Effects of Different Preservative Solutions on the Vase Life of Cut Tuberose Flowers at Usual Home Conditions

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Abstract

Tuberose is one of the tropical and subtropical bulbous cut flowers cultivated extensively in most floricultural regions of Iran. Due to its delicate fragrance, Iranians use it in all seasons for flower arrangements. Although tuberose has a high potential for a long vase life after harvesting, it declines rapidly at home. In order to overcome this problem an experiment was conducted in order to find a suitable preservative which provides the longest vase life for tuberose. The experiments were carried out by applying the carelessness of most consumers: not recutting stem ends nor changing the vase solutions. In the first experiment the preservative solutions were: sucrose (1, 2 and 3%), silver thiosulphate (0.4, 0.8 and 1.2 mM), silver nitrate (50, 100 and 150 mg l^{-1}), citric acid (150, 300 and 450 mg l^{-1}) and tap water as the control. In the first days of the experiment, silver thiosulphate caused severe burning of the florets; silver nitrate caused wilting of the florets and bent the end of the flower spikes; and sucrose didn't have any useful effect, it decreased the vase life. The longest vase life belonged to citric acid, followed by the control (tap water). The second experiment was conducted for determining the role of the water quality. In this part the treatments were: sterilized distilled water, citric acid made with sterilized distilled water (150, 300 and 450 mg l^{-1}) and tap water as the control. The longest and the shortest vase life belonged to sterilized distilled water and the control (tap water), respectively. The citric acid prepared with sterilized distilled water had a desirable effect on the vase life of cut tuberose flowers. This effect increased with the increment of the acid up to 450 mg l^{-1}.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.), a member of Agavaceae family, is a perennial bulbous plant (De Hertogh and Le Nard, 1993). It is one of the most important cut flowers in Iran (Anonymous, 2002). According to previous investigation (Alvarez et al., 1994; Gawade et al., 1994; Gowda, 1990; Khondakar and Mazumdar, 1985; Reddy et al., 1995a; Reddy et al., 1995b) several treatments have been used to increase the vase life of cut tuberose at laboratory conditions or during storage. Iranian consumers are a little relucant purchasing the cut flowers, due to their short vase life and high expense (unpublished data). Although tuberose has a high potential for a long vase life after harvesting, it declines rapidly at home. Consumers' carelessness, including neither recutting stem ends nor changing the vase solutions are the major factors in reducing the vase life of cut flowers (unpublished data). The present experiments were conducted to find a suitable preservative which provides the longest vase life for tuberose without recutting or changing the vase solution at home conditions.

MATERIALS AND METHODS

Tuberose 'Gol Dorosht', a local Mahallat cultivar, cut flowers were purchased from a producer in Ardakan city, 60 km north of Shiraz, Iran. Experiments were conducted in a room with standardised home conditions: maximum and minimum temperatures of 25±3ºC and 21±3ºC, 221 lux light and 48% relative humidity. Cut

flowers with 75±5 cm length were kept in distilled water until the time of use. Experiments were conducted in two separate sections:

Experiment 1

In this experiment, the following treatments were used: a) silver thiosulphate (STS) with concentrations of 0.4, 0.8 and 1.2 mM, b) citric acid with concentrations of 150, 300 and 450 mg l^{-1}, c) sucrose with concentrations of 1, 2 and 3%, d) silver nitrate ($AgNO_3$) with concentrations of 50, 100 and 150 mg l^{-1} and e) tap water as control. All solutions were prepared in tap water.

Experiment 2

Based on the results of the first experiment, the following treatments were used to evaluate the effect of water quality on tuberose vase life: a) tap water as control; b) sterilized distilled water and c) citric acid with concentrations of 150, 300 and 450 mg l^{-1} prepared in sterilized distilled water.

Vase Life Evaluations

Vases were sterilized using 5% Chlorox (containing 5.25% sodium hypochlorite) for 2 hr and then rinsed three times with distilled water. In the $AgNO_3$ treatments, vases were wrapped in aluminum foil, because of the light sensitivity of these compound solutions. Stem ends were placed in solutions for 20 min at 25ºC (Reid et al., 1980) and dark conditions (Nowak and Rudnicki, 1990) in STS treatments. Then these cut flowers were placed in tap water. In all the treatments, the stems were not recut and the vase solutions were not changed either. The number of semi-opened, opened and wilted florets were daily recorded until the end of the experiments. Vase life was recorded as the time in which a minimum of 4 florets were healthy and opened on each inflorescence.

The experiments were conducted as complete randomized design, 8 replicates in each treatment. Data were analyzed using MSTAT-C software and means were separated by Tukey's test at 1% level.

RESULTS

Experiment 1

Results are shown in Table 1.

1. $AgNO_3$. On the fourth day, along with the appearance of the first wilted floret, total stem wilting was also observed, leading to bending of the top of the flower spike. In $AgNO_3$ treatments, the longest vase life was 5 days.

2. STS. In this treatment, both semi-opened and opened florets showed wilting and petal tip-burn at the fourth day. These symptoms were observed earlier in the concentration of 1.2 mM. The vase life was 4-4.5 days in different concentrations of STS.

3. Sucrose. Concentrations of 2 and 3% significantly increased the number of wilted florets on the fourth and fifth day, compared to the control (data are not shown). In 1% sucrose vase life lasted 7 days and the other concentrations had 6 and 5 days vase life.

4. Citric Acid. On the initial days, the pH of the 150, 300 and 450 mg l^{-1} solutions was 5.26, 4.98 and 3.85, respectively. The mean vase life with this treatment was 7 days with the longest vase life (12 days) in 450 mg l^{-1}.

5. Control (Tap Water). The mean vase life of this treatment was 7 days.

Experiment 2

Sterilized distilled water significantly increased the vase life, compared to tap water (Table 2). The mean vase lives were 8, 8 and 9 days in 150, 300 and 450 mg l^{-1} citric acid treatments, respectively (Table 2). Flowers were healthier in the 450 mg l^{-1} solution of citric acid compared to the other concentrations and showed more opened florets until the end of the vase life (Table 3).

DISCUSSION

Ethylene directly can accelerate senescence and will result in flower drop (Kofranek, 1985; Nowak and Rudnicki, 1990). Anti-ethylene compounds, especially STS, can overcome the ethylene effects, and prolong the flower vase life (Kofranek, 1985; Nowak and Rudnicki, 1990). In this experiment, STS-treated flowers had a short vase life and also showed the symptoms of Ag^{+} toxicity. The same results have been reported for *Strelitzia reginae* (Finger et al., 1999) in which silver nitrate reduced the vase life, too. This is in accordance with Alvarez et al. (1994) results with cut tuberose flowers. According to these results, we conclude that tuberose is an ethylene non-sensitive cut flower and so it is non-climacteric. The same situation had been reported in *Strelitzia* (Finger et al., 1999), *Gladiolus* (Mor et al., 1981) and *Sandersonia* (Eason, and De Vre, 1995).

Carbohydrates are important resources of energy in plant tissues (Rajapakse et al., 1996). Previous investigations on tuberose cut flowers (Alvarez et al., 1994; Gawade et al., 1994; Gowda, 1990; Khondakar and Mazumdar; 1985, Reddy et al., 1995a; Reddy et al., 1995b) have shown the prolonged vase life using sucrose in vase solution. In the present study, sucrose was not suitable. It may be due to probable increase of microbial agents in vase solution in the presence of sucrose. Combining sucrose with a biocide, changing the vase solution or recutting the stem end may reverse this effect.

Citric acid, especially in higher concentrations, increased the turgidity and the number of opened florets compared to other treatments. This may be due to reducing the solution viscosity and the microorganism growth (Alvarez et al., 1994; Reddy et al., 1995b; van Doorn and Peirik, 1990) via lowering the pH of vase solution.

In the present study, sterilized distilled water was the best treatment for prolonging the vase life. Similar results had been reported by Halevy (1976). In our study the positive effect of water quality was also observed in citric acid solutions prepared with sterilized distilled water.

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Tables

Table 1. Effects of different treatments on the vase life of cut tuberose in the first section.

Treatments	Mean vase life (days)
Sucrose (1 %)	7.25a[1]
Sucrose (2 %)	5.75 b
Sucrose (3%)	5.25 b
Control (Tap water)	6.25 ab
Silver thiosulphate (0.4 mM)	4.50 c
Silver thiosulphate (0.8 mM)	4.00 c
Silver thiosulphate (1.2 mM)	4.00 c
Citric acid (150 mgl^{-1})	7.25 a
Citric acid (300 mgl^{-1})	7.25 a
Citric acid (450 mgl^{-1})	7.37 a
Silver nitrate (50 mgl^{-1})	4.25 c
Silver nitrate (100 mgl^{-1})	4.25 c
Silver nitrate(150 mgl^{-1})	4.25 c

[1] Means followed with the same letters are not significantly different at 1% level of probability using Tukey's test.

Table 2. Effects of different treatments on the vase life of cut tuberose in the second section.

Treatments	Mean vase life (days)
Control (Tap water)	6.25c[1]
Sterilized distilled water	13.50a
Citric acid [2] (150 mgl^{-1})	7.75bc
Citric acid (300 mgl^{-1})	8.25b
Citric acid (450 $mg^{-1}l$)	9.00b

[1] Means in each column followed with the same letters are not significantly different at 1% level of probability using Tukey's test.

[2] In this section, the citric acid treatments were prepared with sterilized distilled water.

Table 3. Effects of different citric acid treatments on the number of opened florets in each flower spike up to the end of the cut tuberose vase life in the second section.

Mean of opened florets in each flower spike up to the end of vase life	pH	Citric acid concentrations (mgl^{-1})
9.00b[1]	5.24	150
10.50a	4.95	300
10.75a	3.82	450

[1] Means in each column followed with the same letters are not significantly different at 1% level of probability using Tukey's test.