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Prolonging the vase life of cut Carnation 'GIOKO' by using different chemicals

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Summary: Cut flowers of *Dianthus caryophyllus* L. cv. GIOKO were treated with different concentrations of sucrose and in combination with 1-methylcyclopropene (1-MCP) to compare the effect of these treatments with floral preservative ('Spring') on the longevity of flowers. Distilled water was used for preparing all solutions. The control flowers were held in distilled water. Clorox at 2 mL^{-1} was added to all treatments containing sucrose and it was also applied as a separate treatment. The vase life of cut carnations was significantly prolonged due to the use of chemical treatments, as compared to the untreated control. The longest vase life (18.33 days) was obtained by using 1-MCP 0.5 g m^{-3} for 6 h treatment. All concentrations of sucrose had a positive effect on flower diameter. The best treatment in this respect was 1-MCP with 30 gL^{-1} sucrose. 1-MCP treatment significantly increased the chlorophyll content, as compared to the control or the "Spring" treatment. The highest values in this respect were obtained by 1-MCP treatment alone or with the lowest level of sucrose. The effect of these treatments on the pH of solutions is discussed.

Key words: carnation, vase life, chlorophyll, sucrose, Clorox, 1-MCP

Introduction

Carnation (*Dianthus caryophyllus* L.) is still one of the mainstays of the cut flower industry. It is among the most popular florist crops that grow naturally in many parts of the world. In addition, there is a considerable competition among carnation producers (*AIPH*, 2005). Therefore, it is very important to ensure the longest vase life of the flowers. There are different factors affecting the vase life of cut flowers: such as carbohydrate content, blockage of xylem vessels and ethylene. Carnation flowers are sensitive to ethylene. Cut flowers produce small amounts of ethylene just after harvest, whereas there is a sharp increase in the ethylene production, a few days after harvest. Some deleterious effects of ethylene exposure include leaf yellowing, flower (or petal) drop, irregular opening and premature death. Because of these harmful phenomena it is important to control the effect of ethylene production during the post harvest life of cut flowers.

One of the most common chemicals used in floral industry against ethylene is the STS (silver thiosulphate) (*Menguc & Usta*, 1994, *Altman & Solomos*, 1995, *Hassan & Schmidt*, 2003). Due to its STS content of silver and being an environmental pollutant its use is banned in a range of countries, mainly in the EU. An alternative, 1-MCP (1 methylcyclopropene) was used in the last years as an inhibitor of ethylene biosynthesis and binding for preventing the undesirable postharvest effects of ethylene. 1-MCP treatments improved the vase live and postharvest quality of various cut flowers (*Sisler & Serek*, 1997, 1999, 2001, *Hassan & Gerzson*, 2002; *Hassan* et al., 2004). There is another floral preservative compound ('Spring') widely used in floral industry for prolonging the vase life of cut flowers. Sucrose treatment also led to an increase in vase life and improved the quality of various cut flowers (*Eason* et al 1997; *Jen* et al., 2000; *Kwon & Kim*, 2000; *Beura* et al., 2001; *Hassan & Schmidt*, 2004).

From the review of the special literature it can be seen that there were experiments on combinations between 1-MCP and sucrose. Similarly, no comparison has been made between 'Spring' and 1-MCP. Based on these findings, the aim of our research was to compare the effect of 1-MCP and 'Spring' on carnation cut flowers c.v. GIOKO, with or without sucrose addition.

Materials and methods

White and large cut flowers of *Dianthus caryophyllus* L. cv. GIOKO were used in this experiment. The flowers were supplied by a commercial grower in Hungary. Flowers were harvested in March and April 2008 and transported to the laboratory of the Department of Floriculture and Dendrology, Faculty of Horticultural Sciences, Corvinus University of Budapest, right after harvest. Lower leaves were removed and the flowering stems were trimmed to a uniform length of 45 cm.

The floral preservative'Spring' was used at 10 gL^{-1}, the recommended dose by manufacturer. 1-MCP (as EthylBloc) was obtained from AgroFresh Inc. Rohm and Haas Company and used at 0.5 g m^{-3} for 6 h at 20 °C, as recommended for carnations on the basis of our previous experiments (Hassan et al. 2004). After the treatment the flowers were put in distilled water. Sucrose was used at 10, 20, 30, 40 and 50 gL^{-1} separately or in combination with 1-MCP. Distilled water was used for preparing all solutions. The control flowers were held in distilled water. Clorox at 2 mlL^{-1} was added to all treatments containing sucrose and it was also applied as a separate treatment. Four replications of five flowers each were used per treatment. The cut flowers were arranged in a complete randomized block design with the following treatments:

1. Distilled water (control)
2. 'Spring' 10 gL^{-1}
3. Clorox 2 mlL^{-1}
4. Clorox 2 mlL^{-1} + 10 gL^{-1} sucrose
5. Clorox 2 mlL^{-1} + 20 gL^{-1} sucrose
6. Clorox 2 mlL^{-1} + 30 gL^{-1} sucrose
7. Clorox 2 mlL^{-1} + 40 gL^{1} sucrose
8. Clorox 2 mlL^{-1} + 50 gL^{-1} sucrose
9. 1-MCP 0.5 g m^{-3} for 6 h
10. Clorox 2 mlL^{-1} + 1-MCP+ 10 gL^{-1} sucrose
11. Clorox 2 mlL^{-1} + 1-MCP+ 20 gL^{-1} sucrose
12. Clorox 2 mlL^{-1} + 1-MCP+ 30 gL^{-1} sucrose
13. Clorox 2 mlL^{-1} + 1-MCP+ 40 gL^{-1} sucrose
14. Clorox 2 mlL^{-1} + 1-MCP+ 50 gL^{-1} sucrose

Visual rating of carnation cut flowers was carried out on a scale from 1 to 4 where: 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 flowers was defined by the number of days in vase life required for 50 % of the flowers to reach stage 2 or more advanced stages. The longevity of flowers was determined in the laboratory at normal day light at 21–23 °C and 70–80 RH.

The chlorophyll analyses were carried out by a Konica Minolta SPAD-chlorophyll meter, 502 type. The chlorophyll content of the calyx was measured. The pH measurements were made with an Jenway 3510 pH Meter. The diameter of flowers was also measured.The photographs were taken with a digital camera Panasonic Lumix FZ-8.

Results

Vase life. The vase life of cut carnations was significantly prolonged as a result of all chemical treatments, as compared to the untreated control. Increasing the level of sucrose decreased the vase life whether sucrose was applied alone or in combination with 1-MCP. In addition, Clorox had a positive effect on the vase life. The longest vase life (18.33 days) was observed by using 1-MCP 0.5 g m^{-3} in the 6 hrs treatment. There were no significant differences between 'Spring', 1-MCP + 10 gL^{-1} sucrose and 1-MCP+ 20 gL^{-1} sucrose treatments, which resulted in 17.66, 17.33 and 17.11 days, respectively (Table 1 and Fig. 4).

Flower diameter. The flower diameter of carnation cut flowers was increaing with the time until the 6^{th} day, then a decline was observed. All concentrations of sucrose had a positive effect on flower diameter. The best treatment in this respect was the 1-MCP with 30 gL^{-1} sucrose treatment. The differences were significant in comparison with the untreated control (Fig.1 A and B).

Chlorophyll content. Examining the chlorophyll content of the flower calyx,a positive effect was observed. 1-MCP treatment significantly increased the chlorophyll content as compared to the control or 'Spring' treatment. The highest values in this respect were obtained by 1-MCP treatment alone or with the lowest level of sucrose (Fig. 2 A and B)

pH measurement. The pH values of solutions for all treatments were gradually decreasing until the 10^{th} day, except for the control and 1-MCP treatments. Clorox had the highest pH of a treatment, while the lowest 'Spring''s. Both of their pH decreased mildly in the course of the experiment. The final value of every treatment was lower, than which was measured on the 3^{th} day, except for the two treatments, mentioned above. Generally, the 1-MCP had no effect on the change of the pH values (Fig. 3 A and B).

Table 1. Effect of different chemical treatments on the vase life of carnation cut flowers

Treatments	Vase life (Days)
Distilled water (control)	8.66 g
'Spring' 10 glL^{-1}	17.66 b
Clorox 2 mlL^{-1}	15.54 c
Clorox 2 mlL^{-1} +10 gL^{-1} sucrose	14.66 c
Clorox 2 mlL^{-1} + 20 gL^{-1} sucrose	12.55 e
Clorox 2 mlL^{-1} + 30 gL^{-1} sucrose	12.33 e
Clorox 2 mlL^{-1} + 40 gL^{-1} sucrose	10.66 f
Clorox 2 mlL^{-1} + 50 gL^{-1} sucrose	9.88 f
1-MCP 0.5 g m^{-3} for 6 h	18.33 a
Clorox 2 mlL^{-1}+ 1 – MCP+ 10 gL^{-1} sucrose	17.33 b
Clorox 2 mlL^{-1}+ 1 – MCP+ 20 gL^{-1} sucrose	17.11 b
Clorox 2 mlL^{-1}+ 1 – MCP+ 30 gL^{-1} sucrose	14.66 c
Clorox 2 mlL^{-1}+ 1 – MCP+ 40 gL^{-1} sucrose	14.33 d
Clorox 2 mlL^{-1}+ 1 – MCP+ 50 gL^{-1} sucrose	12.33 e

Means followed by different letters differ significantly for each other according to Duncan multiple range test at $P = 0.05$..

Discussion

Extending the vase life of carnation cut flowers by using 1-MCP could be attributed to the role of 1-MCP as an inhibitor of ethylene biosynthesis, as well as to ethylene binding and subsequent inhibition of the undesirable postharvest effects of ethylene (*Serek* et al., 1995; *Sisler* et al., 1996), Fig. 4. As regards the role of sucrose, it is well known that sugar supply increases the longevity of many cut flowers. While sucrose can act as a source of nutrients for

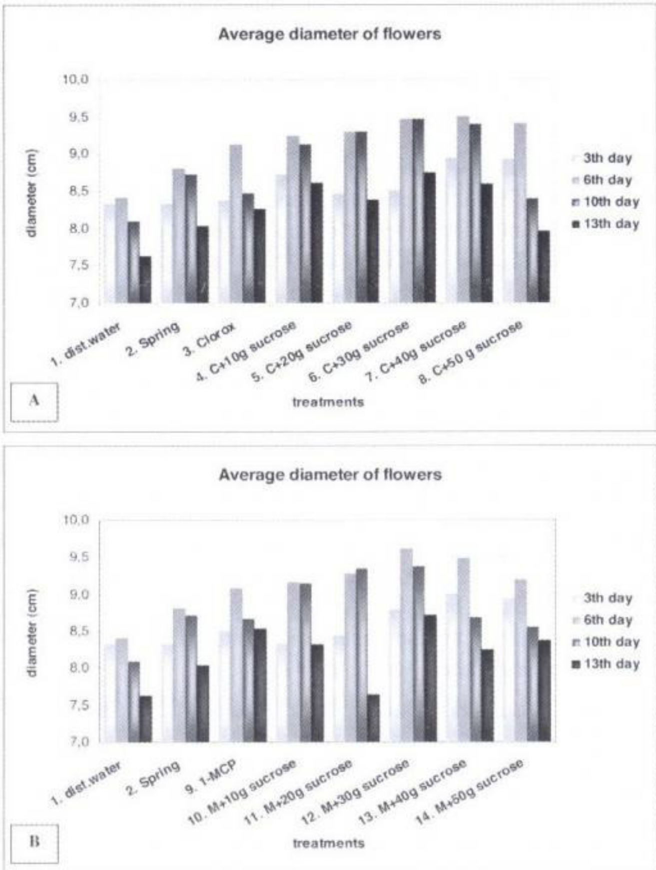

Figure 1. The effect of chemical treatments on the flower diameter of carnation cut flowers during the shelf life. A) The effect of sucrose treatments compared to control, 'Spring' and Clorox. B) The effect of 1-MCP alone or in combination with sucrose treatments compared to control and 'Spring'.

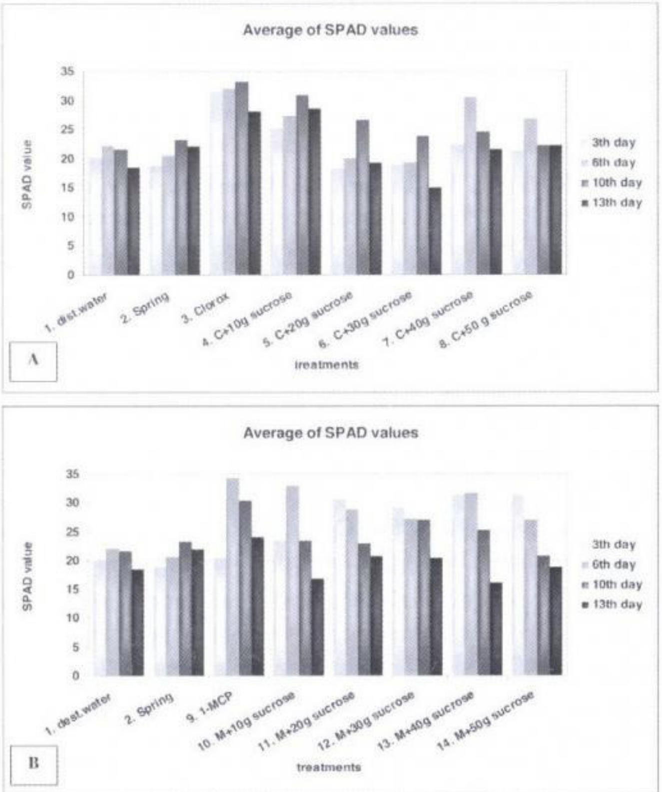

Figure 2. The effect of chemical treatments on the chlorophyll content of flower calyx of carnation cut flowers during the shelf life. A) The effect of sucrose treatments compared to control, 'Spring' and Clorox. B) The effect of 1-MCP alone or in combination with sucrose treatments compared to control and 'Spring'.

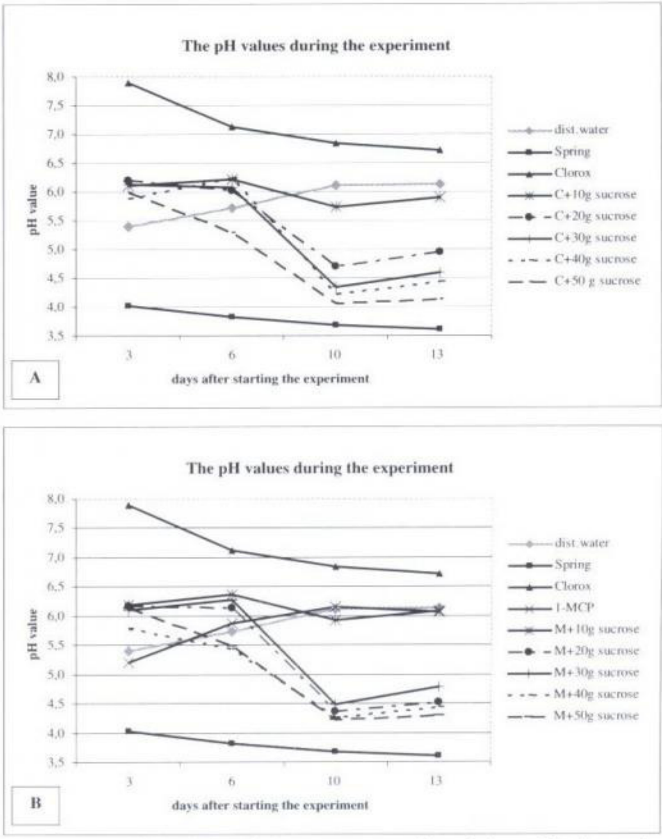

Figure 3. The effect of chemical treatments on the solutions pH of carnation cut flowers during the shelf life. A) The effect of sucrose treatments compared to control, 'Spring' and Clorox. B) The effect of 1-MCP alone or in combination with sucrose treatments compared to control and 'Spring'.

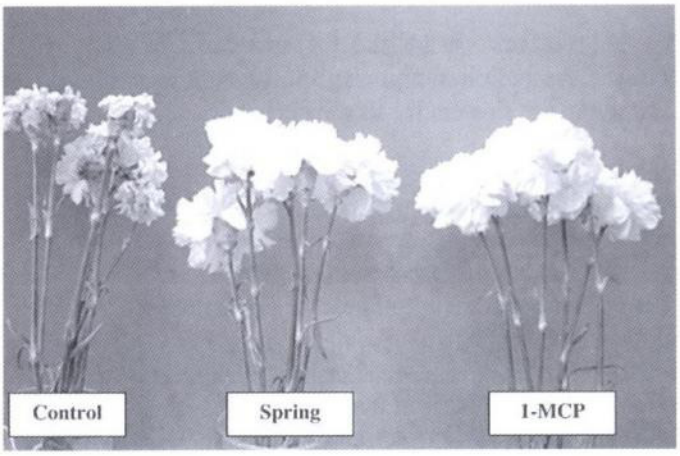

Figure 4. Effect of 'Spring' and 0.5 g m^{-3} for 6 h 1-MCP compared with the untreated control. The photo was taken 17 days after the beginning of the evaluation.

tissues approaching carbohydrate starvation, it may also act as an osmotically active molecule, thereby having a role in flower opening and subsequent water relations (*Kuiper* et al., 1995). Similar findings were obtained by *Erin* et al. (2002) who found that vase solutions containing sugar can improve the vase life of many cut flower crops.

The flower diameter was increased until full bloom as shown in Fig. (1 A and B), whereas subsequently a decrease was observed. The positive effect of 1-MCP and sucrose combination on flower opening may reflected by the highest values in this respect. The positive role of 'Spring', sucrose and 1-MCP on keeping the freshness of flowers may be reflected byi the increase in the chlorophyll content. Consequently, by retarding the chlorophyll degradation this process may lead to the increase of vase life. In the same context , *Celikel & Reid* (2002) reported that, even in the absence of exogenous ethylene, the life of the flowers was significantly increased by inhibiting ethylene action using 1-MCP pretreatment wit.

Similar results were obtained by Sisler and Serek (2001) who reported that 1-MCP treatment protected carnation flowers for several days against ethylene and consequently, the vase life were extended. Also, the 1-MCP at 0.5 g m^{-3} treatment for 6 hrs extended the vase life and improved the quality of different cut flowers (*Hassan & Gerzson*, 2002; *Hassan & Schmidt*, 2003, 2004). On the other hand, 1-MCP had no effect on the pH of the solution because this is a gas and therefore its mode of action is different from the other floral preservatives or sucrose treatments. Therefore, the values of Clorox solutions is higher than those of 1-MCP. On addition of sucrose to the 1-MCP treatment the values were reduced.

It can be concluded that 1-MCP alone or in combination with sucrose has a positive effect in both prolonging vase life and improving the postharvest quality of carnation cut flowers c.v. GIOKO. This treatment iswas superior to the single application of floral preservative 'Spring'.

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