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Response of various cut lisianthus cultivars to silver thiosulfate treatment

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Abstract

The effects of postharvest silver thiosulfate (STS) treatments on physicochemical characteristics of four cut lisianthus (*Eustoma grandiflorum*) cultivars (Purple, White, Purple-Rim and Pink-Rim) were investigated. Cut lisianthus flowers were pulse-treated with silver thiosulfate at 0, 0.5, 1 and 2 mM for 24 h at 22±2°C. Experiment was conducted in completely randomized designs with factorial arrangement and seven replications. The results of experiment revealed that STS at all concentrations applied significantly ($P > 0.05$) extended vase life of all cut lisianthus flowers compared to control. No significant differences were found between STS concentrations in Purple, White and Pink-Rim cultivars. However, in 'Purple-Rim', STS at 1 and 2 mM significantly increased vase life of flowers compared to 0.5 mM STS. There were significant differences between cultivars in response to STS concentrations, too. STS-treated flowers at all concentrations maintained a higher relative fresh weight (RFW) in all cultivars. Solution uptake of STS-treated flowers was higher than in control during whole experiment.

Key words: Cultivars, postharvest, relative fresh weight (RFW), silver thiosulfate (STS), solution uptake.

Introduction

Eustoma grandiflorum is native to the United States [8]. It has fairly large flower and it is very popular in Iran because of its various colours. Recently it's reported that ethylene is involved in flower senescence of *Eustoma grandiflorum* [4]. The vase life of ethylene sensitive flowers can be considerably increased by silver thiosulfate (STS) treatment. STS is known to suppress autocatalytic ethylene production by inhibition of ethylene action [4, 11]. Liao *et al*. [6] reported that application of STS at 0.2 mM significantly increased the vase life of *Rosa hybrida* cv. Diana. Ichimura *et al*.[5] suggested that pulse treatment of sweet pea flowers with 0.2 mM STS, significantly increased the flower vase life. Treatment of *Rosa hybrida* cv. Evel tower with STS at different pulsing time revealed that STS at 4 mM for 60 min increased its vase life by 54.16% in comparison with control [3]. Treatment of cut rose flowers by STS at 1 mM for 2 h revealed that STS significantly increased the vase life of cut *Rosa hybrida* 'Victory Parade' flowers [10]. Vase life of cut rose 'Red Sandara' maintained in distilled water or pulsed with 1 mM $AgNO_3$ or 1 mM STS for 3 hours without recutting was 8.3, 10.8 and 11.1 days, respectively [12]. Chamani *et al*.[2] reported that 0.25 to 4 mM STS significantly increased vase life of cut 'First Red' rose flowers [2].

The present experiments were conducted to determine the effect of STS treatments on the longevity of various lisianthus cultivars, as well as physico-chemical changes during postharvest life in the lisianthus petals.

Material and Methods

***Plant material*:** Cut flowers of lisianthus cultivars (Purple, White, Purple-Rim and Pink-Rim) at the commercial stage were obtained from a commercial greenhouse (Pakdasht, Tehran) and transported to the postharvest laboratory of Mohaghegh Ardabili University, Ardabil.

***STS treatment*:** Flowers were pulsed with 0.5, 1 and 2 mM silver thiosulfate (STS) for 24 h at 22°C. For preparation of STS, 1.36 g $AgNO_3$ was dissolved in 100 ml of deionized water and 7.94 g sodium thiosulphate penthahydrate ($Na_2S_2O_3 \cdot 5H_2O$) was dissolved in 100 ml of deionized water. The two solutions were then combined by slowly pouring $AgNO_3$ solution into the vigorously stirred $Na_2S_2O_3$ solution to obtain 200 ml of 4 mM STS. This stock solution was diluted with water to obtain the working concentrations (0.5, 1 and 2 mM). Experiment was conducted in completely randomized design with factorial arrangement and seven replications. Postharvest experiments were carried out under vase life evaluation room conditions of 22±2°C, 60-70% relative humidity (RH) and 12 h photoperiod with cool white fluorescent lamps. The harvested flowers were put into vases containing distilled water and 10 mg l^{-1} chlorine.

***Postharvest assessments*:** Longevity was recorded as days of vase life from the time flowers were placed into vases. The vase life of the inflorescence was considered terminated when 50% of the open flowers had wilted [1]. Relative fresh mass for stems was calculated using the formula: %fresh mass = $(W_t/W_{t=0}) \times 100$; where W_t = weight of stems (g) at Day 0, 2, 4, 6, etc. and $W_{t=0}$ = weight of the same stem (g) at day 0. Vase solution usage was determined using the formula: Solution uptake (ml $day^{-1}g^{-1}$, fresh weight) = $(S_{t-1}-S_t)/W_{t=0}$; where, S_t = solution weight (g) at t = Day 1, 2, 3, etc. S_{t-1} = solution weight (g) on the previous day and $W_{t=0}$ = fresh weight of the stem (g) at Day 0.

***Statistical analyses*:** Data were analyzed with SAS Release 9.1 for Windows. Duncan's Multiple Range Test (DMRT; $P = 0.05$) was used for comparison of treatment means. Least significant difference (LSD; $P = 0.05$) values were also calculated.

Results

The results of experiment revealed that STS at all concentrations applied significantly ($P > 0.05$) extended vase life of all cut lisianthus cultivars (Purple, White, Purple-Rim and Pink-Rim) compared to control (Table 1). No significant differences were found between STS concentrations in Purple, White and Pink-Rim cultivars. However, in 'Purple-Rim', STS at 1 and 2 mM significantly increased vase life of flowers compared to 0.5 mM (Table 1). There were significant differences between cultivars in response to STS concentrations, too (data not shown).

In 'Purple', until Day 9, no significant differences were found between STS-treated flowers and control. However, STS-treated flowers at all concentrations, after 9 days maintained a higher relative fresh weight, with significant differences at 11, 13 and 15 d after treatment compared to control. However, at Day 11, there were significant differences between 2 mM STS-treated flowers and control (Fig. 1,C1). Vase solution usage tended to be higher in STS-treated flowers. However, significant differences were found between 2 mM STS-treated flowers and control during its vase life (except Day 5), but no significant differences were found between 0.5 and 1 mM STS-treated flowers (except at Day 13, for 1 mM STS-treated flowers) and control, at the moment those values were higher than control (Fig. 2, C1).

In White cultivar, STS at all concentrations significantly increased the relative fresh weight at Days 3, 5, 7 and 9 compared to control, but at Days 11, 13 and 15, STS at 0.5 and 1 mM concentrations (except at Day 11 for 1 mM STS-treated flowers) couldn't significantly affect it. Significantly highest relative fresh weight was specifically associated with plants treated with 2 mM STS during whole vase life (Fig. 1, C2). STS-treated flowers had high solution uptake during experiment, but it was significant only at Day 13 for 2 mM STS-treated flowers compared to control (Fig. 2, C2).

In 'Purple-Rim', flowers treated with STS at all concentrations maintained a higher relative fresh weight during experiment and its significant effects started at Day 3 and were extended by Day 9. However, it could not significantly affect the relative fresh weight after 9 days, but those values were higher than control until end of experiment (Fig. 1, C3). Solution uptake of STS-treated flowers was higher than in control during the whole experiment, but STS at 1 mM at Days 7, 11 and 13 significantly increased the solution uptake compared to control (Fig. 2, C3).

In Pink-Rim cultivar, relative fresh weight tended to be higher in STS-treated flowers during the experiment. STS at 0.5 mM had highest and significant effects on maintaining relative fresh weight of flowers compared to other treatments. No significant differences were found between STS concentrations. STS at 2 mM at Days 9 and 11 and at 1 mM at Day 9 significantly affected the relative fresh weight of flowers compared to control (Fig. 1, C4). Solution uptake of STS-treated flowers in 'Pink-Rim' was higher than in control during the whole experiment, but difference was not significant (Fig. 2, C4).

Table 1. Effects of different STS concentrations on vase life of cut Purple (C1), White (C2), Purple-Rim (C3) and Pink-Rim (C4) lisianthus cultivars.

	Concentration of STS (mM)				
Cultivar	0	0.5	1	2	LSD
Purple	13.71 b	17.43 a	16.71 a	15.71 a	1.79
White	14.43 b	17.57 a	18.43 a	17.71 a	2.61
Purple-Rim	13.28 c	15.57 b	17.43 a	17.14 ab	1.68
Pink-Rim	15.85 b	19.43 a	19.28 a	18.28 a	1.95

Values represent means of four cultivars in response to STS concentrations and those in each row with the same letters are not significantly different ($P<0.05$) by Least Significant Difference.

Discussion

Our results support the suggestions of some previous researches that the postharvest life of cut lisianthus is greatly improved by providing STS in the vase solution [4, 11]. Ichmura *et al*. [4] reported that lisianthus flowers produce ethylene and are sensitive to ethylene, too. Effect of STS, an ethylene action inhibitor, in extending vase life of cut lisianthus may be attributed to inhibition of the autocatalytic production of ethylene in the petals [4]. It is reported that in anthurium, decline in water uptake is related to reduced vase life [9]. The results of this study showed that at all cultivars on which STS increased solution uptake, it increased vase life, too. Ichimura *et al.* [4] reported that treatment of cut lisianthus (Asuka-no nami cultivar) flower by STS for 24 h significantly extended vase life and most effective concentration was 0.1 mM. A 24-h treatment with 0.1 mM STS retarded the decrease in fresh weight [4]. Newman *et al*. [7] reported that the STS complex remained available in the inflorescence and capable of binding to receptors formed as the buds opened into flowers. In this capacity, STS treatment has greater efficacy on different cultivars of lisianthus. This may be attributable to a residual 'pool' of STS in treated flowers that yields silver ions to block newly forming ethylene binding sites, followed by maintaining relative fresh weight and increasing solution uptake.

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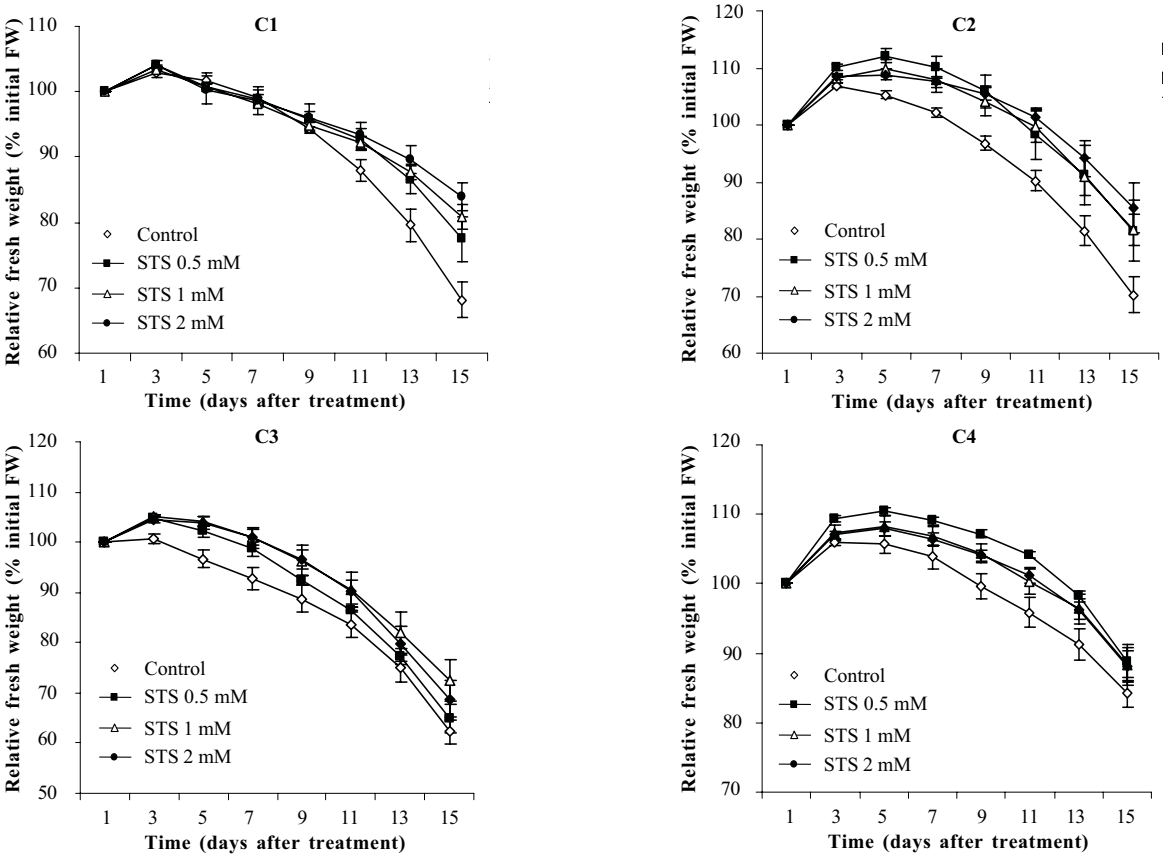

Figure 1. Effects of different STS concentrations on fresh weight of cut Purple (C1), White (C2), Purple-Rim (C3) and Pink-Rim (C4) lisianthus cultivars.

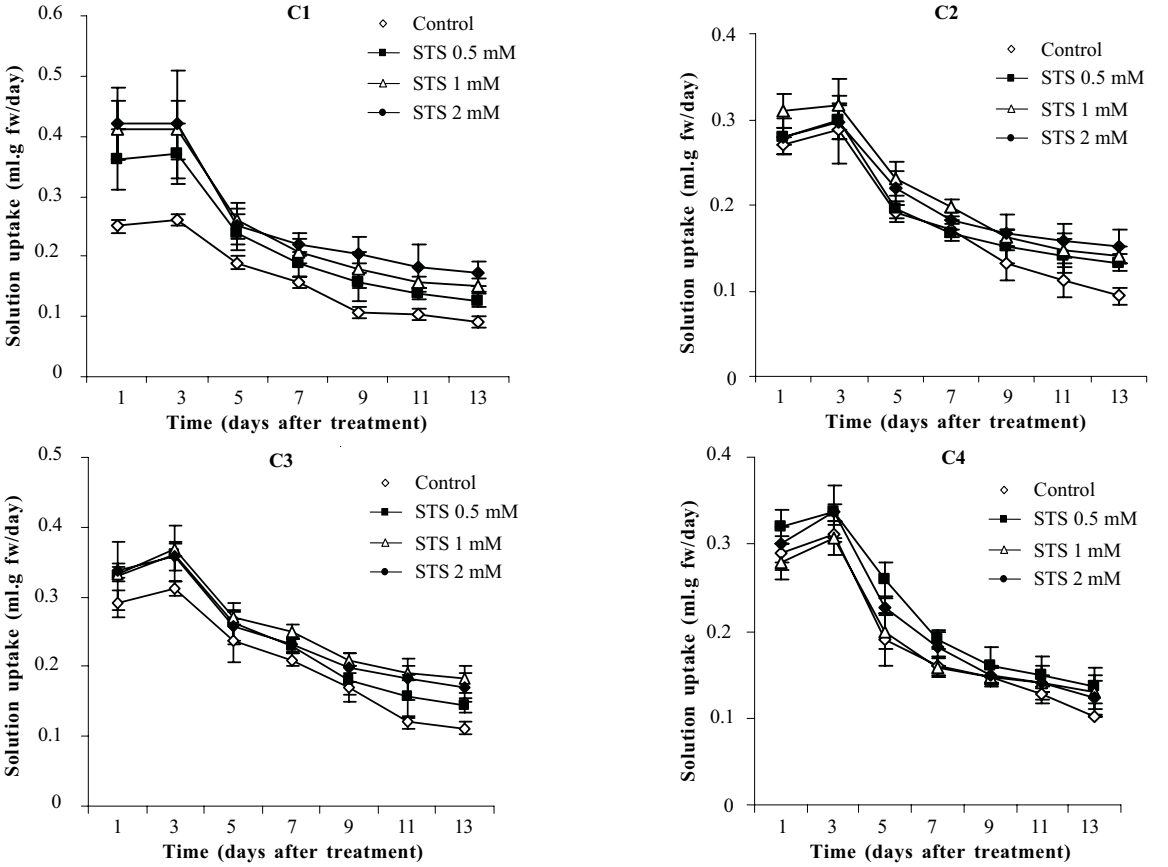

Figure 2. Effects of different STS concentrations on solution uptake of cut Purple (C1), White (C2), Purple-Rim (C3) and Pink-Rim (C4) lisianthus cultivars.