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Effect of Silver Thiosulfate Pretreatment on Vase Life of Cut Carnation Flowers

after Truck Shipment [1]

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ABSTRACT

The effect of pulsing solutions on vase life on cut carnation flowers was studied. Carnation flowers were pulsed in well water, 10% sucrose, Chrysal solution, 34 mg/l $AgNO_3$ + 397 mg/l $Na_2S_2O_3.5H_2O$ + 10% sucrose, 68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_35H_2O$ + 10% sucrose and 136 mg/l $AgNO_3$ + 1588 mg/l $Na_2S_2O_35H_2O$ + 10% sucrose for 18 hours at Chiang Mai production site, then packed dry and shipped by non-refrigerated truck to Bangkok Carnation flowers pulsed in the solution containing 68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_35H_2O$ + 10% sucrose had the longest vase life of 4.03days while the control had vase life of 2.05 days. Inprovement of vase life of carnation flowers was obtained with 50 mg/l BA including in the pulsing solution and packed wet having their stem bases wrapped with cotton during transit.

INTRODUCTION

Early senescence of cut carnation flowers is primarily the result of ethylene produced by the flower or present as a pollutant in the atmosphere surrounding the flower (Nichols, 1968; Barden and Hanan, 1972). Delay of senescence in carnation flowers caused by ethylene can be achieved by dipping flower heads in a solution of silver nitrate. These results are explained by the observation that silver ions move very slowly in the stem of cut carnation flowers (Halevy and Kofranek, 1977). Veen and van de Guijin (1978) demonstrated that silver moved readily in the stems of carnation flowers if silver was present as the silver thiosulfate complex, $Ag(S_2O_3)_2^{3-}$ formed by combining solutions of $AgNO_3$ and $Na_2S_2O_3$.

A build up of bacterial growth in the vascular tissue during holding in water can also reduce water uptake causing short vase life of cut carnation flowers (Mayak *et al,* 1977). Additions of silver nitrate to the preservative solutions have resulted in greater vase life in many species including carnations (Mor *et al,* 1981; Paull and Goo 1982; Mor *et al,* 1984).

Carnation is an important cut flower which has been extended to hilltribe by Royal Project. Generally, qualities of carnation flowers from the Royal Project such as color, form and size of flowers are as good as those imported ones except stem length which is sometime shorter and not straight. However, florist retailers or wholesalers still prefer to buy imported carnation flowers even though the imported carnation flowers is more expensive than those flowers from Royal Project. It has been claimed that the vase life of carnation flowers from Royal Project is not as long as that of imported ones. This may be true because carnation flowers from the Royal Project are not well treated after cutting. There is no use of pulsing solutions, precooling

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and refrigerated trucks. Vase life of carnation flowers under these conditions especially high temperature will be more rapidly terminated. In contrast the imported carnation flowers are well treated with high postharvest technologies after cutting

In the present study it was our objective to develop pulse treatments of carnation by using the silver thiosulfate complex for pretreatment at the production site before shipment

MATERIALS AND METHODS.

Flowers of 'Red Sim' carnation *(Dianthus caryophyllus)* were harvested at commercial stage (80% blooming) from Inthanon Research Station at Chiang Mai. Vase life evaluation flowers were held at 30.7°C and 63.2% RH in tap water under the natural light from the sun during daytime. Wilting of flowers was used as a criterion for terminating vase life of the control and treated flowers. Two hundred ml of tap water were added to a bottle glass and three flowers were held in the bottle glass. Mean values were present as an average of 12 flowers.

Preparation of silver thiosulfate (STS) solution

Stock solutions of $AgNO_3$ and of $Na_2S_2O_3$ $5H_2O$ were stored in the dark. STS was prepared as needed onthe day of the experiment by combining calculations of STS solution and well water.

Time of immersion

Flower stems were immersed to a depth of 7 cm for 18 hours in pulsing solutions as indicated in tables. One cm of stem was recut before holding in bottle glasses containing tap water for vase life evaluation.

Packing and shipment

After stems were removed from water or pulsing solutions, each five flowers was bunched and either packed dry or wet (Fig 1). If they were packed wet, their stem bases were wrapped with moistened cotton containing well water or pulsing solutions as indicated in Table 2. Bunched flowers were placed into carton boxes and shipped to Bangkok within 12 hours by Royal Project non-refrigerated truck together with other horticultural commodities.

RESULTS

Vase life of carnation flowers pulsed in sucrose and Chrysal was not different from the control while those pulsed in STS plus sucrose had longer vase life, particularly the solution containing 68 mg/1 $AgNO_3$ + 794 mg/1 $Na_2S_2O_3$ $5H_2O$ gave the longest vase life of 4.0 days (Table 1) However, all pulsed carnation flowers did not look fresh upon arrival at Bangkok because they were packed dry and shipped by non-refrigerated truck. Therefore, the solution containing 68 mg/1 $AgNO_3$ + 794 mg/1 $Na_2S_2O_3 \cdot 5H_2O$ was used for further experiment and all carnation flowers were packed wet.

Carnation flowers pulsed in STS alone or together with BA and sucrose had different vase life. STS and BA alone was capable of increasing longer vase life of carnation flowers than sucrose alone. STS together with BA and sucrose caused vase life of carnation flowers longer than STS alone (Table 2). Carnation flowers packed wet either with water or pulsing solutions having their stem bases wrapped with cotton looked fresh upon arrival at Bangkok. However, packing wet with pulsing solutions had the tendency to make carnation flowers longer vase life (Table 2). General appearance of 'Red Sim' carnation flowers pulsed in the solution containing STS, BA and sucrose was found superior to the non-pulsed ones after holding in tap water for 5 days (Fig. 2). Vase life of 'White Sim' carnation flowers was also increased after pulsing in the solution containing STS, BA and sucrose (Fig. 3).

Table 1 Vase life of 'Red Sim' carnation flowers pulsed in different solutions for 18 hours and packed dry during shipment

Treatment	Vase life	
	days	%
well water (control)	2.05 ± 0.37	100.00
10% sucrose	2.52 ± 0.46	113.64
Chrysal	2.43 ± 0.46	109.91
STS (34 mg/1 $AgNO_3$ + 397 mg/1 $Na_2S_2O_3{\cdot}5H_2O$) + 10% sucrose	2.60 ± 0.49	118.18
STS (68 mg/1 $AgNO_3$ + 794 mg/1 $Na_2S_2O_35H_2O$) + 10% sucrose	4.03 ± 0.72	181.82
STS (136 mg/1 $AgNO_3$ + 1588 mg/1 $Na_2S_2O_35H_2O$) + 10% sucrose	3.12 ± 0.29	140.91

DISCUSSION

Vase life of carnation flowers was extended by overnight (18 hours) pretreatment with STS, sucrose and BA Optimum concentration of STS (68 mg/1 $AgNO_3$ + 794 mg/l $Na_2S_2O_3{\cdot}5H_2O$) was the same as that reported by Aldrufeu *et al,* (1981). Chrysal, a commercial preservative solution has been routinely added to the cotton wrapping the stem bases of carnation flowers for wet pack at the production sties before shipment. However, the results from our experiment showed that Chrysal was not so effective in prolonging vase life of carnation flowers. This may be due to the fact that Chrysal is not a pulsing solution but it is a holding solution. Therefore, it should not be used solution to moisten the cotton for wet pack of carnation flowers. Though vase life of carnation flowers pulsed in STS solution and packed dry was increased satisfactorily, carnations did not look fresh upon arrival at Bangkok. This may be due to the truck used for shipment of agricultural commodities from the Royal Project is not refrigerated and ambient temperature is high. Therefore, carnation flowers shipped under these conditions were readily transpired and wilted (Rij *et al,* 1979).

Effectiveness of STS was increased when it was used together with sucrose and BA. Sucrose is widely used in preservative solutions in which the stems of flowers are placed because it serves as food for cut flowers (Reid and Kofranek, 1980) and sucrose is probably the translocation sugar (Nichols, 1975). Additive effect of sucrose also indicates that cut flower is a metabolically active

Table 2 Vase life of 'Red Sim' carnation flowers pulsed in different solutions for 18 hours and packed wet with water and pulsing solutions having the stem bases wrapped with cotton.

Treatment	Vase Life	
	Days	%
Packing wet with water		
Well water (control)	2.70 ± 1.10	100.00
STS (68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 \cdot 5H_2O$	4.50 ± 0.47	170.37
50 ppm BA	4.00 ± 0.56	148.15
10% sucrose	3.67 ± 0.84	137.04
STS (68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 5H_2O$) + 50 ppm BA	3.38 ± 0.41	125.93
STS (68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 5H_2O$) + 10% sucrose	4.80 ± 0.35	177.78
50 ppm BA + 10% sucrose	5.25 ± 0.33	196.30
STS (68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 5H_2O$) + 50 ppm BA + 10% sucrose	5.10 ± 0.37	188.89
Packing wet with pulsing solution		
well water (control)	2.80 ± 0.31	100.00
STS (68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 \cdot 5H_2O$	4.29 ± 0.49	153.57
50 ppm BA	4.00 ± 0.50	142.86
10% sucrose	3.15 ± 0.72	110.71
STS (68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 5H_2O$) 50 ppm BA	4.57 ± 0.54	164.29
STS (68 mg/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 5H_2O$) + 10% sucrose	5.30 ± 0.45	196.43
STS (68 ml/l $AgNO_3$ + 794 mg/l $Na_2S_2O_3 \cdot 5H_2O$) + 50 ppm BA + 10% sucrose	6.22 ± 0.33	221.43

center and energy supply is required during maintaining the vase life (Nichols, 1973).

Ethylene is well known as a primary cause of early senescence of carnation flowers (Nichols, 1968; Barden and Hanan, 1972). The increase in effectiveness of STS by BA may be related to its inhibition of ethylene biosynthesis in carnation flowers (Mor *et al*, 1983; Cook *et al*, 1985). Though STS can inhibit both ethylene production (Veen and Kwakkenbos 1982/83) and ethylene action (Beyer, 1976, Halevy and Kofranek, 1977) and subsequently vase life of carnation flowers was increased, the role of STS as germicide in impregnated stems of pulsed carnation flowers cannot be ruled out since $AgNO_3$has been shown to reduce the number of bacteria in solutions (Bravdo *et al*, 1974). It was noted that stems of $AgNO_3$-treated carnation flowers rotted at the lesser rate than those of $AgNO_3$-nontreated ones during holding in tap water. This indicates that STS may prevent bacteria in tap water which can cause rot and/or block vascular tissue and subsequently increased the vase life of carnation flowers (Mayak *et al*, 1977).

Effect of wet pack used as pulsing solutions was better than using water alone. This indicates that uptake of solution by carnation flowers still proceed during shipment. Therefore, pulsed carnation flowers should be packed wet by adding the pulsing solution to moisten the cotton wrapping the stem bases in order to get maximum efficiency from pulsing.

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Figure 1 Bunching and wet packing of carnation flowers before being placed into carton boxes for shipment.

Figure 2 Non-pulsed (left) and pulsed (STS + BA + sucrose) (right) 'Red Sim' carnation flowers after holding in tap water for 5 days.

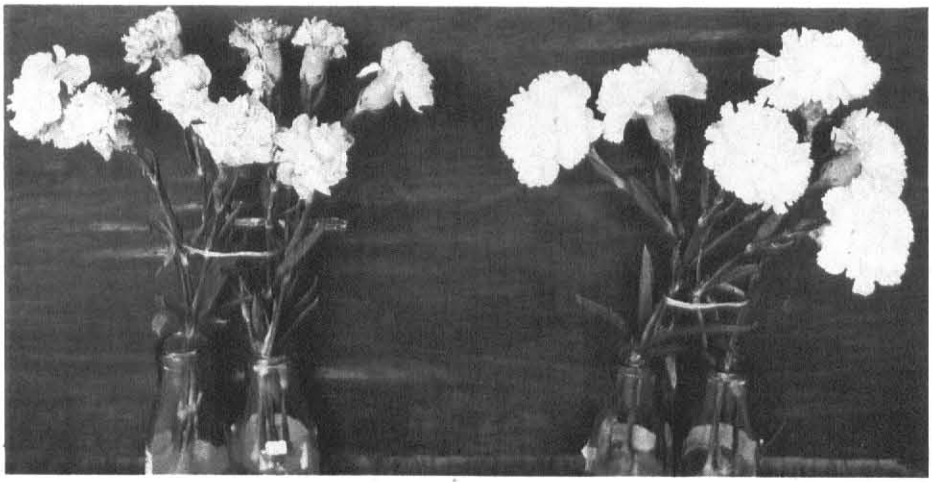

Figure 3 Non-pulsed (left) and pulsed (STS + BA + sucrose) (right) 'White Sim' carnation flowers after holding in tap water for 5 days.