptom of chemical injury was observed by treating with this treatment.

CONCLUSION

In conclusion, although it is reported that chemical compounds can extend rose cut flowers longevity and improve post harvest flowers quality, but their effects varies depending on the cultivar. In this study STS + sucrose was the best treatment for cultivar 'Sena' and citric acid + sucrose was the best and safest treatment for 'Bouing' and 'Creamly'.

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