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Effect of Silver Thiosulfate and Preservative Solutions on the Vase Life of Miniature Carnations[1]

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Abstract. **Short-term or over-night pretreatment with solutions of a silver thiosulfate complex extended the vase life of fresh or stored miniature carnations (*Dianthus caryophyllus* L.) as much as the continuous use of commercial vase preservatives. Combining the 2 treatments further extended the vase life to 4 times that of control flowers. The time to wilting of the first flower was closely correlated with the mean vase life of all the flowers in a spray.**

"Sleepiness" caused by ethylene gas is the most frequent cause of losses during the commercial handling of carnations, and as the normal symptom of senescence, terminates the vase life of the flowers in the home. The silver thiosulfate complex (STS) has been successfully used as a pretreatment to delay ethylene-induced senescence of standard 'Sim' carnations (1, 3); the benefits of such a pretreatment are additive to those obtained using commercially available floral preservatives for standard carnations (2).

Miniature spray-type carnations are now being produced in increasing quantities–U.S. production was valued at $7 million in 1978. These cultivars are harvested with only some of the blooms on each spray open. Ethylene-induced "sleepiness" terminates the vase life of these open flowers and can shorten the life of the flowers that open postharvest. In this paper we examine the response of miniature carnations to STS pretreatment and to commercial vase preservatives.

Miniature carnation flowers were obtained from commercial greenhouses in the Watsonville/Salinas area, transported to Davis and held dry at 2°C until required. STS solutions were prepared by pouring 8 mM $AgNO_3$ into an equal volume of 32 mM $Na_2S_2O_3$ with rapid stirring. "Everbloom" and "Viva la Fleur," prepared according to the manufacturers instructions, were used as control preservatives.

Flowers were pretreated with STS by dipping the ends of the stems into the solution at 25°C, usually for 20 min. After treatment the flowers were removed from the solution and the stem ends were rinsed before being placed in storage or in vase solutions for evaluation of vase life. The relationship between STS uptake and flower vase life was determined by allowing flowers to stand in the solution for different lengths of time, and measuring the amount of solution taken up, before evaluating the vase life.

The flowers were held in 0.5 liter of vase solution at 25°C under continuous Cool White fluorescent light (1 klx) until termination of vase life by wilting or necrosis of the flowers. Vase life was evaluated either as the days to wilting of the first flower on each spray, or as the mean longevity of all flowers that opened on each spray. Experiments used at least 2 replicates of one bunch of flowers (7-9 sprays) per treatment.

In pretreating standard carnations with STS, the flowers are either pulsed with 4 mM STS at 25°C for 10 min, or held overnight at 2° in a solution containing 1 mM STS. Both of these treatments extended the mean vase life of a range of miniature carnation cultivars by 30-50% (Table 1). The overnight treatment was significantly better than the short pulse for flowers of the 'Barbi' and 'Sweetheart' cultivars.

The relationship found for the different treatments in this experiment between mean vase life of the first flower and mean vase life of all the flowers in the spray (Fig. 1) showed the 2 functions to be highly correlated ($r^2 = 0.95$). This indicates that the days to the first wilted flower in a spray (end of commercial acceptability) can be assumed to indicate the mean vase life of all the flowers on the spray (acceptability to the consumer). In subsequent experiments we therefore used days to the first wilted flower as measure of vase life. Miniature carnations took up about 0.8 ml of 4 mM STS/spray-hr over the first hour under our experimental conditions. Uptake of 0.5 μmoles of Ag^+ per spray doubled the vase life of 'Barbi' (Fig. 2). Uptake of more than 5 μmoles per spray damaged the leaves and calyces of the flowers. These quantities are close to those recommended for standard 'Sim' carnations (1), and show the wide range of Ag^+ that can safely be used for this pretreatment. In subsequent experiments we used a 20 min pretreatment with 4

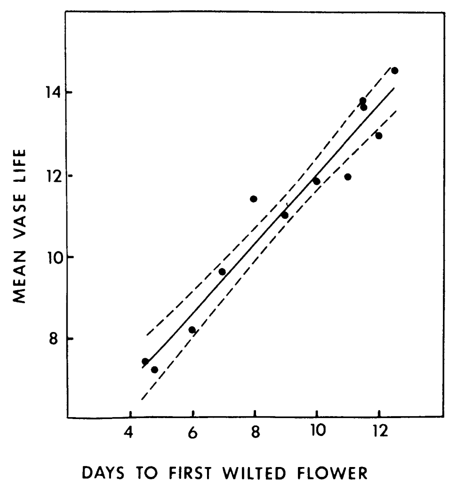

Fig. 1. Relationship between vase life parameters for miniature carnations. Days to the first wilted floret and mean vase life of the flowers in each spray were determined for a number of different treatments. The dotted lines show the 95% confidence limits.

Table. 1. Effect of "pulse" and "overnight" treatments with STS on the vase life of miniature carnation cultivars. Carnations were pretreated in different ways prior to evaluation of their vase life in DI water.

	Mean life of flowers in spray (days)^z			
Treatment	Elegance	Barbi	Sweetheart	Orchid Royalette
Control	8.2a^y	7.2a	9.6a	7.6a
4 mM STS, 10 min 25°C	11.4b	11.0b	11.8b	13.6b
1 mM STS, 20 hr 2°C	11.9c	12.9c	13.7c	14.5b

^{z}About 60 flowers per spray.
^{y}Mean separation in columns by Duncan's multiple range test, 5% level.

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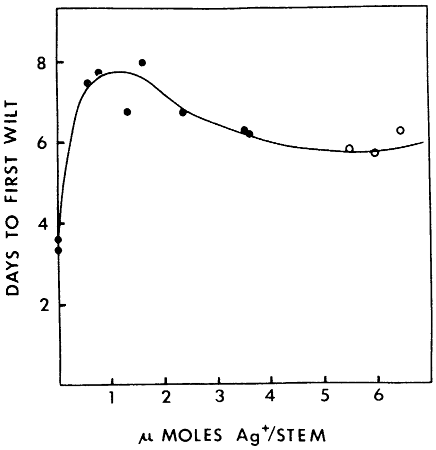

Fig. 2. Effect of silver content on vase life of miniature carnations (days to first wilted floret). Silver content was calculated from the volume of 4 mM STS taken up by each stem.

mM STS (providing about 1-1.5 μmoles Ag^+ per spray).

The active ingredients of most commercial vase preservatives are 8-hydroxyquinoline (about 200 μg/ml) and sucrose (1.5-2%). These materials can improve the vase life of untreated miniature carnations (Table 2). As with standard carnations (2), while STS pretreatment can substitute for a vase preservative its benefits are additive to those obtained from the preservative alone. Thus, when flowers pretreated with STS were evaluated in preservative solutions there was further substantial improvement in their vase life.

The vase life of miniature carnations ('Barbi') after storage for a simulated shipping period of 5 days at 2°C was also improved by STS treatment, either before or after the storage period (Table 3). Significant further improvement in vase life was again obtained by including floral preservatives in the vase water. The time to wilting of the first flower in sprays treated this way was as much as 4 times that of control flowers.

Table 2. Effect of STS pretreatment and of commercial flower preservatives on the vase life of cut 'Barbi' carnations. Carnations were pretreated with 4 mM STS for 20 min or deionized (DI) water, then placed in different solutions for evaluation of their vase life.

Vase solution	Mean days to first wilted bloom on each spray — Pretreatment DI	STS
DI	3.5a[z]	7.5b
Everbloom	6.7b	12.2c
Viva la Fleur	4.3ab	10.5c

[z]Mean separation by Duncan's multiple range test, 5% level.

Table 3. Effect of STS on the vase life of stored miniature 'Barbi' carnations. Carnations were treated for 20 min with 4 mM STS either before or after storage, then held in different solutions for evaluation of vase life.

Pretreatment	Treatment after 5 days	Vase life (days to first wilted floret)
None	DI	2.9a[z]
STS	DI	7.0b
STS	Everbloom	11.9c
STS	Viva la Fleur	10.1c
None	STS DI	8.0bc

[z]Mean separation by Duncan's multiple range test, 5% level.

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Effects of Leaf Position and Storage Conditions on Pressure Bomb Measurement of Leaf Water Potential in Chrysanthemums[1]

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Abstract. **There were generally no decreases in water potential when leaves of chrysanthemum (*Chrysanthemum morifolium* Ramat.) were stored in plastic bags for 1-5 hours, individually or together, provided a moist towel was included. Decreases in water potential occurred after 1 and 3 hours in leaves stored individually or together without a moist towel. Maximum stress was observed in the third negative at 0600 hours with values increasing to a maximum of −8.1 bars at 1400 hours.**

Physiological reactions to water stress, such as photosynthesis reduction or stem elongation, usually occur before visible, morphological changes become apparent (2, 3). Stomatal aperture is reduced, with a decline in transpiration and photosynthetic rates, when a plant is subjected to reduced water availability (2). Reestablishment of growth after a period of stress depends on recovery of leaf water potential after watering (6).

Chrysanthemums grown under high light intensities and fertilization require relatively large amounts of water and wilt rapidly when water is withheld. The exact timing of watering is difficult to determine and is usually based on visual observations. Watering schedules ideally should be determined by measuring stress levels within plants using physiological indicators, such as leaf water potential, osmotic potential, or stomatal aperture. Halevy (2) reported stomatal aperture to be a reliable and convenient guide for irrigation of gladioli. The pressure bomb is a relatively simple and fast method for determining leaf water potential but improper handling of plant samples frequently leads to incorrect values resulting in widely variable readings (1, 8). Maturity of sampled leaves, time of day, transpiration rate, light intensity and handling conditions prior to taking water potential readings may affect water potential values obtained with the pressure bomb (1).

Rooted cuttings of 'Bright Golden Anne' chrysanthemums were planted 5 per 15 cm pot on June 11 in a mixture of 1 sand: 1 peat: 1 perlite (by volume) amended with 5.6 kg dolomite, 2.9 kg superphosphate and 1.8 kg Perk (a micronutrient blend manufactured by Estech General Chemical Corp., Chicago, Ill.) /m^3, respectively. Pots were watered and placed in a lightly shaded glass greenhouse with fan and pad cooling in Gainesville, Florida. Pinching occurred at time of planting and short day treatments (SD) were initiated 4 days later by covering the greenhouse bench with a black, light opaque woven cloth from 1700-0800 hr. A 5000 ppm foliar spray of butanedioic acid mono-(2,2-dimethylhydrazide) (daminozide) was applied when shoots were 4.5 cm in length.

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