Short Communication

Evaluation of the effect of plant growth substances on longevity of gerbera cut flowers cv. Sorbet

Elham Danaee[1]* and Vahid Abdossi[2]

1. Department of Horticulture, Islamic Azad University, Garmsar Branch, Garmsar, Iran
2. Department of Horticulture, Islamic Azad University, Science and Research Branch, Tehran, Iran

Abstract

Gerbera is one of the most popular cut flowers in the world. Several experiments have been done on the effect of different chemical compounds on longevity and quality of cut flowers. In the present study, two experiments based on a completely random design with two treatments and three replications were conducted on gerbera cut flower cv. Sorbet. The first experiment examined the effect of BA, GA_3, and SA at 2 concentrations (50 and 100 ppm) as a pulse treatment and then holding vase life solution containing 3 ppm silver nanoparticle with 3% sucrose. The second experiment investigated the effect spray application of BA, GA_3, and SA at 2 concentrations (25 and 50 ppm) and then holding vase life solution containing 3 ppm silver nanoparticle with 3% sucrose. Distillated water and 3 ppm silver nanoparticle with 3% sucrose were used as control. During the experiments traits such as vase life, relative fresh weight, anthocyanin content, PAL activity, and SOD activity were measured. Results showed that there was significant difference between treatments and control. As for different concentrations of BA, GA_3, and SA followed by NSP and sucrose treatment in the first excrement, SA 100 ppm with 8.9 day longevity compared with control (5.6 day) and in second experiment, SA 50 ppm with 9.8 day longevity compared with control (5.9 day) had better result than other treatments in quantity and quality of enzymatic traits and vase life, respectively. Results revealed that there was significant difference between treatment and control ($p \leq 0.01$) in postharvest life in gerbera cut flowers.

Key words: Benzyle adenine; gibberellin acid; salicylic acid, silver nanoparticle; vase life
Abbreviations: BA: Benzyladenine; GA_3: gibberellic acid; SA: salicylic acid; SNP: silver nanoparticle; SOD: superoxide dismutase; PAL: phenylalanine ammonia lyase

Danaee, M. and V. Abdossi. 2016. 'Evaluation of the effect of plant growth substances on longevity of gerbera cut flowers cv. Sorbet'. *Iranian Journal of Plant Physiology* 7 (1), 1943- 1947.

*Corresponding author
E-mail address: dr.edanaee@yahoo.com
Received: October, 2015
Accepted: March, 2016

Introduction

Gerbera is a member of Asteraceae family. In recent years, there has been a significant growth in gerbera cultivation in Iran. Many preservative solutions have been introduced to increase the quality and vase life of cut flowers. Exogenous application of cytokinin because of its participation in critical processes such as nutrient mobilization, tissue metabolism, senescence and stress may induce changes leading to desirable results in horticultural activities. Benzyladenine, a synthetic cytokinin, has been used by many researches mainly because of its possible impacts on crucial process such as cell divisions, senescence processes, biochemical reactions, and activities of various enzymes (Riefler et al., 2006). Vase life and membrane stability of the cut spike of gladiolus has been increased by using BA (Singh et al., 2008). Treatment with GA_3 has also been shown to enhanced postharvest life and quality of Gerbera cut flowers (Emongor, 2004). Conversely, the effect of GA_3 has been demonstrated to reduce oxidative enzyme activity in cut leaves of Hosta (Robiza-Swider et al., 2004). Participation of salicylic acid, a natural phenolic secondary metabolite, in various aspects of vital processes like ethylene biosynthesis, stomatal conductance, respiration, senescence, and the activation of defense systems against different pathogens is well-documented and its exogenous application may modify some plant reactions like respiration, transpiration, and senescence (An et al., 2011). In order to extend the longevity of cut flowers, the application of various chemicals such as SA, BA, and GA_3 as preservatives in the vase solution have been recommended by many researchers (Danaee et al., 2011). In recent years, SNP, as a novel antiseptic, is being applied to many industrial processes such as medical industry, water purification, and vegetable disinfection. In addition, NSP treatment has been proposed for the aim of modifying the postharvest life of cut flowers (Liu et al., 2009). In view of BA, SA, GA_3, and NSP potential, the present research was conducted to screen various treatments for promoting the vase life as well as evaluating the possible physiologically induced changes by the applied mixture treatments during the postharvest life of gerbera cut flowers.

Material and Methods

Cut gerbera flowers, *Gerbera jamesonii* sorbet, were obtained from the reliable commercial growers. The flowers were harvested just before sunrise at the mature stage. The experiments were performed in the postharvest room (22 ± 1° C, 60 ± 5% relative humidity and 12 h photoperiod). In the first experiment, the effect of BA, GA_3, and SA at 2 concentrations (50 and 100 ppm) was investigated as a pulse treatment and then holding vase life solution containing 3 ppm SNP with 3% sucrose. In the second experiment, the effect of spray application of BA, GA_3, and SA with 2 concentrations (25 and 50 ppm) was investigated after the flowers were transferred to the holding solution containing 3 ppm NSP with 3% sucrose. Distillated water and 3 ppm SNP were used with 3% sucrose as control. Flowers were grouped into sixteen different treatments in the two experiments with three replications and five flowers per each replication. The relative fresh weight (Clicle, 2002), the concentration of anthocyanin (Meng, 2004), PAL activity (Readman et al., 1999), SOD activity (Readman et al., 1999), and vase life were calculated.

Statistical analysis

The experiments were based on a completely randomized design. Analysis of variance was carried out using SPSS software. Mean separation was performed with Duncan's multiple range test at $P < 0.05$.

Results

The results of the research and analysis of variance (Tables 1 and 2) showed that the effects of treatment, time, and treatment × time interaction in traits such as fresh weight relative, petal anthocyanin, and superoxide dismutase enzyme activity of phenylalanine ammonia and vase life in both experiments were significant at 1% level. With the passage of time, the amounts of relative fresh weight gradually decreased although the application of different

Table 1
Analysis of variance: the first experiment

S.O.V(first)		Mean Squar				
	df	Vise Life	Relative Fresh Wight	Petal Antocyanin	PAL Activity	SOD Activity
Treat	7	9/675**	737/290**	0/033**	10/123**	2/465**
Day	3	---	23335/037**	0/448**	148/924**	30/707**
Treat×Day	21	---	189/131**	0/005*	3/205**	0/779**
Error	---	0/031	0/412	0/002	0/067	0/022
CV(%)	---	11/25	12/77	12/66	11/55	11/89

*Mean values followed by different letters are significantly different at P < 0.05 according to Duncan's multiple range test.

Table 2
Analysis of variance: the second experiment

S.O.V(second)		Mean Squar				
	df	Vise Life	Relative Fresh Wight	Petal Antocyanin	PAL Activity	SOD Activity
Treat	7	14/141**	771/769**	0/038**	14/739**	3/867**
Day	3	---	22643/609**	0/483**	166/640**	34/760**
Treat×Day	21	---	200/145**	0/007**	5/129**	1/110**
Error	---	0/032	0/361	0/002	0/074	0/021
CV(%)	---	10/99	11/91	12/17	11/91	11/18

*Mean values followed by different letters are significantly different at P < 0.05 according to Duncan's multiple range test.

concentrations of BA, GA_3, or SA had declining effects on the weight loss of the cut flowers in the first and second experiment. The rates of anthocyanin degradation during the experiment days were reduced by the application of BA, GA_3, or SA. In the first and second experiment, effectiveness of the used treatments was promoted by the utilization of NSP. As the time went by, the activities of PAL and SOD diminished; however, the applied treatments of BA, GA_3, or SA, especially SA 25 ppm and SA 50 ppm in both experiments led to the induced activities of these enzymes compared to the control group. Flowers kept in water containing BA, SA, or GA_3 had significantly increased vase life compared to control for all concentrations of BA, SA, and GA_3. In the first experiment, application of SA 50 ppm resulted in a greater extension in vase life than other treatments. In the second experiment, SA 100 ppm resulted in a greater extension in vase life than other treatments.

Discussion

Cut flowers are complex organs and loss of quality flowers and leaves leads to rejection of flowers in the local and global markets. The quality and therefore marketability can be affected by the factors at pre-harvest, harvest, and postharvest stages. External application of cytokinin slows down the aging process of the

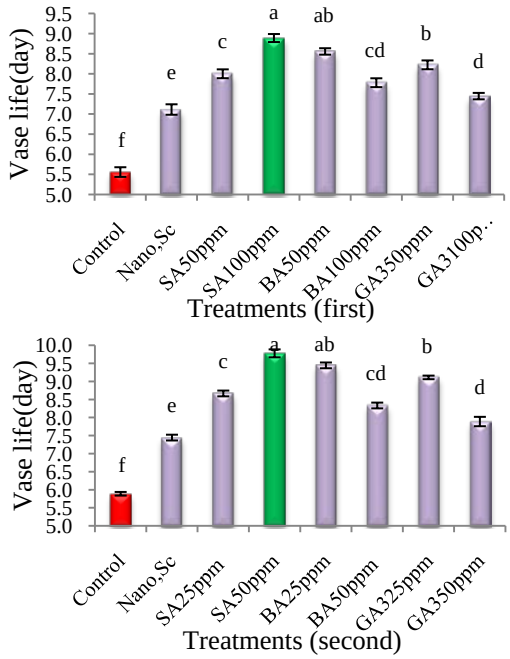

Fig. I. The effects of SA, GA_3 and BA as preservatives on the vase life of gerbera cut flowers in first (top) and second experiment (down).

flowers. The mechanism through which cytokinin controls the aging process has not been exactly determined, but the studies indicate its potential impact on plants pigments and as a plant growth regulator to maintain chlorophyll, protein, and RNA which basically are reduced in the aging process. In other words, application of sufficient amounts of cytokinin and at the right time according to the type used can delay aging in most plant tissues. GA_3 plays a role in delaying aging through reducing decomposition of ribonucleic acid, protein, and petals. Decreased levels of GA_3 before or during the aging process in a number of plant tissues have been reported. In fact, in the tissues are aging, GA_3 activity can extending life of tissue(Arteca, 1995).

SA is another plant growth regulator effective in improving quality characteristics and shelf life of cut flowers. SA enhances production of plant pigments such as anthocyanins, carotenoids, and chlorophyll (Cevahir et al., 2005). It may also increase the antioxidant capacity of the cell which is probably the mechanism used to reduce the aging process in cut flowers (Ezhilmathi et al., 2007).

SNP is one of the materials used to prevent the growth of microorganisms in cut flower preservative solutions. Also, the use of carbohydrates is essential in the cut flower preservative solutions to meet the required carbohydrates. In general, cut flower preservative solutions include materials such as carbohydrates, anti-ethylene materials, plant growth regulators and so on. Presence of SNP, BA, GA_3, and SA in preservative solutions of cut flowers increased duration of water uptake by the flower petals and leaves and delayed dehydration (Figueroa et al., 2005). Also, the correlations between the traits in both experiments were positive and significant ($p \leq 0.01$).

References

An, F.C. and **Z. Mou.** 2011. 'Salicylic acid and its function in plant immunity'. *J Integr Plant Biol*, 53 (6): 412–428.

Arteca, R. 1995. 'Plant growth substances, principles and applications'. Chapman and Hall, 332p.

Celicel, F.G. 2002. 'Postharvest handling of stock(*Matthiola incana*).' *Hort Sci*, 37: 144-147.

Cevahir, G., S. Yentur and N. Yilmaze. 2005.' The effect of nitric oxide, salicylic acid and hydrogen peroxide on the pigment content in excited cotyledons of red cabbage'. *Freschius Env. Bulletin*, 14: 591-598.

Danaee, E., Y. Mostofi and **P. Moradi.** 2011. 'Effect of GA_3 and BA on postharvest quality and vase life of gerbera cut flowers'. *Hortic Environ Biotechnol*, 52: 140–144.

Emongor, V.E. 2004. 'Effect of GA_3 on postharvest quality and vase life of Gerbera Cut Flowers'. *J Agron*, 3 (3): 191-195.

Ezhilmathi, K., V. Singh, P. Arora, R. K. Sairam. 2007. 'Effect of 5-sulfocalicylic acid on antioxidant in relation to vase life of gladiolus cut flower'. *Plant Growth Regul*, 51: 99-108.

Figueroa, I., M. T. Colinas, J. Mejia, F. Remirez Cien. 2005. 'Postharvest physiological changes in roses of different vase life', *Cien Inv Agr*, 32: 167-176.

Liu, J., Z. Zhang, S. He, J. Cao, P. Lv, D. C. Joyce. 2009. 'Effects of postharvest nano-silver treatments on cut flowers', *Acta Hortic*, 847: 245–250.

Meng, X. 2004. 'Relation of flower development and anthocyanin accumulation in *Gerbera hybrida'. Hort Sci Biotech*, 79 (1): 131-137.

Readman, R.S., S. Freeman, D. R. Clifton and **R. J. Rodroguez.** 1999. 'Biochemical analysis of plant protection afforded by nonpathogenic endophytic mutant of *Colletotrichum magna*'. *Plant Physiol*, 119: 795-804.

Riefler, M.,O. Novak, **M. Strnad** and **T. Schmulling.** 2006. '*Arabidopsis* cytokinin receptor mutants reveal functions in shoot growth, leaf senescence, seed size, germination, root development and cytokinin metabolism'. *Plant Cell*, 18(1): 40–54.

Robiza-Swider, J., A. Lukaszewska, E. Skutnik, Z. Rybka and **M. Wachowicz.** 2004. 'Lipoxygenase in senescing cut leaves of *Zatedeschia aethiopica* Spr. and Hosta *'Undulata Erromena'* treated with GA_3 or

BA'. *J Acta Physiolgiae Plantarum*, 26(4): 411-415.

Singh, A., J. Kumar and P. Kumar. 2008. 'Effect of plant growth regulators and sucrose on postharvest physiology, membrane stability and vase life of cut spikes of *Gladiolus'. J Plant Growth Regul*, 55: 221-229.