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Chemical Treatments of *Eustoma* Cut Flower Cultivars for Enhanced Vase Life

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ABSTRACT

Effects of some chemical treatments (continuous methods) on two cultivars of eustoma (*Eustoma grandiflora* Mariachii. cv. Blue & *E. grandiflora* Maraichii. cv. Cream) cut flowers were studied. Cut flowers were kept in vases containing 2.5% sucrose solutions supplemented with aluminum sulfate (100, 150 & 200 ppm), 8-hydroxyquinoline citrate (200, 300 & 400 ppm), ethanol (2, 4 & 6%), cobalt chloride (200, 300 & 400 ppm), copper sulfate (100, 150 & 200 ppm), citric acid and aluminum sulfate (150 ppm each) and water (no chemical treatment). The vases were placed in chambers at 25°C, relative humidity about 70% and 14 h photoperiod maintained using fluorescent lamps (light intensity of 15 µmol m^{-2} s^{-1}) at the top of the corolla. Determinations were made for vase life, corolla fresh weight, ethylene production rate, solution uptake and analyzed statistically. Data revealed differential responses of both the cultivars to chemical treatments. Copper sulfate at 100 ppm and 8-hydroxyquinoline citrate at 300 ppm concentrations in sucrose were the most effectiveness in blue and cream eustoma cultivars, respectively in enhancing vase life and keeping quality.

Key Words: Eustoma cultivars; Vase life; Chemical treatments; Fresh weight; Water uptake

INTRODUCTION

Prolonged vase life is one of the most important factors for quality of cut flowers. Senescence of cut flowers is induced by several factors e.g., water stress (Sankat & Mujaffar, 1994), carbohydrate depletion (Ketsa, 1989), microorganisms (van Doorn & Witte, 1991) and ethylene effects (Wu *et al.*, 1991). A major cause of deterioration in cut flowers is blockage of xylem vessels by microorganisms that accumulate in the vase solution or in the vessels themselves. For many years, floral preservatives have been acidified and have usually included biocides to inhibit bacterial proliferation (Nowak & Rudnicki, 1990). Ethylene has long been associated with abortion, abscission and premature death of buds and flowers of many plant species. For sensitive species, C_2H_4-induced senescence and abscission of flowers may result from endogenous production of C_2H_4 or from exposure to exogenous C_2H_4 (Kim *et al.,* 2005). Ethylene production of cut Eustoma flowers increased with flower senescence and treatment with silver thiosulphate (STS), an ethylene action inhibitor, extended flower longevity (Ichimura *et al*., 1999). Flowers that are sensitive to ethylene are often pulse-treated soon after harvest with silver ion, applied as STS to delay senescence (Van Doorn & Woltering, 1991; Song *et al*., 1996). However, it contains silver, which is a possible environmental pollutant. Ethanol has been found to be effective in increasing the vase life of carnation flowers by inhibiting ethylene biosynthesis (Wu *et al*., 1992; Pun *et al*., 1999) as well as its action (Wu *et al*., 1992).

Sucrose alone has not been usually used, because sugar treatment without germicides promotes bacterial proliferation, leading to shortening of the vase life. For flower opening, large amount of soluble carbohydrates is required as the substrate for respiration and synthetic materials as well as osmolytes. Some vase solutions including sucrose extend the vase life of cut flowers (Kuiper *et al*., 1995; Ichimura & Korenaga, 1998; Han, 2003). Floral preservative solution containing aluminum sulfate at 150 mg L^{-1} under 25°C, extended cut eustoma (*Eustoma grandiflorum* Shinn. cv. Hei Hou) vase life (Liao *et al*., 2001). The effect of other chemical treatment in increasing vase life of some cut flowers has been suggested by many authors (Saradhi & Ram, 1989; Ichimura & Korenaga, 1998; Van Meeteren *et al*., 2000). Therefore, the vase life varied among various cultivars in carnation (Wu *et al.*, 1991; Onozaki *et al*., 2001) and gerbera (Wernett *et al.*, 1996). The purpose of the present study was determining cultivar responses of eustoma cut flowers to different chemical treatments in order to increase their post-harvest vase life of eustoma cut flowers.

MATERIALS AND METHODS

Experimental details. In order to study the effect of aluminum sulfate (100, 150 & 200 ppm), 8-hydroxyquinoline citrate (200, 300 & 400 ppm), ethanol (2, 4 & 6%), cobalt chloride (200, 300 & 400 ppm), copper sulfate (100, 150 & 200 ppm) and 150 ppm each of citric acid and aluminum sulfate on vase life and some quality attributes of Eustoma (*Eustoma grandiflorum* Mriachii cv. Blue & *E. grandiflorum* Mriachii cv. Cream) cut flowers, a study was conducted on the base of factorial design with two cultivars in three replications. Cut flower stems (40 cm long) of *Eustoma* were placed in solutions containing different chemicals. Four cut flowers, each cut stem contained 1 - 2 flowers, were placed in a 500 mL flask with 400 mL of solution. Distilled water was used for the controls. In all treatments, except controls, 2.5% sucrose was used and the flasks placed in chambers at 25°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} s^{-1} at the top of the corolla. Data were statistically analyzed using SAS software.

Physiological determinations. The vase life of cut flowers was completed when the petals or stem below the flower head lost turgidity. For measurement of ethylene production in flowers, one flower was sealed in a 300 mL flask vessel. All vessels were sealed and kept at 25°C. After 2 h., 1 mL gas samples were withdrawn with a hypodermic syringe for ethylene determination. Ethylene content was measured using a Shimadzu Gas Chromatograph equipped with an activated alumina column fitted with a flame ionization detector. Nitrogen was used as a carrier gas. Measurements were repeated three times. Ethylene production was calculated as mL g^{-1} h^{-1}. The water uptake was calculated by subtracting the volume of water evaporated from a flask of the same volume without cut flowers.

RESULTS

Vase life. Two cultivars showed different reaction to chemical treatments. Vase life was significantly grater in blue cultivar (Fig. 1). Copper sulfate at 100 ppm concentrations along with 2.5% sucrose was the most effectiveness in enhancing vase life of blue cultivar (23 days) although 8-hydroxyquinoline citrate at 300 ppm concentration was better for cream cultivar. Flower stems kept in water containing different chemicals had significantly increased vase life relative to the water control for all concentration (Fig. 2).

Fresh and dry weight. Fresh weight of cut flowers in all treatments increased initially and declined later. In blue cultivar from 3 days of vase life, fresh weight of cut flowers decreased for control. In 100 and 150 ppm copper sulfate, fresh weight of cut flowers increased up to 9 days and decreased for 150 ppm copper sulfate and constant to 12 days for 100 ppm copper sulfate (Fig. 3). In cream cultivar fresh weight of cut flowers increased up to 3 days and decreased for all concentrations except HQC 300 ppm. In this concentration fresh weight of cut flowers increased up to 6 days and then decreased (Fig. 4). Dry weight of leaves in blue cultivar was significantly lower than the other at all various chemical treatments vase solutions control (Fig. 5).

Water uptake. Both the cultivars differed significantly for this attribute. However average of water uptake, from beginning treatment to control flower wilting, in blue cultivar was significantly greater than others (Fig. 6).

Ethylene production. Treatment with chemical treatment in sucrose solution decreased ethylene production in all concentrations. Reciprocal effects of cultivars and treatments had no significant (data not shown). Highest means of ethylene production was found in cream cultivar (Fig. 7).

Percentage of flowers and buds bending. Percentage of flowers and buds bending were significantly lower in blue cultivar than the other (Fig. 8).

Table I. Chemical treatments that have been shown by number in the sub figure

Chemical treatment	Number	Chemical treatments	Number
Ethanol 2%	1	8-hydroxyquinoline citrate 200 ppm	10
Ethanol 4%	2	8-hydroxyquinoline citrate 300 ppm	11
Ethanol 6%	3	8-hydroxyquinoline citrate 400 ppm	12
Cobalt chloride 200 ppm	4	Aluminum sulfate 150 ppm + Citric acid 150 ppm	13
Cobalt chloride 300ppm	5		
Cobalt chloride400 ppm	6	Cupper sulfate 100 ppm	14
Aluminum sulfate 100 ppm	7	Cupper sulfate150 ppm	15
Aluminum sulfate 150 ppm	8	Cupper sulfate 150 ppm	16
Aluminum sulfate 200 ppm	9	Control	17

Fig. 1. Average of vase life of two cultivars. Means followed by the same letter are not significantly different at 1% level, using DMRT

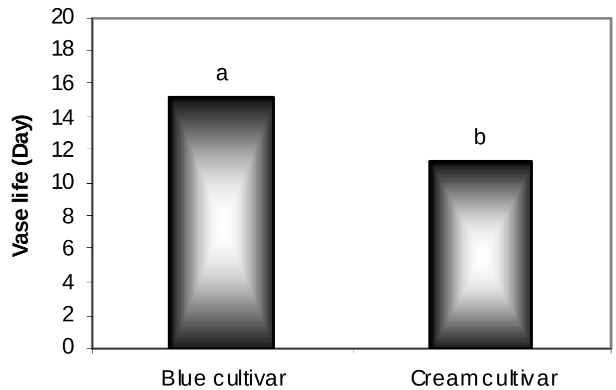
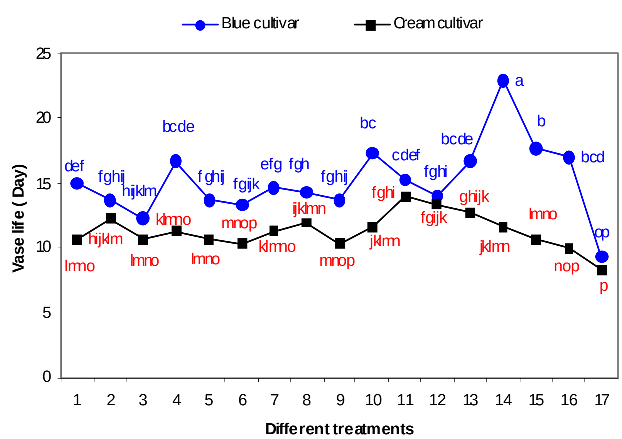


Fig. 2. Comparer effect of various chemical treatments vase solutions on the vase life of two cultivars. *Means followed by the same letter are not significantly different at 1% level, using DMRT



DISCUSSION

In the present study, we found that the vase life of cut Eustoma markedly varied among 2 cultivars; the vase life

Fig. 3. Effect of various copper sulfate-containing vase solutions on the average of fresh weight during vase life in blue cultivar

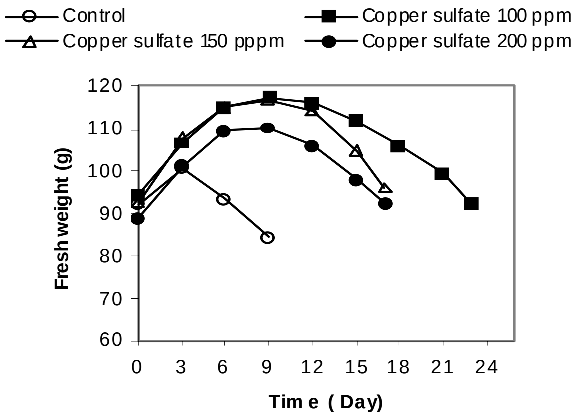


Fig. 4. Effect of various HQC-containing vase solutions on the average of fresh weight during vase life in cream cultivar

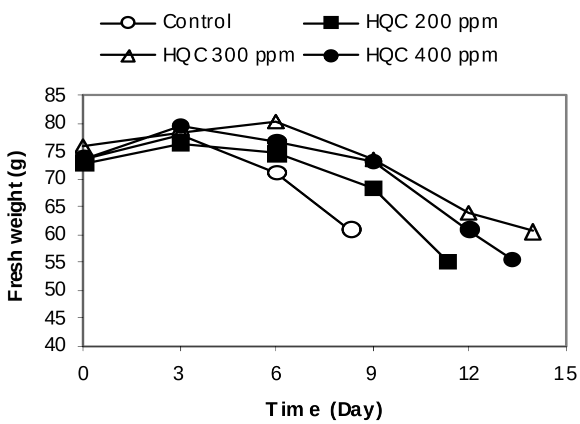


Fig. 5. Average of dry weight of two cultivars. Means followed by the same letter are not significantly different at 1% level, using DMRT

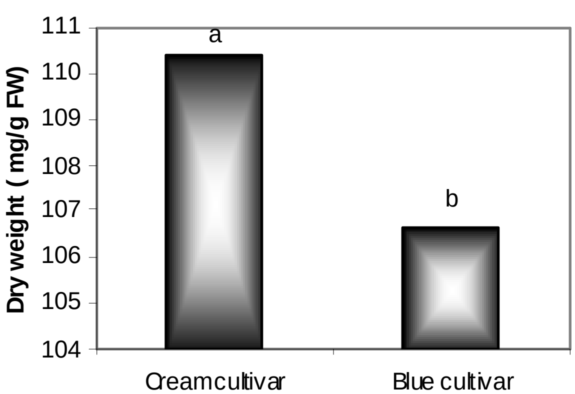


Fig. 6. Average of water uptake of two cultivars. Means followed by the same letter are not significantly different at 1% level, using DMRT

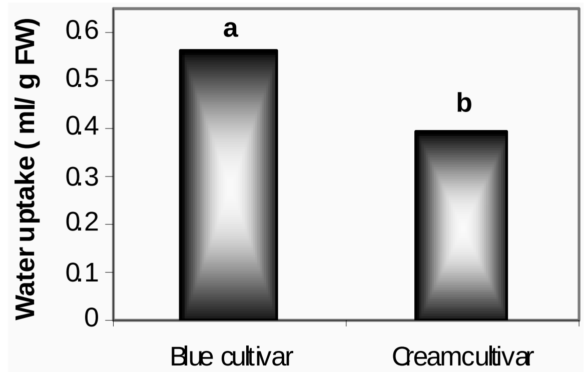


Fig. 7. Average of ethylene production of two cultivars. Means followed by the same letter are not significantly different at 1% level, using DMRT

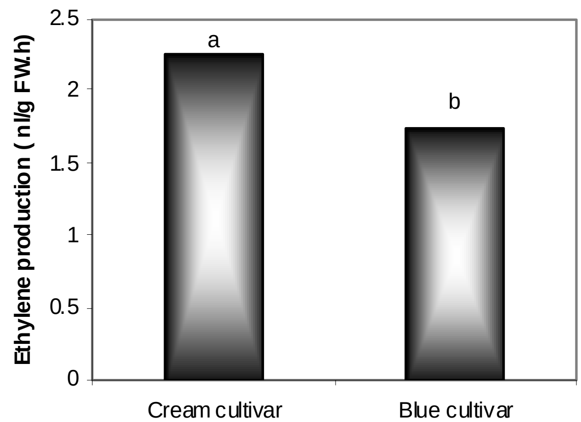
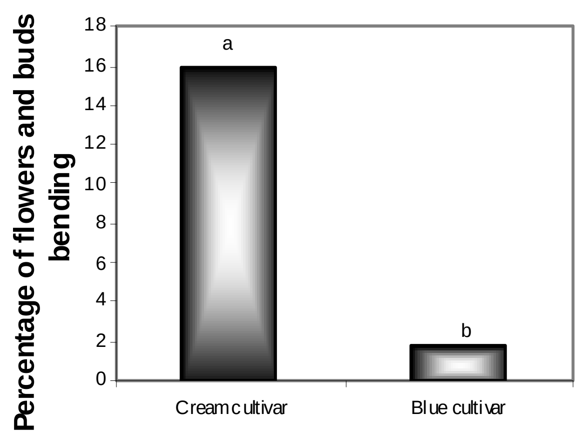


Fig. 8. Average of percentage of flowers and buds bending in two cultivars. Means followed by the same letter are not significantly different at 1% level, using DMRT



was shorter in cream cultivar (Fig. 1). It has been suggested that use of disinfectants improve water conductance by preventing bacterial growth and producing occlusions (Van Doorn, 1998). In addition to HQS, many germicides, such as silver nitrate, aluminum sulfate, copper sulfate, cobalt chloride atc have been shown to inhibit bacterial growth in cut flower stems (Van Doorn, 1997; Van Meeteren, 2000). Whether these chemicals are effective for various cultivars needs to be examined. We found that two cultivars of Eustoma cut flowers not only have different vase life, what also show different reaction to chemical treatments (Fig. 2). It was suggested that uptake of different solution (Ichimura *et al*., 2002), ethylene production (Branadt & Woodson, 1992) carbohydrate (Ketsa, 1989) and transpiration (Ichimura *et al*., 2002) between cultivars could be the causes of variation in vase life. It is reported that cut flowers of 'Madelon' rose do not open completely (Van Doorn & Witte, 1991; Kuiper *et al.*, 1995). Shortage of soluble carbohydrates is involved in this phenomenon (Ichimura *et al.,* 2002). Result showed that variation in water uptake and ethylene production between two cultivars of Eustoma cut flowers were main cause of differences in vase life. Higher water uptake in blue cultivar allowed more increase in fresh weight, mainly due to better corolla development (Fig. 3 & 4). Ichimura and Hiraya (1999) reported that treatment with sucrose extends the vase life of florets harvested at a bud stage. Cut flowers treatment with sugars increases the availability of respirable substrates (Da Silva, 2003), delay the onset of hydrolysis of structural cell components (Donoghue *et al.*, 2002), decrease ethylene production and sensitivity (Pun *et al.*, 2005). Treatment with sucrose in combination with chemical treatments extends the vase life of cut Eustoma flowers. This effect is due to supply of carbohydrates as well as inhibition of vascular occlusion by chemical treatments.

In conclusions present studies have reconfirmed the role of chemical treatments along with sucrose for increasing the vase life of Eustoma flowers. For using this results in other cultivars more experiments should be conducted.

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