South Western Journal of Horticulture, Biology and Environment
P-Issn: 2067- 9874, E-Issn: 2068-7958

Vol.2 , No.2, 2011
pp.157-165

STUDY ON PROLONGING THE VASE LIFE OF TUBEROSE CUT FLOWERS (*Polianthes tuberose* L.)

Jafar ABBASI, Moazzam HASSANPOUR ASIL*

Department of Horticultural Sciences, Faculty of Agricultural Sciences,
University of Guilan, P. O. Box. 41635-1314, Rasht, Iran
* Corresponding author, M. Hassanpour Asil, E-mail: hassanpurm@guilan.ac.ir;
hassanpurm@yahoo.com

Abstract. *We investigated the effects of gibberellic (GA_3) acid and silver thiosulphate complex (STS) on postharvest quality of tuberose cut flowers. Cut spikes of tuberose were kept in GA_3 and STS with various concentrations to see their effects on keeping quality and vase life of the cut flowers. Vase life of cut spike was 4 days more in 40 ppm GA_3 than water control. The result showed flower vase life was significantly affected by STS concentrations and vase life was lower in 0.4 and 0.6 mM STS than in water control and other concentrations. Also, results showed that STS at higher concentrations caused severe burning of the florets. Moreover, results indicate that sensitivity of tuberose to ethylene is very little. Ethylene, therefore, may not be important in flower senescence of tuberose.*

Key words: *gibberellic acid, keeping quality, senescence of flowers, silver thiosulphate complex*

INTRODUCTION

The short vase life of many cut flowers continues to pose a challenge to the florist industry in general. Flowers are extremely perishable; maintaining their physiological functions very actively even after harvest, and the beginning of their senescence very often depends on ethylene (Figueroa et al. 2005). Other important factor in the deterioration of cut flowers involves the diminishing of respiration substrates, the speed of these changes depend, at least in part, on the amount of reserves that are present in the flower when they are cut (Rogers 1973). Carbohydrates are important reserve compounds. Furthermore, a decrease of macromolecular component such as starch occurs through the course of the petal senescence. The senescence of cut flowers is closely related to a considerable reduction of the energy needed for synthesis reactions.

Therefore, an exogenous carbohydrate supplementation would be enough to delay the senescence, considering that the main effect would be to maintain the structure and activity of the mitochondria (Coorts 1973, Kaltaler & Steponkus 1976). The plant hormone, ethylene, is responsible for early senescence in many flowers such as orchids, roses etc. (Leiv & Hans 2005). Vase life of cut flowers can be improved by delaying senescence using ethylene synthesis and receptor inhibitors such silver thiosulphate complex (STS). The use of preservative solution is considered a common practice for the storage of floral stems. These treatments allow to control ethylene synthesis, pathogen development, maintenance of hydric and respiration balance, to contribute to color conservation, floral buttons induction and latter to complete their development (Arboleda 1993, Halevy & Mayak 1981). For these reasons, many floral preservative contain germicides, ethylene synthesis inhibitors, growth regulators, some mineral compounds, and carbohydrates that are essential to extend the vase life of cut flowers (Halevy & Mayak 1981). Several treatments have been tested for their ability to improve cut flowers opening and vase life. STS is the most common bactericides and competes with ethylene for the same site of action (Arboleda 1993). STS is markedly effective in extending the vase life of many cut flowers including carnation, *Delphinium* (Ichimura et al. 2002, Uda et al. 1997), sweet pea (Ichimura et al. 2002), *polianthes tuberose* (Hutchinson et al. 2003) and *Dendrobium* orchids (Uthaichay et al. 2007). GA_3 has been reported to delay leaf yellowing and flower shedding in *Alstroemeria* (Dai & Paull 1991), and *Narcissus* (Ichimura & Goto 2002). Also, GA_3 tends to retard initiation of floral senescence, maintaining the quality of some cut flowers (Hunter et al. 2004). GA_{4+7} delayed the onset of flower senescence of iris (Lee et al. 2005). The purpose of this study was to investigate effect of GA_3 and STS on floret opening and their influence in the postharvest quality of tuberose cut flowers.

MATERIALS AND METHODS

Plant material

Cut flowers of tuberose were obtained from a commercial grower in National Station of Botanical Researches in Mahalat, Iran. Flowers were selected at commercial maturity when lower florets (2 florets) of the spike were opened. Stems were 70 cm length and all leaves on the lower section of the stem were removed.

Treatments

Treatments were set following a completely randomized design. Each treatment cosisted of 3 replications and three stems were used for each replication. Cut

spikes were pulsed with solution containing different concentrations of STS (0.2, 0.4 and 0.6 mM) and GA_3 (40, 80 and 120 ppm) for 24 h and control stems were treated with distilled water. The treated flowers were further submerged in distilled water that was replaced every 2 days until the experiment was over. The flowers were kept at room temperature (25±1°C and 70% RH) at 16 h day light (40±10% µ $mol \cdot m^{-2} \cdot s^{-1}$ PAR at plant level) and natural ventilation.

Characters evaluations

Observations were recorded on floret opening of cut spike, the vase life of cut flowers (spikes to be terminated when the number of senesced flower in each spike exceed the number of not senesced flowers (day), and quality changes of leave, stem and floret including visible signs of spot, petal discoloration and in-rolling of the petal distal edge. Visual rating of flowers quality was carried out on the basis of a scale from 1 to 10, where: 1=entirely fresh flowers and 10= wilting in 50-100% of the petals.

Statistical analysis

Data of vase life was analyzed using GLM procedure, SAS (Version 9.1, SAS Institute Inc., Cary, NC, USA) software. Statistical significance was judged at *P*=0.01. Means comparison to identify significant different among treatments were performed using Tukey method. Graphs were plotted using Microsoft Excel. All collected data of floret opening and quality of cut spikes were coded and analyzed using Kruskal Wallis Test, which is a non-parametric test in SPSS.

RESULTS

Floret opening of cut spike

Kruskal Wallis Test for floret opening of cut spike factor was used, the results of the analysis indicates that there is a significant difference in the medians, $X^2(6, N =21) = 15.3$, $P= 0.01$. Floret opening was strongly inhibited in freshly harvested tuberose inflorescences placed in vase solution containing STS. The minimum floret opening was recorded in 0.6 mM STS.

Quality of cut flowers

The results of the analysis indicates that the p-value (Asymp. Sig.) is 0.005. There is significant difference in median between seven groups (Table 1). Our results showed that a statistically significant difference between the different STS and GA_3treatments ($X^2 = 18.5$, $P = 0.005$) with a mean rank of 20 for 40 ppm GA_3 and 2 for 0.6 mM STS. Pulsing of cut spikes with GA_3 largely overcame the negative effect of petal senescence. Abscission and

senescence of floret in cut spike of *P. tuberose* was substantially delayed by GA_3 plus than STS (Table 1).

Table 1. Effects of GA_3 and STS on floret opening and quality of tuberose cut flowers.

Treatment	Floret opening	Quality of cut flower
Control	19.3[a]	9.3
GA_3 (ppm)		
40	13.1	20.0
80	11.5	16.6
120	15.3	13.3
STS (mM)		
o.2	9.0	10.6
0.4	6.7	5.0
0.6	2.0	2.0
Chi-Squar	15.3	18.5
df	6	6
Asymp. Sig.	0.01	0.005

[a] Data were analyzed using Kruskal Wallis Test

Vase life

A significant effect ($P < 0.01$) was obtained on flowers treated with GA_3. The vase life of cut flowers was extended by the different concentrations of GA_3 (Table 1). The vase life was longer in cut flowers pulsed with GA_3 at 40 ppm which resulted in 12.3 days compared to controls. No clear differences were observed between 4o, 80 and 120 ppm GA_3. While vase life of cut flowers treated with different concentration of STS was lower (Figure 1). The longest vase life was attained when STS was applied at 0.2 mM, which gave 10.3 days in comparison to 8.3 days for control. But higher concentration of STS not increased vase life, when cut flowers were treated with 0.4 and 0.6 mM STS, resulted in sever burning of florets and decline the vase life (Figure 1).

DISCUSSION

Senescence of flower is a major limitation to the marketing of many species of cut flowers and considerable effort has been devoted to developing postharvest treatments to extend the marketing period. Silver ion, applied as STS, is in widespread use to delay senescence in ethylene-sensitive cut

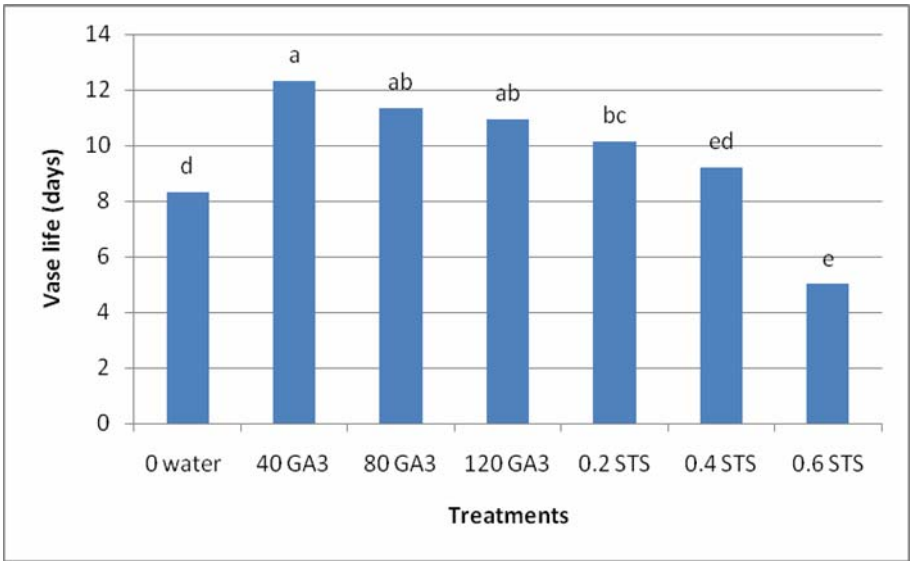

Figure 1. Effects of GA_3 and STS on vase life of cut spikes *P. tuberose*. Significant different among treatments were performed using Tukey method.

flowers. Silver reduces ethylene-binding capacity and suppresses endogenous ethylene production (van Doorn & Wolthering 1991) thereby delaying the appearance of characteristics such as premature wilting, petal in-rolling and abscission of flowers and buds (Nichols 1966; Wu et al. 1991). But, this study shows that STS pulsing of cut tuberose inflorescences at high concentrations decreased their vase life and floret opening significantly. Similar results to us were found by some researchers. Roein et al. (2009) on *Narcissus jonquilla* cv. German and Jowkar and Salehi (2006) on *P. tuberose* cv. Goldorosht-e-Mahallat reported that in the early days of the experiment, STS caused severe burning of the florets. Also, similar results were reported by Naidu and Reid (1989), who observed a severe reduction in solution uptake by tuberose flower stems pulsed with STS which resulted in rapid senescence of florets. Waithaka et al. (2001) similarly found that STS did not delay flower senescence of *P. tuberosa*. Naidu and Reid (1989), suggested that tuberose floret produced very little ethylene, and were not affected by exposure to ethylene. In the current study, the negative effects of STS on tuberose spikes were perhaps due to the use of silver as it is a heavy metal salt and sensitivity of florets to the STS. Ethylene, therefore, may not be important in flower senescence of tuberose. In contrast, Ichimura et al. (2002) was reported to delay

senescence of cut sweet pea, carnations and *Delphinium* by STS. Also, Uthaichay et al. (2007) who indicates that treatment with STS extended vase life of *Dendrobium* (orchid) inflorescences.

It is interesting to note that various concentrations of a chemical did not differ significantly with each other, indicating that the chemical is more important and the concentration is the least. In fact, the treatment that delays floret opening is considered better because it results in longer vase-life. This study shows that pulse application of STS did not increase vase life or floret opening. Similarly, STS treatment on flower quality of cut spikes significantly decreased their quality, but there was no significant difference in floret opening between GA_3 and STS treatment. Among plant hormones, gibberellins are well known to delay leaf senescence in many species. There is increasing evidence of leaf senescence-delaying effects of gibberellins in some species. In *Alstroemeria pelegrina* L. cut flowering stems and *Lilium longiflorum* plants, GA_4 and GA_7 are far more effective in delaying leaf chlorosis than GA_3 (Han 1997, Jordi et al. 1995). Ranwala and Miller (2000) reported that foliar sprays of GA_{4+7} prevented rapid leaf senescenc in *Lilium*. Franco and Han (1997) observed reduction in respiration rates by GA_3 treatments in excised *L*. *longiflorum* leaves. Our finding is agreement with Hye and Miller (2009) who reported that GA_{4+7} enhances postproduction quality in pot tulips. Yu et al. (2009) reported that GA_3 treatment retards the natural senescence of the aerial parts in the herbaceous perennial *Paris polyphylla* and increases their longevity. In the present study, we demonstrated that treatment with GA_3 significantly improves vase life and flower quality in cut spike of tuberose. Gibberellins are well known to increase hydrolysis of starch and sucrose in to glucose and fructose, which were utilized by the flowers for disc floret opening (Emongor 2004). Our experiment is agreement with Saifuddin et al. (2009) who mentioned that a delay in discoloration of *Bougainvillea spectabilis* and prolonging of longevity were increased in the presence of GA_3.

The increased reducing sugar in the floret and stem of tuberose cut spikes may increase the osmotic potential of the stem and petals, thus improving their ability to absorb nutrients and maintain their turgidity, which may explain the increase of flower longevity in different treatment and observed in this study. Effects of GA_3 on increase quality cut spikes may be its role in promote hydrolysis of starch and sucrose in to fructose and glucose which delayed petal abscission and color fading.

CONCLUSIONS

Results showed that the optimum pulse treatment to extend the vase life of cut flowers of *P. tuberose* cv. Single was 40 ppm GA_3, although no clear differences were observed between other concentrations, but treatment cut spikes by STS was toxic. Our findings indicated that *P. tuberose* cv. Single not sensitive to the ethylene.

ACKNOWLEDGEMENTS. We offer our thanks to Director of Research at University of Guilan, Rasht, Iran, for providing the facilities.

REFERENCE

Arboleda, J.A. (1993): Principios fundamentales de la postcosecha de flores. En*:* Tercer Seminario Técnico de Floricul 93: 11-14.

Coorts, G.D. (1973): Internal metabolic changes in cut flowers. Horticultural Science 8: 195-198.

Dai, J.W., Paull, R.E. (1991): Postharvest handling of *Alstroemeria*. Horticultural Science 26: 314.

Emongor, V.E. (2004): Effects of gibberellic acid on postharvest quality and vase life of Gerbera cut flowers (*Gerbera jamesonii*). Journal of Agronomy 3: 191-195.

Figueroa, I., Colinas, M.T., Mejía, J., Ramírez, F. (2005): Postharvest physiological changes in roses of different vase life. Ciencia e Investigation Agraria 32: 167-176.

Franco, S.E., Han, S.S. (1997): Respiratory changes associated with growth regulator-delayed leaf yellowing in Easter lily. Journal of the American Society for Horticultural Science 122: 117-121.

Halevy, A.H., Mayak, S. (1981): Senescence and postharvest physiology of cut flowers, Part 2. Horticultural Reviews 3: 59-143.

Han, S.S. (1997): Preventing postproduction leaf yellowing in Easter lily. Journal of the American Society for Horticultural Science 122: 869-872.

Hunter, D.A., Yi, M., Xu, X., Ried, M.S. (2004): Role of ethylene in perianth senescence of daffodil (*Narcissus pseudonarcissus* L. 'Dutch Master'). Postharvest Biology and Technology 32: 269-280.

Hutchinson, M.J., Chebet, D.K., Emangor, V.E. (2003): Effect of accel, Sucrose and silver thiosulphate on the water relations and postharvest physiology of cut tuberose flowers. African Crop Science Journal 11: 279-287.

Hye, J.K., Miller, W.B. (2009): GA_{4+7} plus BA enhance postproduction quality in pot tulips. Postharvest Biology and Technology 51: 272-277.

Ichimura, K., Goto, R. (2002): Extension of vase life of cut *narcissus tazetta* var. *chinensis* flowers by combined treatment with STS and Gibberellin A_3. Journal of the Japan Society for Horticultural Science 71: 226-230.

Ichimura, K., Shimizu, H., Hiraya, T. Hisamatsu, T. (2002): Effect of 1-methylcyclopropene (1-MCP) on the vase life of cut carnation, *Delphinium* and sweet pea flowers. Bulletin of the National Institute for Floricultural Science 2: 1-8.

Jordi, W., Stoopen, G.M., Kelepouris, K., van der Krieken, W.M. (1995): Gibberellin-induced delay of leaf senescence of *Alstroemeria* cut flowering stems is not caused by an increase in the endogenous cytokinin content. Journal of Plant Growth Regulation 14: 121-127.

Jowkar, M.M., Salehi, H. (2006): The effects of different preservative solutions on the vase life of cut tuberose (*Polianthes tuberose* L.) cv. Goldorosht-e-mahallat. Journal of Science and Technology of Agricultural and Natural Resources 10: 306-309.

Kaltaler, R.E.L., Steponkus, P.L. (1974): Uptake and metabolism of sucrose in cut roses. Journal of the American Society for Horticultural Science 99: 490-493.

Lee, A.K., Rhee, S.R., Suh, J.K., Cha, H.C. (2005): Development of floral organ and physiochemical changes of cut *Iris hollandica* 'Blue Magic' according to plant growth regulators and storage temperature. Acta Horticulturae 673: 315-321.

Leiv, M.M., Hans, R.G. (2005): Effect of air humidity variation on powdery mildew and keeping quality of cut roses. Scientia Horticulturae 140: 49-55.

Naidu, S.N., Reid, M.S. (1989): Postharvest handling of tuberose (*Polianthes tuberosa* L.). Acta Horticulturae 261: 313-317.

Nell, T.A. (1992): Taking silver safely out of the longevity picture. Grower Talks 6: 35-38.

Nichols, R. (1966): Ethylene production during senescence of flowers. Journal of Horticultural Science 41: 279-290.

Ranwala, A.P., Miller, W.B. (2000): Preventive mechanisms of gibberellin$_{4+7}$ and light on low-temperature-induced leaf senescence in *Lilium* cv. Stargazer. Postharvest Biology and Technology 19: 85-92.

Roein, Z., Hassanpour Asil, M., Rabiei, B. (2009): Silver thiosulphate in relation to vase life of narcissus cut flowers *(Narcissus jonquilla).* Horticulture, Environment and Biotechnology 50: 308-312.

Rogers, M.N. (1973): An historical and critical review of postharvest physiology research on cut flowers. Horticultural Science 8: 189-194.

Saifuddin, M., Hossain, A.B.M.S., Normaniza, O., Nasrulhaq Boyce, A., Moneruzzaman, K.M. (2009): The effects of naphthaleneacetic acid and gibberellic acid in prolonging bract longevity and delaying discoloration of Bougainvillea apectabilis. Biotechnology 8: 343-350.

Uda, A., Yamanaka, M., Fukushima, K. (1997): Pretreatment effect of novel ethylene inhibitors on extending longevity of carnation, larkspur and sweet pea cut flowers. Kinki Chugoku Agricultural Research 93: 65-70.

Uthaichay, N., Ketsa, S., Van Doorn, W.G. (2007): 1-MCP pretreatment prevents bud and flower abscission in *Dendrobium* orchids. Postharvest Biology and Technology 43: 374-380.

Van Doorn, W.G., Wothering, E.J. (1991): Developments in use of growth regulators for the maintenance of postharvest quality in cut flowers and potted plants. Acta Horticulturae 298: 195-208.

Waithaka, K., Reid, M.S., Dodge, L.L. (2001): Cold storage and flower keeping quality of cut tuberose (*Polianthes tuberosa* L.). Journal of Horticultural Science and Biotechnology 76: 271-275.

Wu, M.J., Zacarias, L., Reid, M.S. (1991): Variations in the senescence of carnation (*Dianthus caryophyllus* L.) cultivars II. Comparisons of sensitivity to exogenous ethylene and of ethylene binding. Scientia Horticulturae 48: 109-116.

Yu, K., Wei, J., Ma, Q., Yu, D., Li, J. (2009): Senescence of aerial parts is impeded by exogenous gibberellic acid in herbaceous perennial paris polyphylla. Journal of Plant Physiology 166: 819-830.