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Effect of Some Chemicals on Keeping Quality and Vaselife of Argyranthemum Flowers

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Abstract: The experiment was carried out to investigate the effect of different concentrations of gibberellin 4+7 (Gi), 5-sulfosalicylic acid (5-SSA) and essential oils (EOS) of Thyme (*Thymus vulgaris*) (EOs) on keeping quality and vase life of Argyranthemum cut flowers. In this study six levels of gibberellin 4+7 (1, 2.5, 5, 7.5, 10 and 12.5 mg L^{-1} GA4+7), three levels 5-sulfosalicylic acid (1, 1.5 and 2.5 mM) and three levels of essential oils of Thyme (50, 100 and 150 mg L^{-1}) were applied in a factorial arrangement, carried out in a complete randomized design on 216 Argyranthemum cut flowers. The recorded traits included Vase life, total chlorophyll content (SPAD reading), anthocyanin leakage, Malondialdehyde (MDA) content and ACC-Oxidase (ACO) activity. Results show that solution containing gibberellin 4+7 and 5-sulfosalicylic acid, could increase flower longevity in compared to control. Vase life in solution containing essential oils of Thyme did have significantly difference than control. Results showed that the microbal population of vase solution in cut flowers treated with essential oils and 5-sulfosalicylic acid were lower than other treatments. The results showed that gibberellin 4+7 (Gi) and 5-sulfosalicylic acid (5-SSA) treatments descreasing MDA content, ACC-oxidase activity and membrane premeability together with total delaye of senescence and peroxidation of lipids. our results suggest the application of gibberellin 4+7 (Gi) and 5-sulfosalicylic acid (5-SSA) in preservative solutions for Argyranthemum flowers maintained the vase life of flowers for a longer period.

Key words: Vase life, essential oils, gibberellin 4+7, 5-sulfosalicylic acid

INTRODUCTION

Argyranthemum is a versatile annual plant that provides a great color display during the summer months. Historically grown for cut flower usage, it is catching on as an ideal annual suitable for containers, rock gardens and borders. It has a fast growing, mounding habit and is available in many varieties to suit anyone's taste. The flower of Argyranthemum is highly ethylene sensitive and the longevity of the cut flower is very short. In many flowers, senescence is closely linked to ethylene evolution (Borochov and Woodson, 1989). These include an increase in hydrolytic enzyme activity, degradation of macromolecules, increased respiratory activity and loss of membrane integrity and cellular compartmentation (Ezhilmathi *et al*., 2007). Activated oxygen species such as O^{2-} or H_2O_2 and their interaction product, hydroxyl radical (OH), react with and degrade proteins, lipids and nucleic acids leading to senescence (Arora *et al*., 2002; Thompson *et al*., 1987). Increased concentrations of Malondialdehyde/Thiobarbituric Acid Reactive Substances (TBARS) indicating lipid peroxidation have been reported during senescence (Prochazkova *et al*., 2001). Treatment with ethylene and its precursor 1-aminocyclopropane- 1-carboxylic Acid (ACC) promoted flower senescence (Borochov and Woodson, 1989) that was delayed by inhibitors of ethylene synthesis (Kazemi and Shokri, 2011; Kazemi *et al*., 2011a-c). Senescence is a normal catabolic process that enables the plant to salvage and redistribute its carbon and nitrogen into growing tissues (Bleecker, 1998). However, internal senescence-inducing factors i.e., ethylene and Abscisic Acid (ABA) appear to be hormonally regulated (Thimann, 1980; Weaver *et al*., 1998). In contrast, phytohormones, such as cytokinins and in some cases Gibberellins (GA), can delay the loss of chlorophyll (Thimann, 1980). Essential Oils (EOs) are also used as flavoring agents in food industry. Numerous studies have reported the antimicrobial activity and chemical composition of essential oils (Teissedre and Waterhouse, 2000). Thyme (*Thymus vulgaris*) essential phenolic oil has been counted to have antibacterial, antimycotic and antioxidative properties (Deans and Ritchie, 1987; Deans *et al*., 1993). Salicylic acid is a plant phenol and today it is in use as internal regulator hormone, because its role in the defensive mechanism against biotic and abiotic stresses has been confirmed (Zahra *et al*., 2010). In this study, we investigated the effects of various chemical agents that reportedly affect flower longevity or senescence on floral senescence.

MATERIALS AND METHODS

Plant material: The experiment was started May 1, 2011 and chlorophyll content, vase life, Microbal population and ACC Oxidase activity were measured. This study was on the effect of some essential oils, gibberellin 4+7 (Gi) and 5-sulfosalicylic Acid (5-SSA) treatments on vase life of Argyranthemum cut flowers. Cut flowers were harvested in half-open stage from local commercial greenhouses (Mahallat, Arak, Iran), in the morning and transported with appropriate covers immediately. In this study six levels of gibberellin 4+7 (1, 2.5, 5, 7.5, 10 and 12.5 mg L^{-1} GA4+7), three levels 5-sulfosalicylic acid (1, 1.5 and 2.5 mM) and three levels of essential oils of Thyme (50, 100 and 150 mg L^{-1}) were applied in a factorial arrangement, carried out in a complete randomized design on 216 Argyranthemum cut flowers. Distilled water was used for the controls and placed in chambers at 19°C. The relative humidity was about 70% while 14 h photoperiod was maintained using fluorescent lamps with a light intensity of 15 μmol m^{-2} sec^{-1} at the top of the corolla.

Vase life: Vase life was determined as the number of days to wilting of flowers.

Chlorophyll content measurement: Total chlorophyll (a+b) content was measured by chlorophyll meter (SPAD-502, Minolta Co. Japan) which is presented by SPAD value. Average of 3 measurements from different leaves of a single leaves was considered.

Determination of anthocyanin leakage: Anthocyanin leakage was measured based on the method of Poovaiah (1979).

Determination of ACC-oxidase activity: ACC oxidase activity was assayed by measuring to the method described by Maye-Lean and John (1994).

Assays of MDA content (Lipid peroxidation): Lipid peroxidation rates were determined by measuring the malondialdehyde equivalents according to Heath and Packer (1968).

Superoxide dismutase (SOD): The activity of SOD was measured based on the method described by Beauchamp and Fridovich (1971).

Microbe population: Test microbe population were isolated from vase solutions of Argyranthemum by measuring to the method described by Zagory and Reid (1986).

Experimental design and statistical analysis: Experiment was arranged in a factorial test with complete randomized design with four replications. Analysis of variance was performed on the data collected using the General Linear Model (GLM) procedure of the SPSS software (Version 16, IBM Inc.). The mean separation was conducted by tukey analysis in the same software ($p = 0.05$).

RESULTS AND DISCUSSION

The flowers of Argyranthemum were treated with various compounds that affect flower senescence or longevity (Table 1). Solution containing Gi and 5-SSA could extend the vase life than control ($p<0.05$). Studies with nasturtium (*Tropaeolum majus* L.) suggest a relationship between GA concentration in leaves and the timing of the onset of senescence (Beevers, 1966) with concentrations of GA declining as senescence begins. Application of GAs to isolated petals of carnation has been reported to delay their senescence (Garrod and Harris 1978), while the delay in appearance of leaf chlorosis caused by GA4+7, in the current study, seems to be linked to increased concentrations of GA4+7 in leaves. However, there was no significant difference ($p<0.05$) among other treatments and control (Table 1). EOs applications had significant effect on the vase life Argyranthemum flowers ($p<0.05$). Previously, Kazemi *et al.* (2011a-c) showed that SA inhibited the ethylene production and lengthened the vaselife of cut flowers. Similarity, present result showed that, All concentrations of GA4+7 and 5-SSA delayed the senescence. Salicylic acid is a plant phenol and today it is in use as internal regulator hormone, because its role in the defensive mechanism against biotic and abiotic stresses has been confirmed. During the postharvest, EOs had no effect on retarding chlorophyll breakdown (Table 1). According to Table 1, under the influence of 5-SSA and Gi the Chlorophyll content greatly increased. Kazemi *et al.* (2011a-c), observed that chlorophyll biosynthesis increased treatment with SA in the cut flower ($p<0.05$). El-Tayeb *et al.* (2006) and Canakci (2008) found that Chl a, b and carotenoids increased significantly in SA treated plants in comparison to controls of barley plants. EOs applications had no significant effect on chlorophyll biosynthesis Argyranthemum flowers. According to Table 1, 5-SSA affected water uptake and fresh weight and microbal population significantly ($p<0.05$). Increase of 5-SSA levels caused increases in water uptake and fresh weight in vase solution of *Argyranthemum* cut flowers significantly, also the microbial population decreased with the increase in concentrations of 5-SSA and EOs (Table 1).

Table 1: Mean comparisons of chlorophyll content, Vase life, MDA, SOD activity, Membrane stability and ACC Oxidase activity in Gi, 5-SSA, Eos treatments

Treatment	Vase life (day)	Total chlorophyll (SPAD reading)	ACC Oxidase activity (nmol h^{-1} mL^{-1})	Antocyanin leakage (absorption at 525 nm)	MDA (μmol mg^{-1} protein)	Water uptake (mL per flower)	SOD (U g^{-1} protein)	Colony count (cfu mL^{-1})
Control	3	1.0	87.45	159.65	187.63	80.00	100.00	175.00
Gi (mg L^{-1})								
1	4.0	1.06	80.12	152.36	167.84	85.00	100.00	170.0
2.5	4.5	1.00	80.00	150.00	167.00	85.00	101.02	160.0
5	5.5	2.60	76.36	150.12	160.00	95.00	100.00	163.0
7.5	5.5	2.89	75.00	147.36	154.36	90.00	105.30	164.0
10	6.0	3.00	70.36	146.20	160.03	95.00	108.90	160.0
12.5	7.0	3.10	65.11	141.23	148.90	95.00	115.00	113.0
5-SSA (mM)								
1	6.0	2.54	64.80	70.12	76.36	115.00	142.36	68.0
1.5	7.0	3.15	61.36	70.00	70.12	120.00	163.20	60.0
2.5	9.0	3.96	52.36	62.36	65.39	135.00	180.92	44.0
Eos (mg L^{-1})								
50	5.5	1.02	84.15	112.00	145.60	90.00	80.17	60.0
100	6.0	1.00	86.36	110.30	150.00	85.00	96.32	55.0
150	6.5	1.45	84.00	100.00	142.36	95.00	105.36	40.0
F-test probabilities								
Gi	0.03	0.00	0.10	0.07	0.067	0.00	0.059	0.1
5-SSA	0.00	0.00	0.00	0.00	0.02	0.00	0.0	0.0
EOs	0.04	0.61	0.10	0.056	0.10	0.04	0.058	0.0

There were no significant ($p<0.05$) difference between Gi levels and control. These results are in agreement with those of (Anjum *et al*., 2001), who found that adding a suitable germicide in vase water can prevent the growth of microbes and increased water uptake. Kazemi *et al*. (2011a) showed that the treatment of salicylic acid reduced Microbial population in vase solution of *Gerbera* cut flowers and increased water uptake in cut flowers. Treatment with 5-SSA and Gi showed remarkable decreases in the Anthocyanin leakage and ACO activity as compared with the control ($p = 0.05$). EOs applications had no significant effect on the Anthocyanin leakage and ACO activity Argyranthemum flowers. These results are in agreement with those of Khan *et al*. (2003), El-Tayeb *et al*. (2006), Ansari and Misra (2007), Mba *et al*. (2007), Mahdavian *et al*. (2007), Canakci (2008), Hussein and Orabi (2008), Karlidag *et al*. (2009) and Ahmed *et al*. (2010), who found that the treatment of salicylic acid reduced anthocyanin leakage and ACO activity in cut flowers. According to Table 1, 5-SSA affected MDA content and Superoxide dismutase activity significantly. Table 1 showed that under the effect of 5-SSA treatment increased SOD activity and decreased accumulation MDA significantly in compared to control ($p<0.05$). The results indicate that the treatment by 5-SSA improved membrane permeability by increasing SOD activity and decrease accumulation MDA in compared to control. This indicates that with 5-SSA concentration increased, the SOD activity was increased. Kazemi *et al*. (2011c) showed that the treatment of salicylic acid increase SOD activity and decreased accumulation MDA significantly in cut flowers. Similarly, Reezi *et al*. (2009) showed that Si could extend the vase life of Rose cut flowers by decreasing ROS, malondialdehyde content and ethylene.

CONCLUSION

The improvement of vase life of Argyranthemum by the use of 5-SSA, Gi and EOs remained approximately for 5 days more compared with control which suggests that an extensive research work should be carried out to reach in a final conclusion for using such chemicals to enhance the vase life in Argyranthemum.

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