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The Effects of Different Floral Preservative Solutions on Vase life of Lisianthus Cut Flowers

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Abstract

Two factorial experiments were conducted to study the interactive effects of four levels of sucrose (0, 20, 40 and 60 g l^{-1}), two levels of citric acid (0 and 160 mg l^{-1}) and two levels of one of the following compounds (aluminum sulphate, 0 and 160 mg l^{-1} and silver nitrate, 0 and 120 g l^{-1}) on vase life and quality attributes of lisianthus cut flowers 'Mariachi blue fonce.' The experiments carried out a randomized complete block design with three replications. After 34 days of storage at 20± 2 °C the amount of water absorption, relative water content and opened flower buds were determined. According to the results application of 60 g l^{-1} sucrose in combination with citric acid led to the highest vase life (31 days). The highest relative water content (82.37%) and also the highest percentage of opened flower buds were obtained in flowers treated with 60 g l^{-1} sucrose and 160 mg l^{-1} aluminum sulphate.

Keywords: Aluminum sulphate, Citric acid, Relative water content, Silver nitrate, Sucrose, Vase life.

INTRODUCTION

Lisianthus (*Eustoma grandiflorum*) from Gentianaceae family is from wild flowers of north and west America. It is native of Nebraska, Colorado and Texas. Another names of lisianthus are 'Parirgentiane', 'Eustoma' and 'Texas Blue Bell' which the scientific name obtained from 'Eustoma' (Reid, 2009). Lisianthus in horticulture known both as indoor ornamental pot plant and cut flower. At present, there are in different color and shape and it is grown as cut flower in wide parts of the world. There are about 10 hactare of orchards under lisianthus in England. U.S.A, Netherland, Isreal, Kenia, Tanzania and Japan are major producers of this plant (Ohkawa & Sasaki, 1999). In recent decade, lisianthus as a cut flower increasingly known in all over the world (Reid, 2009) and because of their similarity with rose and more vase life than rose, had been located in 10 major cut flowers of the world.

Treatment of cut flowers with 2% sucrose, increases anthesis and develops color, remarkably (Ichimura & Korenaga, 1998).

The effect of $Al_2(SO_4)_3$ (50, 100 and 150 mg l^{-1}) had been tested on lisiantus vase life. The results indicate that applying 150 mg l^{-1} $Al_2(SO_4)_3$ in 25°C increases vase life by 4.15 days, while control plants wilted after 3 days. Also, $Al_2(SO_4)_3$ had positive effect on water uptake rate and raising fresh weight (Liao *et al.,* 2001).

Also, it had been reported that $AgNO_3$, STS and $Al_2(SO_4)_3$ are the most important bactericides that are used in preservative solutions (Figueroa *et al.,* 2005).

Most of cut flowers including lisianthus have short vaselife which affect on production, selling and export. The most important goal of this research is to access a cheaper preservative solution which can diminish the problem of storage and transport of lisianthus cut flowers by the least environmental pollution and make possible supply and export into different part of the world.

MATERIALS AND METHODS

Lisianthus cut flowers, 'Mariachi Blue fonce', harvested in 40 cm length and had two open buds in early morning and transferred to laboratory, quickly. Then flower had been located into pots contain 250 ml preservative solutions. In each pot, 3 cut flowers had been located. In vase life room light intensity was 15-20 µmol s^{-1} m^{-2} and photoperiod was 12 hours from fluorescent white light, relative humidity was about 60% and environmental temperature was 20± 2 °C.

In order to investigation of the effects of various preservative solutions on vaselife of cut liciantus, two different experiments performed as factorial experiment based on RCBD in 3 replications. In the first experiment, the effects of sucrose (S_1=0, S_2=20, S_3=40, S_4=60 g l^{-1}), citric acid (C_1=0, C_2=160 mg l^{-1}) and $Al_2(SO_4)_3$ (A_1=0 & A_2=160 mg l^{-1}) and in the second experiment, the effects of sucrose (S_1=0, S_2=20, S_3=40, S_4=60 g l^{-1}), citric acid (C_1=0, C_2=160 mg l^{-1}) and AgNO3 (V1=0 and V2=120 mg l-1) had been investigated on licianthus cut flowers, continuously. In each experiment, we have 16 treatments, 48 plots and 144 cut flowers.

Changing of preservative solutions and 2 cm r

ecutting of cut flowers carried out in every 10 days. Vase life was ended when the last flower wilted. A wilted flower is a flower which their petal loses its turgidity.

Relative water content (RWC) in leaves calculated due to Nerd and Nobel formula (1991):

RWC = (fresh weight – dry weight)/ (saturation weight-dry weight)

14th Days, after starting the experiment, 1/3 of leaves was sampled. Then, in order to measure saturation weight, samples maintained in a tubes containing distilled water in 4°C for 24 hours. In order to obtain dry matter, samples maintained in an oven with 60°C for 3 days.

For evaluated the effect of chemical treatments on the percent of opened bud, the number of flowers (open flowers, semi-open flowers and wilted flowers) and completely closed buds available in the first day and also the number of flower available in the end of vase life had been calculated and the percent of opened bud calculated according the following formula:

Opened flowers = The number of flower in last day -The number of flowers in first day
The number of flowers in first day

Data were analysed with MSTATC software, means were compared with DNMRT and figures were prepared with Excel software.

RESULTS AND DISCUSSION

Vase life

Sucrose increased vase life of flower compared to control plants (table1). Mean comparison the of $AgNO_3$ indicated that, with existing of 120 mg l^{-1} $AgNO_3$ in the preservative solution, vase life of cut flowers increased compared to control plants and reach to 27 days (table 1).

The results of present research agreed with Ichimura and Hiraya (1999) states that the treatment with sucrose, cause to increase vase life in cut Lathyrus. Also the results of this research well supported the data from Anjum *et al.,* (2001). He said that $AgNO_3$ to inhibits bud opening and increasing vase life in tuberose cut flowers. Sucrose can provide the energy needed to cell processes including maintain the structure and function of mitochondria and the other cellular organelles (Capdeville *et al.,* 2003). Also, sucrose is the important material which obtained through photosynthesis and transferred in to the plant, widely (Halevy and Mayak,1981; Kuiper *et al.,* 1995; Huang and Chen, 2002 and Williamson *et al.,* 2002).

Sucrose in preservative solution can replaces with the losses carbohydrates and prevents all activity related to senescence (Goszczynska and Rudnicki, 1988). Also, Van doorn (2001) reported that flowers in present of sugar, are resistant to ethylene. In postharvest treatments, sucrose can directly prevents from ACC oxidise and ACC synthase and delays the senescence (Nakai *et al.,* 1997).

Ag^{+} blocks the special receptors on cell membrane and prevents from ethylene activity delays the senescence (Capedeville *et al.,* 2003).

Mean comparison from interaction between sucrose, citric acid and $Al_2(SO_4)_3$ indicated that the vase life of 60 g l_{-1} sucrose +160 mg l^{-1} citric acid was 31 days and vase life of flowers in 60 g l^{-1} sucrose + 160 mg l^{-1} $Al_2(SO_4)_3$ was 28 days (Fig. 1).

The mean comparison interaction effect of sucrose, citric acid and $AgNO_3$ indicated that vase life of cuts in 60 g l^{-1} sucrose +160 mg l^{-1} citric acid 31 days and vase life of cuts in 60 g l^{-1} sucrose +160 mg l^{-1} citric acid +120 mg l^{-1} $AgNO_3$ was 31 days, while the vase life of flowers in control plants was 14 days. Adding $AgNO_3$ to 60 g l^{-1} sucrose + 160 mg l^{-1} citric acid had not effect on increasing the vase life of cut flowers until more than 3 days (Fig. 2). This results can supported Reid (2009), who reported that, cut lisianthus is slightly sensitive to ethylene.

Relative Water Content

Various concentrations of sucrose in all experiments indicated that, sucrose in preservative solution can increases relative water content (table 1).

Sucrose as a main material used in respiration (Liao *et al.,* 2000) and can increase the respiration. Steam from respiration become a part of total water mass in cell which called metabolic water (Meyer *et al.,* 2002). In addition, sucrose in this research had been prevented from the reduction of fresh weight. Although, sucrose reduced water uptake, but with existence of sucrose in the preservative solutions, relative water content in petals had been increased.

Kiamohamad *et al.,* (2009) reported that $AgNO_3$ increased water uptake in lisianthus cut flowers and this can a reason to increase relative water content in the petals of lisianthus cut flowers. In this experiment, 60 g l^{-1} sucrose +160 mg l^{-1} $Al_2(SO_4)_3$ was the most effective treatment to increase relative water content (82.37%) in the petals of cut flowers (Fig. 3). Our results are agreed with the report of khan *et al.,* (2006). They observed that with 40 g l^{-1} sucrose + 200 mg l^{-1} $Al_2(SO_4)_3$, relative water content increased in leaves and petals of cut tulips.

Also, 160 mg l^{-1} citric acid + 120 mg l^{-1} $AgNO_3$ had significant effect on raising of relative water content (81,44%) in the petals of cut lisianthus (Fig. 4). Over transpiration can causes to water deficiency (Vandoorn, 1997) and reducing relative water content in the plant Al^{3+} can stop transpiration in the plants. In this research, $Al_2(SO_4)_3$ increased water uptake in cut lisianthus.

Bud Opening

Sucrose, citric acid, $AgNO_3$ and $Al_2(SO_4)_3$ individually, increased bud opening (table1). The results of current experiment about being more effective of high sucrose concentrations are agreed with Doi and Reid (1995) on gladiolus and liathris. It seems that carbon is a key factor to anthesis (Yamane *et al.,* 1991). It is possible that sucrose applied as a osmolite in anthesis of cut flowers (Liao *et al.,* 2000).

The results from mean comparison of interaction effects of sucrose + citric acid + $Al_2(SO_4)_3$ indicated that, the most bud opening percent observed in 60 g l^{-1} sucrose + 160 mg l^{-1} $Al_2(SO4)_3$ and the lowest bud opening percent observed in 160 mg l^{-1} citric acid without sucrose and $Al_2(SO_4)_3$ (Fig. 5). Cell growth which have direct relation with anthesis, needed to water uptake (Capedeville *et al.,* 2003)

Embolism can reduce the water uptake + sugar from preservative solution and it can reduces anthesis (Srilaong and Buanong, 2006). $Al_2(SO_4)_3$ is the most important bactericide which as same as citric acid have positive effect water uptake rate and consequence in anthesis (Liao *et al.,* 2001).

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Tables

Table 1. Mean comparison of effect of different chemical compound on traits

Treatment		First experiment Vase life (days)	(R.W.C) (%)	Bud opening (%)	Second experiment Vase life (days)	(R.W.C) (%)	Bud opening (%)
Sucrose (g l-1)	0 (S1)	14 d*	48.96 c	18.58 d	15 c	58.56 b	20.89 c
	20 (S2)	22 c	59.89 ab	45.96 b	26 b	67.48 a	46.67 b
	40 (S3)	25 b	55.80 b	39.82 c	28 ab	62.85 ab	49.37 b
	60 (S4)	28 a	61.32 a	59.56 a	29 a	59.19 b	58.59 a
Citric acid (mg l-1)	0 (C1)	23 a	62.64 a	40.23 a	23 b	64.68 a	41.71 b
	160 (C2)	22 b	50.37 b	41.74 a	25 a	59.36 b	46.05 a
Al2 (SO4)3 (mg l-1)	0 (A1)	22 a	55.54 a	37.6 b	-	-	-
	160 (A2)	22 a	57.44 a	44.37 a	-	-	-
AgNO3 (mg l-1)	0 (V1)	-	-	-	23 b	55.54 b	37.59 b
	120 (V1)	-	-	-	27 a	68.50 a	50.17 a

*Means followed by some letter within each column don't differ significantly according to Duncan multiple range test at P≤0.01

Figures

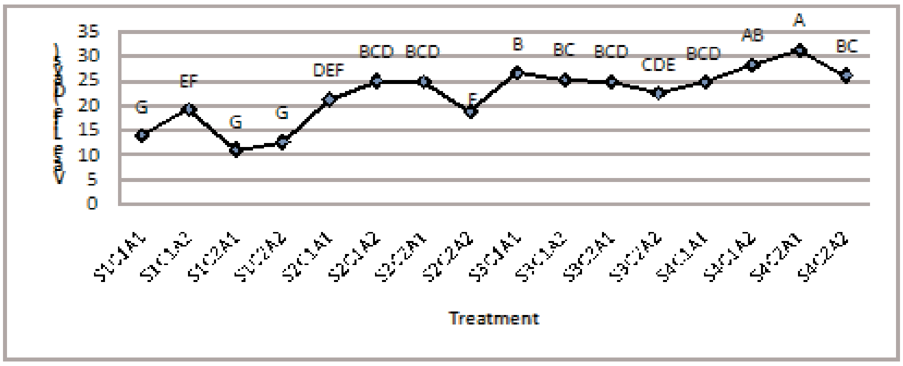

Fig.1. Interaction between Sucrose(S), Citric acid(C) and $Al_2(SO_4)_3$ (A) on vase life of cut lisianthus

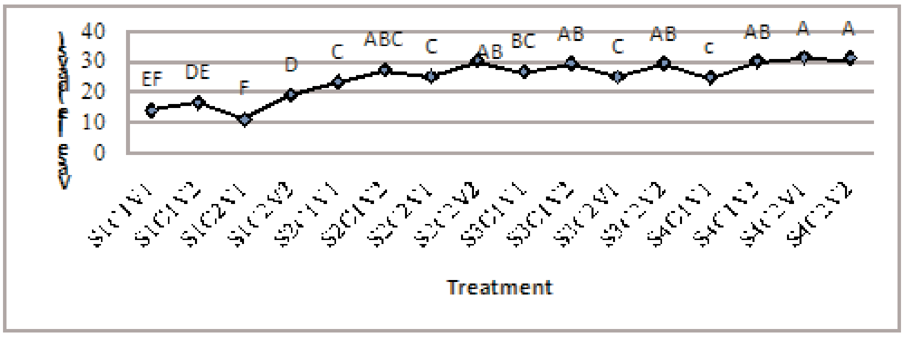

Fig.2. Interaction between Sucrose(S), Citric acid(C) and $AgNO_3$ (A) on vase life of cut lisianthus.

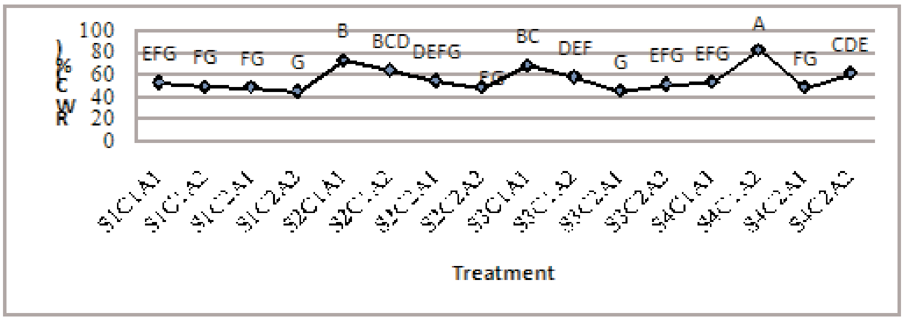

Fig.3. Interaction between Sucrose(S), Citric acid(C) and $Al_2(SO_4)_3$ (A) on RWC.

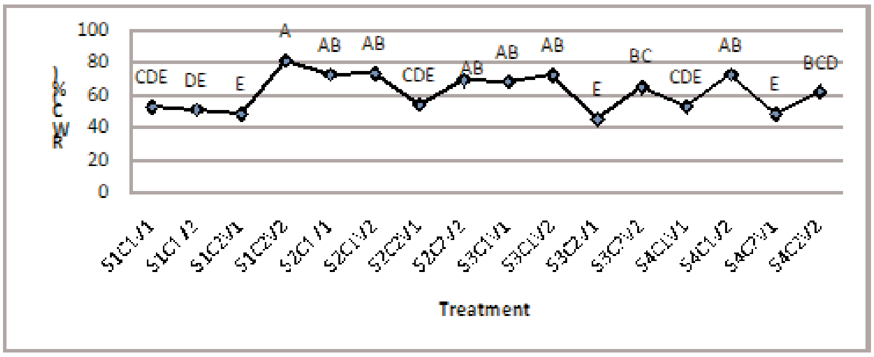

Fig.4. Interaction between Sucrose(S), Citric acid(C) and $AgNO_3$ (A) on RWC.

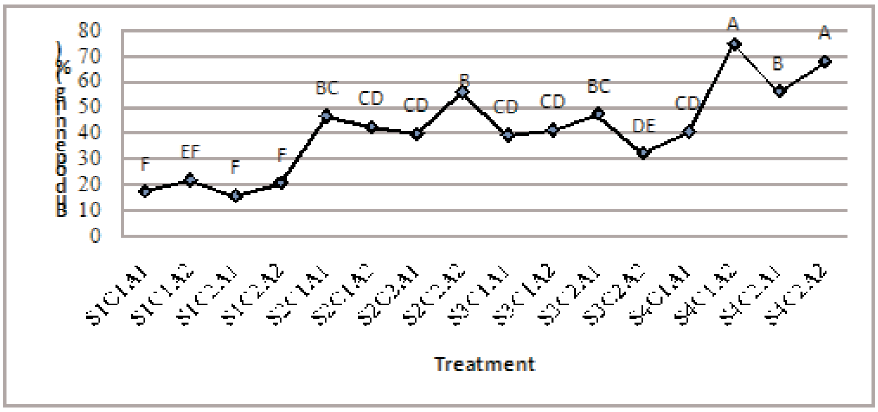

Fig.5. Interaction between Sucrose(S), Citric acid(C) and $Al_2(SO_4)_3$ (A) on bud opening.