Effect of 1-MCP (1-methylcyclopropene) on the vase life of Chrysanthemum and Carnation cut flowers

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Summary: The effect of 1-MCP on extending the vase life of chrysanthemum and carnation cut flowers was studied. The flowering stems of both flowers were terminated to 50 cm. in height. Then, the flowers were pre-treated with 1-MCP at 0.3, 0.5 and 0.7g/m3 for 3 hours or 6 hours. The control flowers were placed in ambient air during the treatment. After the period of treatments the flowers were aerated then put in glass vials contained tap water. The vase life determination was conducted in a vase life evaluation room at 22 ± 1°C. Fresh weight determinations of the flowers were made just before the immersion of the flowers into the glasses of water and were repeated on the day when the vase life of the control flowers was terminated. The treatment of 1-MCP at 0.5g/m3 for 6 hours was the most effective treatment of chrysanthemum and carnation cut flowers.

Key words: 1-MCP: 1-methylcyclopropene, vase life of flowers, chrysanthemum, carnation

Introduction

In the last few years a fantastic development of cut flower sales and consumption has taken place throughout the world (International Association of Horticultural Producers, *Den Haag*, 2001). People all over the world love flowers and many try everything possible to prolong their life and supply the consumer with cut flowers of the best possible quality. Yet people still love cut flowers. They not only continue to buy them, but, flower consumption in many countries all over the world is rapidly increasing. The problem with whole matter of distribution is that flowers nowadays have to be transported all over the world. This means that more attention than ever is paid now, and in the future to be best possible treatments for the flower.

Flowering plants and cut flowers are often exposed to ethylene during production, transport, storage or retail marketing. Ethylene levels above 100 ppb (part per billion) may damage flowers over time periods longer than 24 hours but levels of about 250 ppb damage flowers in a short time as even 12 hours. Damaging levels of ethylene are commonly found in supermarket distribution centers and occasionally in other areas of the floral industry. Some deleterious effects of ethylene exposure include leaf yellowing, flower (or petal) drop, irregular opening and premature death. In a normal, non-contaminated atmosphere, ethylene content fluctuates between 0.003–0.005 (µl/l (3–5 ppb) changing with the seasons.(Nowak and Rudnicki 1990). Since the 1970s, the best means against ethylene has been silver thiosulfate (STS) which can at least double the vase life of cut flowers. A few drawbacks exist with STS, however, including the extra step in the postharvest process to allow for uptake by cut flowers, the timing of uptake necessary to prevent phytotoxicity, and the proper disposal of spent solutions, not to mention the many areas which are restricting the amount of silver in run-off water *(Michael* et al 1999). Researchers have therefore been seeking alternative strategies, including the use of inhibitors of ethylene biosynthesis and inhibitors of ethylene binding for preventing the undesirable postharvest effects of ethylene *(Serek* et al 1995). *Michael* et al (1999) reported that plants can be treated repeatedly with 1-MCP with no ill effects. Flowers treated at the wholesale level can also be treated at the retail store to ensure continued protection from ethylene.

Serek et al (1995) reported that pretreatment of cut carnations with 3 nl/l 1-MCP for 6 hours inhibited their normal wilting response when exposed continuously to 0.4 (µl/l ethylene. The 1-MCP treated carnations also lasted longer than control flowers when held in ethylene-free air. In addition, cut snapdragon flowers similarly treated with 1-MCP were also protected from the effects of exogenous ethylene which normally causes rapid abscission of buds and flowers. 1-MCP was at least as effective as the standard commercial treatment with the anionic silver thiosulfate (STS). *Serek* et al (1995) mentioned that the longevity of cut carnations pre-treated with1-MCP at 1 to 20 nl/l for 6 hours then exposed continuously to 0.4 µl/l ethylene increased with increasing pre-treatment concentration. They also added that the pre-treatment of 1-MCP increased the longevity of cut flowers in comparison with the control. *Porat* et al (1995) found that 6 hours pre-treatment with a volatile inhibitor of ethylene action, (1-MCP) inhibited the ethylene induced abscission of phlox flowers and hence the reduction in the number of open flowers on the stems. 1-MCP was most effective in inhibiting the ethylene response at a low concentration (25 nl/l) and had no visible toxic effects even at 500 nl/l . The effects of 1-MCP on flower abscission were comparable to that of a pulse

treatment with silver thiosulfate (STS) and it was suggested that 1-MCP may serve as an alternative to the commercial treatment of phlox flowers with (STS), the latter being an environmental hazard. *Serek* et al (1996) illustrated that 1-MCP had dramatic effects in inhibiting the ethylene stimulated abscission of buds, leaves and flowers when applied to miniature rose plants at concentrations of 100 nl/l for 6 hours.

Sisler & Serek (2001) reported that a concentration as low as 0.5 nl/l of 1-methylcyclopropene (1-MCP) is sufficient to protect carnation flowers for several days against ethylene and extended the vase life of carnation cut flowers. *Lisa* et al (2001) found that at room temperature, EthylBloc performed well on all four cut flower species tested at concentration of 0.5 g /m^3. In all cases the EthylBloc treated samples with ethylene added were at least equal to the control without ethylene. The number of snapdragon flowers remaining on the stem was reduced to almost zero when treated with ethylene without the EthylBloc. Similar results were observed for *Alstromeria* flowers. *Gypsophila* and *Delphinium* flowers treated with EthylBloc but without ethylene exposure were also superior to the controls without ethylene. The most pronounced results were observed with the *Delphinium* flowers. No flowers remained on the ethylene treated control plants 3 days after treatment and the control without ethylene had only 50% of the number of flowers present at harvest. In contrast, the flowers remained attached and the buds continued to open with EthylBloc treatment so that flower counts 3 days after treatment were 170–200% of initial counts. They concluded that EthylBloc was protecting the flowers against external ethylene as well as ethylene produced by the plant itself. *Cameron & Reid* (2001) reported that continuous exposure to 1.5 µl/l ethylene of *Pelargonium peltatum* plants caused 100 % petal abscission within 2 hours from detached flowers harvested just after the stigmatic lobes had separated. When flowering plants were first pre-treated for 2 hours with 1 µl/l 1-MCP, ethylene-induced petal abscission was completely inhibited.

1-MCP is not marketed and has been not tried in Hungary yet. The aim of this study was to do preliminary trials in order to prolong the vase life of *Chrysanthemum* and *Carnation* cut flowers by using 1-MCP.

Material and method

Plant material

Cut flowers used in the experiment were: *Chrysanthemum morifolium* RAM cv. *Suny Reagan* and *Dianthus caryophyllus* L. cv. *Asso*. The flowers were obtained from some commercial growers in Hungary who are the members of a flower association called (Virágpaletta) at commercial maturity. Flowers were brought to the laboratory of ornamental plants department, Saint Stephan University Faculty of Horticultural Sciences, Budapest as soon as possible. Lower leaves were removed and the flowering stems were trimmed to a uniform length of 50 cm for *Chrysanthemum* and *carnation* flowers.

1-MCP treatment

1-MCP (as EthylBloc) was obtained from AgroFresh Inc. Rohm and Hass company. The flowers of two crops which were treated with EthylBloc in each treatment were put horizontal inside a box which was 118×28×44cm. The box was sealed well with plastic cover and the concentrations of 1-MCP were calculated as g/m^3 (EthylBloc per cubic meters). Soon, the EthylBloc powder was weighed and placed in a test tube taped to the inside wall of the box. Since a significant percentage of 1-MCP is released immediately after addition of water, the box was first sealed, and then, water was injected into the test tube (just enough to cover the powder for each treatment). The treatment of 1-MCP was conducted at 19 °C for all treatments. The control flowers were placed in ambient air during the treatment. Every cut flower crop was tested for the following treatments:

Control for 3h (flowers were placed in ambient air during the treatment).

1-MCP at 0.3 g / m^3 for 3h

1-MCP at 0.5 g / m^3 for 3h

1-MCP at 0.7 g / m^3 for 3h

Control for 6h (flowers were placed in ambient air during the treatment).

1-MCP at 0.3 g / m^3 for 6h

1-MCP at 0.5 g / m^3 for 6h

1-MCP at 0.7 g / m^3 for 6h

Three replications of five flowers each were used per treatment in each experiment. Statistical analyses were performed by using SPSS program. Differences between means were compared by using Post Hoc test and LSD values were calculated at 0.05 level.

Vase life determination

After the treatments the flowers were aerated and then were placed into glass vials containing tap water. The height of the water in each glass was about 5 cm. The longevity of 1-MCP pre-treated and control flowers was determined in a vase life evaluation room at 22 ± 1°C.

Determination of vase life for chrysanthemum

Wilting of leaves was used as the criterion for the termination of the vase life of chrysanthemum flowers. Visual rating of leaf senescence was evaluated periodically during the vase life of flowers. Evaluation was based on a scale ranging from 1 to 4 when: 1 = entirely green leaves, 2 = initiation of wilting in 25% of leaves, 3 = wilting in

25–50% of leaves, 4 = wilting in 50–100% of leaves. The longevity of chrysanthemum cut flowers was defined as the number of days in vase life required for 50% of the flowers to reach stage 2 or advanced stages.

Determination of vase life for carnation

The flowers of cut carnation was used as the criterion for the termination of the vase life of the flowers. Visual rating of flowers was evaluated on a scale from 1 to 4 when: 1 = entirely white flowers, 2 = initiation of darkening (wilting) in 20% of petals, 3 = darkening in 20–50% of petals, 4 = darkening in 50–100% of petals. The longevity of carnation cut flowers was defined as the number of days in vase life required for 50% of the flowers to reach stage 2 or advanced stages.

Fresh weight measurements

Fresh weight determinations of the flowers were made just before the immersion of the flowers into the glasses of water and were repeated on the day when the vase life of the control flowers was terminated. The flowers were taken out of water for as short a time as possible (20–30s). The fresh weight of each flower was expressed relative to the initial weight to represent the % of weight loss .

Results

Chrysanthemum cut flowers

Leaves of cut chrysanthemum flowers deteriorated earlier than inflorescences. It means that it played the main role in determining postharvest quality rather than the inflorescences themselves, which is the case in other cut flower species *(Petridou* et al, 2001).

All pre-treatments of EthylBloc used extended the vase life of cut chrysanthemum flowers compared to the control *(Table 1)*.The treatment of 1-MCP at 0.5 g/m^3 for 6h., was the most effective in prolong the vase life (21.3 days) as well as maintaining leaf turgor, by keeping fresh weight losses to a minimum (1.2%) compared to the control which gave 8.3 days for the vase life and 17.2% loss of fresh weight *(Table 1* and *Figure 1)*.

Table 1 Effect of 1-MCP on the vase life and % loss of initial weight of *Chrysanthemum morifolium* RAM cv. Suny Reagan

Treatments		Vase life (days)	% loss of initial weight
Control	3h	8.3	17.2
1-MCP 0.3 g/m^3	3h	13.3	10.2
1-MCP 0.5 g/m^3	3h	17.7	7.2
1-MCP 0.7 g/m^3	3h	18.7	4.7
Control	6h	8.7	17.7
1-MCP 0.3 g/m^3	6h	19.7	3.2
1-MCP 0.5 g/m^3	6h	21.3	1.2
1-MCP 0.7 g/m^3	6h	19.3	3.6
LSD 0.05		1.7	2.3

Figure 1 *Cut chrysanthemum flowers prefreated with 0.5 g/m^3 1-MCP for 6h comparing to control*

Carnation cut flowers

Data in *Table 2* show that pre-treatment with 1-MCP at all concentrations increased the vase life of carnation cut flowers. A 6h pre-treatment with 1-MCP, an inhibitor of ethylene action, at 0.5 g/m^3 gave the best results in this concern. The control flowers wilted 7.3 days after the start of the experiment, and flowers treated with 1-MCP at 0.5 g/m^3 for 6h lasted for 12.3 days. Also, this treatment resulted in a minimum loss in fresh weight of flowers (1.6%) comparing with control or other treatments *(Table 2* and *Figure 2)*.

Table 2 Effect of 1-MCP on the vase life and % loss of initial weight of *Dianthus caryophyllus* L.cv.Asso.

Treatments		Vase life (days)	% loss of initial weight
Control	3h	7.3	8.9
1-MCP 0.3 g/m^3	3h	10.0	2.9
1-MCP 0.5 g/m^3	3h	11.0	2.4
1-MCP 0.7 g/m^3	3h	10.7	2.7
Control	6h	7.0	9.1
1-MCP 0.3 g/m^3	6h	11.7	1.7
1-MCP 0.5 g/m^3	6h	12.3	1.6
1-MCP 0.7 g/m^3	6h	11.3	2.4
LSD 0.05		1.2	1.9

Figure 2 *Cut carnation flowers pretreated with 0.5 g/m^3 1-MCP for 6h comparing to control*

Discussion

From the previous results it could be concluded that pretreatment of Chrysanthemum and Carnation cut flowers with 1-MCP produced prolonged vase life of both cut flower crops. These results could be attributed to the role of 1-MCP as an inhibitor of ethylene biosynthesis as well as ethylene binding and consequently preventing the undesirable postharvest effects of ethylene as reported by *(Serek* et al 1995). Also, *Serek* et al (1995) reported that pretreatment of cut carnations with 3 nl/l 1-MCP for 6 hours inhibited their normal wilting response when exposed continuously to 0.4 µl/l ethylene. The 1-MCP treated carnations also lasted longer than control flowers when held in ethylene-free air. In addition, cut snapdragon flowers similarly treated with 1-MCP were also protected from the effects of exogenous ethylene which normally causes rapid abscission of buds and flowers. Similar findings were obtained by *Sisler & Serek* (2001) who reported that as low a concentration as 0.5 nl/l of 1-methylcyclopropene (1-MCP) is sufficient to protect carnation flowers for several days against ethylene and extended the vase life of carnation cut flowers. In addition, *Lisa* et al (2001) found that at room temperature, EthylBloc performed well on all four cut flower species tested at concentration of 0.5 g/m^3.

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