Trakia Journal of Sciences, No 1, pp 27-29, 2017

Available online at:
http://www.uni-sz.bg

ISSN 1313-7050 (print)
ISSN 1313-3551 (online) **doi:10.15547/tjs.2017.01.005**

Original Contribution

POSTHARVEST LIFE OF CUT GERBERA FLOWERS AS AFFECTED BY SALICYLIC ACID AND CITRIC ACID

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ABSTRACT
Effect of salicylic acid (SA) combined with citric acid (CA) on gerbera (*Gerbera jamesonii*) cut flowers was studied. The study was conducted in a factorial arrangement, carried out in a complete randomized design. The factors were SA (0.5,1.5 and 3 mM) and CA (1.5 and 3 mM). The effects of treatments on the total chlorophyll content, anthocyanin leakage and malondialdehyde content of cut flowers of gerbera were investigated. The results showed that the vase solution containing 1.5 mM SA significantly increased vase life compared to the control. In addition, the malondialdehyde accumulation reduced in the same solution while membrane stability was improved. Results suggest that SA increases vase life by affecting many of the age-related changes associated with Gerbera petal senescence.

Key words: Cut flower, Gerbera, Salicylic acid, Citric acid, Vase life

INTRODUCTION

Flowers are extremely perishable; maintaining their physiological functions vary actively even after harvest and the beginning of their senescence very often depends on ethylene. Short postharvest vase life is one of the most important problems on the cut flowers. In carnations, senescence of the petals is associated with a climacteric-like increase in ethylene production during the final stages. Ethylene production causes a sharp increase in production of oxygen free radicals which is responsible for stress dependent peroxidation of membrane lipids (1). Salicylic acid (SA) is a well known phenol that can prevent ACC-oxidase activity that is the direct precursor of ethylene and decrease ROS with increase enzyme antioxidant activity. SA is considered as a hormone-like substance, which plays an important role in regulating a number of physiological processes and provide protection against biotic and abiotic stresses in plant. Salicylic acid is the most readily accessible plant growth regulators which are effective in other forms of acetyl salicylic acid and methyl salicylate in plant as well (2). Salicylic acid could induce the alternative oxidase enzyme activity in mitochondria which is involved in stress alleviation mechanism and enhancing or reduction in specific secondary metabolites of plants is reported (3). Mei-hua *et al.*, (4) showed that SA can extending the vase life of cut flowers with decrease ROS and ethylene. Citric acid seems to act by reducing the pH of water and, consequently, the proliferation of bacterial, which block the xylem vessels in the cut region and interfere with the normal flux of water through the stem (5). Therefore, in this study, the preservative effects of SA and CA and their interaction on the vase-life of cut gerbera flowers were studied.

MATERIALS AND METHODS

This study was the effect of SA and CA treatments on vase life of gerbera cut flowers, in a factorial test with complete randomized design with 4 replications. Cut flower stems of gerbera were placed in solution containing SA 0.5, 1.5 and 3 mM and CA 1.5 and 3 after cutting. Four cut flowers were placed in a 300 mL flask with 250 mL of solution. Distilled water was used for the controls and placed in chambers at 19°C. The relative humidity was about 75% while 14h photoperiod was maintained using fluorescent lamps with a light intensity of 15 μmol m^2 s^1 at the top of the corolla. Vase life was determined as the number of days to wilting of flowers. Total chlorophyll (a+b) content was measured by chlorophyll meter which is presented by SPAD

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value. Anthocyanin leakage was measured based on the method of Poovaiah (6). MDA content was measured based on the method of Heath and Packer (7). Data were statistically analyzed using SPSS software. The mean separation was conducted by Duncan's analysis in the same software ($p \leq 0.05$).

RESULTS AND DISCUSSION

Holding gerbera cut flowers in vase solutions containing 1.5 mM SA significantly increased their vase life and delayed flower senescence compared to flowers either held in 0.5 and 3 mM SA or distilled water ($p \leq 0.05$) **(Table 1).** In our experiment adding CA (3 mM) to vase solutions containing SA could increase the vase life of cut flowers compared to control ($p \leq 0.05$) **(Table 1).** The results indicate that 1.5 mM SA caused significant decrease anthocyanin leakage and MDA content compared to control ($p \leq 0.05$) **(Table 1).** MDA content was reduced by SA and was significantly lower in solution preservative containing SA compared to the control and CA ($p \leq 0.05$) **(Table 1).** Result showed that 1.5 mM SA+ 1.5 mM CA leaded to a considerable delay in degradation of chlorophyll compared to other treatments ($p \leq 0.05$) (Table 1). SA is one of the endogenous signals which play an important role in plant defense. SA required for basal resistance against pathogens as well as for the inducible defense mechanism, systemic acquired resistance (SAR), which confers resistance against a broad-spectrum of pathogens (8). Also, SA inhibited the ethylene biosynthesis and delayed senescence progress in plant tissues (9). These results are in agreement with those of (10,11) who found that adding SA, MA and GLU in vase water increased chlorophyll content cut flowers. similarity, Canakci (12) reported that treatment with salicylic acid significantly extends the vase life with increases chlorophyll content. Yuping (13) reported that treatment with salicylic acid significantly extends the vase life with increases the enzyme antioxidant activity and decreased ROS production.

Table 1. *Effects of salicylic acid and citric acid in preservative solution on chlorophyll content, Vase life, Membrane stability, MDA in gerbera cut flowers*

Treatments	Vase life (day)	Total chlorophyll (SPAD reading)	Antocyanin leakage (absorption at 525 nm)	MDA (µmol/mg protein)
Control	6.54	2.04	110.21	121.07
0.5 SA mM	7.32	2.98	104.36	67.14
1.5 SA mM	12.41	3.89	54.65	52.25
3 SA mM	9.65	3.01	75.65	75.41
1.5 CA mM	7.00	3.05	90.65	79.58
3 CA mM	7.65	3.14	89.65	80.65
1.5 SA mM +1.5 CA mM	10.52	4.14	60.54	76.54
1.5 SA mM +3 CA mM	10.74	3.14	74.65	98.54

CONCLUSION

The effect of SA on senescence and vase life extension of cut flowers was reported earlier which is confirmed here was anticipated. This study shows that salicylic acid treatment did show significant effect on quality parameters and gerbera flower longevity. Salicylic acid proved more effective in delaying petal senescence and/or flower wilting.

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