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SHORT COMMUNICATION

Improvement of postharvest quality of cut tulip ‘White Parrot‘ by nano silver

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ABSTRACT

Tulips is one of the most important cut flowers in the world. For the first time, the efficacy of nano silver (NS) in extending the vase life of cut tulip ‘White Parrot’ was evaluated. Cut flowers were kept in solutions containing 0, 10, 20 and 40 mg L^{-1} NS. The NS treatments at all concentrations extended the vase life of cut flowers. The 10 mg L^{-1} NS treatment produced the longest vase life, as compared to the control. On the last day of decorative value, the greater fresh weight was observed in the flowers exposed to the solution of NS in 10 or 20 mg L^{-1}. NS at 20 or 40 mg L-1 prevents the leaves from yellowing.

***Keywords*:** longevity; nanoparticles; preservative solution; *Tulipa*, vase life

1. INTRODUCTION

Tulips (*Tulipa gesneriana* L.) are well established as a mainstream cut flower. About 8000 cultivars are currently in commercial production [1]. Especially interesting are the Parrot tulips have exotic wavy, twisted and deeply frilled petals. Longevity and quality of cut

flowers depend upon the conditions of cultivation, the proper harvest time, and postharvest handling [2]. Various preservative solutions or chemical treatments have been used to enhance the keeping quality and vase life of cut flowers [3]. However, the benefits of the use of floral preservatives in tulips are uneven [4].

It is well documented that microorganisms develop at the stem base of cut flowers or in the vase solution, shortening their longevity [2,3]. Silver nitrate and silver thiosulphate as antibacterial agents are very effective in limiting development of aqueous microflora but they are not used in commercial vase solutions because of highly toxic for the environment. An alternative might be silver in the form of nanoparticles with broad spectrum activity [5]. Recent studies provided increasing evidences that silver nanoparticles treatments prolong the vase life of cut flowers and foliage due to inhibit bacteria growth in the vase solution and at the cut stem-ends in cut flowers [6-12]. To the best our knowledge, no information was available in the literature concerning the effect of nano silver (NS) on postharvest quality of tulip. Therefore, in the present study we tested the effects of NS on vase life, solution uptake, fresh weight and the relative chlorophyll content in postharvest tulip flowers.

2. MATERIALS AND METHODS

In March 2016 cut tulip cv. 'White Parrot' flowers were purchased from a greenhouse of a commercial grower in Szczecin (Poland). The stems were cut to a length of 30 cm and weighted using an electronic scale electronic (RADWAG PS 200/2000/C/2). Flowers in groups of three were placed in 1000 ml flasks. The treatments were four concentrations of NS (Sigma-Aldrich): 10, 20 and 40 mg L^{-1}. Solutions were prepared at the beginning of the experiment and were not renewed during the experiment. Controls were kept in distilled water. Each treatments with four replicates were applied (each replicate consists of three flowers). The flowers were kept in a room with controlled temperature and light conditions (20±2 ºC, 60±5 % RH, 12 h photoperiod, 10-12 µmol m^{-2} s^{-1} light intensity). Vase life was expressed in days. Chlorophyll Meter SPAD 502 (Minolta, Japan) was used over the first four days to evaluate the relative chlorophyll content in leaves (leaf greenness index). On the day when the decorative value of the flowers was lost, their fresh weight and length were assessed. Results were statistically analyzed using analysis of variance (ANOVA) and Tukey's multiple range tests using 12.0 Statistica software.

3. RESULTS AND DISCUSSION

It is considered that a minimum standard for commercial cut tulips is postharvest vase life of 5 to 6 days at room temperature, and any cultivars having shorter shelf life than this are unsuitable for forcing for cut flowers [4]. In current study, all NS treatments significantly extended cut tulip vase life compared to the control (Tab. 1). The longest vase life (8.6 days) was obtained by 10 mg L^{-1} NS treatment. The longevity was slightly decreased when the concentration of NS was increased to 20 and 40 mg L^{-1} (mean 7.7 days). The increase in vase life of cut flowers under silver nanoparticles treatments has also been reported in others cut flowers [6-12]. The improvement in vase life in preservatives solutions containing NS might be due to the fact that silver has bactericidal effect [6] with positively affected water balance and turgidity leading to improved vase life [7,9]. Moreover, silver ions could act as anti-ethylene agent [2,3].

Table 1. Effect of nano silver concentration on vase life and postharvest quality of 'White Parrot' tulips

Nano silver concentrations (mg L^{-1})	Vase life (days)	Final fresh weight (g)	Percentage of initial fresh weight	Final stem length (cm)	Percentage of initial stem length
0	5.0 ± 0.17 c*	27.82 ± 1.71 b	83.9 ± 2.73 c	37.8 ± 1.49 b	126 ± 4.99 a
10	8.6 ± 0.12 a	38.57 ± 2.27 a	110 ± 3.37 a	40.6 ± 1.89 a	135 ± 6.28 a
20	7.8 ± 0.10 b	37.32 ± 3.54 a	101 ± 2.87 b	41.5 ± 1.66 a	127 ±6.81 a
40	7.6 ± 0.25 b	33.62 ± 0.97 ab	97.4 ± 1.68 b	38.0 ± 2.04 b	138 ± 5.52 a

* Date are presented as mean values standard error. Date with a different letter are statistically different ($p \leq 0.05$)

Table 2. Effect of nano silver concentration on the relative chlorophyll content (SPAD) in leaves of cut 'White Parrot' tulips

Nano silver concentrations (mg L^{-1})	Vase time (days)			
	1	2	3	4
0	51.6 ± 2.96 a*	48.0 ± 3.52 a	25.9 ± 1.38 b	15.2 ± 0.91 b
10	51.1 ± 2.16 a	46.0 ± 1.47 a	27.7 ± 2.77 b	18.2 ± 1.38 b
20	55.6 ± 2.82 a	46.0 ± 0.63 a	31.4 ± 3.84 b	26.0 ± 2.03 a
40	51.6 ± 2.30 a	52.8 ± 1.68 a	50.5 ± 3.36 a	27.2 ± 1.24 a

* Date are presented as mean values standard error. Date with a different letter are statistically different ($p \leq 0.05$)

Date presented in Table 1 show that the effects of NS on fresh weight of tulips were dose-depended. Flowers held in 10 or 20 mg L^{-1} NS had greater fresh weight in comparison to control. In similar studies, treatment with NS suppressed reduction in fresh weight during the vase period in cut rose 'Movie Star' [7] and cut gerbera 'Balance' [11] flowers.

Date analysis showed that the effects of different doses of NS were significant on stem length of flowers (Table 1). Maximum stem length (41.5 cm) was observed for tulips kept in solutions containing 20 mg L^{-1} NS. The stem length was slightly decreased using 10 mg L^{-1} NS (40.6 cm). Application of 40 mg L^{-1} NS had no effect in stem length of flowers. The silver nanoparticles in this dose can be suitable for preventing rapid stem elongation of tulips.

Table 2 shows that NS used in the preservative solutions had a significant effects on the relative chlorophyll content in leaves of tulips at day 3 and 4 of measurement. By the 3 day, the 40 mg L^{-1} NS treatment gave the highest chlorophyll content (50.5 SPAD). Thereafter, the chlorophyll content in leaves of flowers held in 20 and 40 mg L^{-1} NS was higher by 10.2 and 12.0 SPAD than controls, respectively. The higher leaf greenness index of leaves can improve tulips quality and appearance. In our previous study [13,14], colloidal silver also improved the relative chlorophyll content in leaves of aspidistra and chrysanthemum 'Filling Green'. Similar to our findings, Jowkar et al. [15] reported increased leaf chlorophyll contents of rose 'Cherry Brandy' in responses to NS application.

4. CONCLUSION

In summary, the NS treatments increased postharvest longevity of cut 'White Parrot' tulip flowers. Furthermore, NS increasing fresh weight and at 20 or 40 mg L^{-1} prevents the leaves from yellowing on the end of decorative value. The study results suggest that NS may be used in preservative solutions for enhancing the quality of cut tulips.

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References

[1] H. Okubo, D. Sochacki, Botanical and Horticultural Aspects of Major Ornamental Geophytes. In: Ornamental Geophytes: From Basic Science to Sustainable Production. Edited by Rina Kamenetsky, Hiroshi Okubo, CRC Press Taylor and Francis Group LLC, Boca Raton (2013)

[2] J. N. Sacalis, Cut Flowers: Prolonging Freshness. Postproduction Care & Handling. Ball Publishing, Batavia, Illinois, USA (1993)

[3] C. Z. Jiang, M. S. Reid, Postharvest Biology and Technology of Cut Flowers and Potted Plants. In: Horticultural Reviews, Vol. 40. Edited by Jules Janick. Wiley-Blackwell. John Wiley & Sons, Inc. Hoboken, New Jersey, USA (2012)

[4] D. K. Salunkhe, Tulip. In: Postharvest Biotechnology of Flowers and Ornamental Plants. Edited by Dattajirao K. Salunkhe, Narayana R. Bhat, Babasaheb B. Desai, Springer-Verlag Berlin Heidelberg (1990)

[5] L. M. Carrillo-Lopez, A. Morgado-González, A. Morgado-González, *Journal of Nanomaterials* (2016) 1-10

[6] J. Liu, S. He, Z. Zhang, J. Cao, P. Lv, G. Cheng, D. C. Joyce, *Postharvest Biology and Technology* 54 (2009) 59-62

[7] P. Lu, J. Cao, S. He, J. Liu, H. Li, G. Cheng, Y. Ding, D. C. Joyce, *Postharvest Biology and Technology* 57 (2010) 196-202.

[8] S. A. Nemati, A. Tehranifar, B. Esfandiari, A. Rezaei, Notulae Scientia Biologicae 5 (2013) 490-493

[9] Z. Nazemi Rafi, A. Ramezanian, *South African Journal of Botany* 86 (2013) 68-72.

[10] M. Solgi, M. Kafi, T. S. Taghavi, R. Naderi, *Postharvest Biology and Technology* 53 (2009) 155-158

[11] Z. Safa, D. Hashemabadi, B. Kaviani, N. Nikchi, M. Zarchini, *Journal of Environmental Biology* 36 (2015) 425-431

[12] H. Li, H. Li, J. Liu, Z. Luo, D. Joyce, S. He, *Postharvest Biology and Technology* 123 (2017) 102-111.

[13] A. Byczyńska, *World Scientific News* 69 (2017) 244-247

[14] A. Byczyńska, P. Salachna, *World Scientific News* 69 (2017) 239-243

[15] M. M. Jowkar, A. Khaligh, M. Kafi, N. Hassanzadeh, *Agriculture and Environment* 11 (2013) 1045-1050

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