Journal of Ornamental Plants
Available online on: www.jornamental.com
ISSN (Print): 2251-6433 ISSN (Online): 2251-6441

Effect of Wall Colors and Nanosilver Treatment on the Vase Life of Cut Carnation "Express"

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Received: 11 June 2014 Accepted: 20 November 2014
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Abstract

Carnation is an important traded crop in many countries. Postharvest senescence is a major limitation to the marketing of many species of cut flowers and considerable effort has been devoted to developing postharvest treatments to extend the marketing period. The split-plot experiment was executed based on two factors randomized complete block design with three replications to examine the effect of reflected light from the stain walls in vase life room and various concentrations of nanosilver on the longevity of cut carnation "Express". The first factor included four colors of walls (red, brown, blue, and white) and the second factor was in three different concentrations of nanosilver (0, 5 and 10 mg/l). Some traits such as vase life, °Brix, flower opening, population of bacteria in solution, water uptake, reduced dry weight, chlorophyll index, weight loss and content of anthocyanins was measured. The results showed that the color of wall has significant effect on vase life, °Brix, water uptake, flower opening, and content of petal anthocyanins ($P<0.05$). Simple effect of different concentrations of nanosilver was significant on the water uptake, °Brix, population of bacteria in solution and content of petal anthocyanins ($P <0.05$). Effect of factors interaction was significant on the content of petal anthocyanins and vase life. Best result was obtained under white walls with 5 mg/l nanosilver. Based on the results, the cold colors including white are better than warm colors for increasing vase life of cut carnation "Express".

Keywords: Carnation "Express", Nanosilver, Postharvest, Stain wall.

INTRODUCTION

Carnation (*Dianthus caryophyllus* L.) belongs to Caryophyllaceae. It is on of the most popular cut flower in the world because of a variety of attractive colors (Matloobi, 2003). Postharvest senescence is a major limitation to the marketing of many species of cut flowers and considerable effort has been devoted to developing postharvest treatments to extend the marketing period (Bowyer *et al.*, 2003). Postharvest physiology of cut flowers importance is mainly for inhibiting of the aging process. Growth of microorganisms in preservative solutions causes to stem obstructing, ethylene production, endogenous phytotoxins and accelerate the aging petals (Edrisi, 2009). Today, postharvest quality of cut flowers is the most important attributes in their evaluation (Ebrahimzade and Seifi, 1996). Usage of nanosilver compounds as a vase solution of cut flowers is important as an antibacterial agent (Morones *et al.*, 2005). The positive effect of a nanosilver treatment was attributed to inhibition of bacterial growth in the vase solution and at the end of cut flowers (Basiri *et al*., 2011). Liu *et al.* (2009) found that nanosilver treatments in combination with sugar further prolonged the vase lives of rose, gerbera and carnation cut flowers.

Among all the parameters that can affect the vase life of cut flowers, wall color of store or floral shops still has not been seriously studied. However, we can find several researches about light effect on plant growth. Narayanan (2012) studied on the effect of the different colors of light on plant growth. He found the plants grown under the green light had extremely thin roots, small stems, and very unhealthy leaves when compared to the plants grown under the red light, which had sturdy roots, thick stems, and healthy leaves. The plants grown under the blue light had healthy stem and leaves but not very healthy roots. Physiological enhancing of greenhouse plants using photoselective filters is common operation todays (Cerny *et al.*, 2003; Ilias and Rajapakse, 2005; Stamps, 2009). Colored shade netting (shade cloth) designed specifically for manipulating plant development and growth has become available. These nets can be used outdoors as well as in greenhouses (Stamps, 2009). They can provide physical protection (birds, hail, insects, excessive radiation), affect environmental modification (humidity, shade, temperature) (Perez *et al.*, 2006), and increase the relative proportion of diffuse (scattered) light as well as absorb various spectral bands, thereby affecting light quality. These effects can influence crops as well as the organisms associated with them (Stamps, 2009). Red netting, in comparison with black and blue netting, induced earlier flowering of *Phalaenopsis* cultivars and hybrids (Leite *et al.*, 2008).

The aim of this trial is evaluation of nanosilver concentration and store wall colors effect (radiation reflex from stain partition) on the postharvest quality of carnation.

MATERIALS AND METHODS

Cut carnation cv. Express flowers (Fig. 1) were purchased from a greenhouse in Varamin, Pakdasht. Lower leaves of cut flowers were removed when they transferred to the preservative solution and three cut flowers placed in each vase life container. Light conditions, temperature, and humidity of trial room were measured daily. Experiment conditions included temperature 22 ± 2 °C, relative humidity 60%, light intensity 400 lux, and day length 12 hours.

This experiment carried out as a split plot with randomized complete block design with two factors. The first factor was preservative solution including different levels of nanosilver including; 0, 5 and 10 mg/l and the next factor was vase life room wall colors (stain partition) including; white, blue, red and brown partition (Fig. 2). Protective solution was used as a pulse during 20 hours, but stain partition was used as continuous.

Fig. 1. Carnatian cv. Express flower.

Then the flowers located in the continuous solution containing sucrose 3%, 8-HQC (600 mg/l) and citric acid (CA) 300 mg/l. 108 cut flowers were tested at various ex-

Fig. 2. Cut carnation in blue and white color and nanosilver solution treatments.

perimental and flower developmental stages. Main measured characteristics in this study were vase life, flower-opening process, the weight loss of stalk, the solution absorption, bacteria population in the solution and the petal anthocyanins content. Vase life of cut carnations was evaluated based on relative flower plasmolysis and petal enrolling index. Process of the flowers opening was measured every four days. The weight loss of stalk was measured by evaluating of recuts weight, evaporation rate and solution absorption amount. Solution absorption amount was calculated using initial solution in vases, remained solution in each vase and evaporation rate. Pulse solutions were sampled for bacterial counting and it was counted after 24 hours. Anthocyanins content in the petals was measured at the end of vase life. Data were analyzed using statistical software MSTATC and mean comparison was performed using Tukey test.

RESULTS AND DISCUSSION

Results showed (Table 1) that the factor of stain partitions (walls) influenced significantly vase life, absorbing solution, opening process of petals and anthocyanins content ($p<0.05$). However, nanosilver different levels affected significantly solution absorption rate, bacterial population in solution and petal anthocyanins. Nanosilver had no significant effect on fresh weight. Interaction of two experimental factor including wall color and nanosilver levels had significant effect on the petal anthocyanins and vase life. The best result was obtained under "white color + 5 mg/l nanosilver" with 18.33 days vase life (Table 2). Moradi *et al*. (2012) reported that short-term treatment by benzyl adenine together with nanosilver preservative solution plus 3% sucrose has the greatest impact on the longevity and qualitative characteristics of *Dianthus* flower. Fallik *et al.* (2009)

Table 1. Analysis of variance experimental factors effect on the cut carnation traits.

Sources of variables	Mean Squares							
	Vase life	°Brix	Flower opening	Bacteria No.	Water uptake	Chlorophyll index	Weight loss	Anthocyanins
Replication	0.39 ^{ns}	7.07 ^{ns}	0.26**	0.28 ^{ns}	5.38**	2.6 ^{ns}	168.9 ^{ns}	20.45 ^{ns}
Stain partition (A)	14.16*	10.87*	0.12*	0.57 ^{ns}	1.15*	8.3 ^{ns}	121.8 ^{ns}	9.6*
Error	1.93	2.27	0.02	0.63	0.16	33.13	68.7	8.07
Nanosilver (B)	2.11 ^{ns}	30.51**	0.05 ^{ns}	28.6**	1.56*	3.00 ^{ns}	72.3 ^{ns}	68.16**
AB	4.66 *	6.71 ^{ns}	0.05 ^{ns}	0.16 ^{ns}	0.74 ^{ns}	11.5 ^{ns}	74.6 ^{ns}	66.98**
Total Error	1.49	2.86	0.03	0.39	0.38	15.06	39.15	8.61

^{ns}: non-significant, * and **: significant at %5 and 1% respectively.

Table 2. Wall color and nanosilver (NS) interaction effect on petal anthocyanins and vase life of cut carnation.

Treatments	Means		
	Vase life (days)	Anthocyanins (ΔA/g.Wt)	°Brix
Red + 0 mg/l NS	15.22 ab	33.03 b	7.99 a
Red + 5 mg/l NS	14.77 ab	34.07 b	1.74 b
Red + 10 mg/l NS	14.11 b	32.87 b	2.18 b
Brown + 0 mg/l NS	13.33 b	33.73 b	5.28 ab
Brown + 5 mg/l NS	13.55 b	30.94 b	1.66 b
Brown + 10 mg/l NS	15.44 ab	33.25 b	2.25 b
Blue + 0 mg/l NS	16 ab	33.76 b	2.64 b
Blue + 5 mg/l NS	17.11 ab	33.97 b	1.03 b
Blue + 10 mg/l NS	16.33 ab	33.99 b	2.39 b
White + 0 mg/l NS	16.78 ab	33.32 b	1.79 b
White + 5 mg/l NS	18.33 a	34.07 b	1.03 b
White + 10 mg/l NS	14.66 ab	49.84 a	1.68 b

Digits with same letters in a column was not significant at P<0.05.

found that pepper grown in an arid region under red and yellow shade nets, had a significant higher yield compared with black nets of the same shading factors, without reducing fruit size. In addition, the export-quality fruit yield was also significantly increased under the red and yellow shade nets. They showed potential use of red and yellow colored shade nets to improve pepper productivity, relative to the traditional black shade nets, and to maintain better fruit quality after prolonged storage and shelf-life.

Based on this trial results, cold color such as white on the wall of store of cut flowers, especially carnation "Express" can significantly increase flowers longevity (Table 3). Our results show that nanosilver applying (5-10 mg/l) in vase solution decreased considerably bacteria number in solution (Table 4). Recent results revealed that nanosilver could replace other toxic antibacterial in preservative solution. Nanosilver serves as an anti-microbial agent contributing to improvement of longevity in *Alestromerria* flowers (Hokmabadi, 2009). Kazemi and Ameri (2012) also reported that nanosilver and acetylsalicylic acid treatments inhibited the growth of microorganisms in vase solution and considerably extended the vase life of cut flowers of gerbera and 5 mg/l was the best treatment.

Content of petal anthocyanins in carnation cut flowers is also significant under simple and interaction effects of experimental factors (Table 1). The white color of store wall with 10 mg/l nanosilver showed increased anthocyanins compared to other treatments (Table 2). Based on these results, anthocyanins content in the recent treatment was 50% more than "brown color + 5 mg/l nanosilver" treatment. Using benzyl adenine of 100 mg/l as pulse treatment and then 4 mg/l nanosilver and 3% sucrose was proved to have the largest value of anthocyanin in comparison with indicator treatment (Moradi *et al*., 2012). The results revealed that petals anthocyanins affected by antibacterial materials such as nanosilver.

Chlorophyll index and weight loss of cut flowers were not affected by simple effect and interaction of trial factors. However, °Brix, bacteria number and water uptake significantly differ under trial factors interaction (Table 1). Moradi *et al*. (2012) found that amount of soluble solids remarkably increased in solutions containing 2 and 4 ppm nanosilver in comparison with control. But, in the present study, °Brix decreased by nanosilver treatments and this index was highest in red partition (Table 3 and 4). According table 1, weight loss in our results was not affected by treatments. While, Amani-Beni *et al*. (2013) reported that the best inhibitors for fresh weight loss preventing in tuberose were 0.5 mg/l nanosilver and 25 mg/l humic acid.

Both simple effect of nanosilver and stain partition affected significantly water uptake and the highest uptake obtained under 10 mg/l nanosilver or white color of store wall (Table 3 and 4). Amani-beni *et al*. (2013) found that water uptake in different concentrations of nanosilver (except 5 mg/l) was more than the control. The most effective treatments were 1 and 0.5 mg/l. Antibacterial

Table 3. Simple effect of stain partitions on trial characteristics of carnation cut flowers.

Stain partitions	Means				
	Vase life (day)	°Brix	Flower opening (cm)	Water uptake (ml)	Anthocyanins (ΔA/g.Wt)
Red	14.70 b	3.97 a	1.54 a	3.97 ab	33.32 b
Brown	14.11 b	3.06 ab	1.64 ab	3.57 b	32.64 b
Blue	16.48 a	2.02 ab	1.26 b	3.86 ab	33.91 b
White	16.59 a	1.50 b	1.48 ab	4.43 a	39.80 a

Means with same letters in a column was not significant at P<0.05.

Table 4. Simple effect of nanosilver (NS) on trial characteristics of carnation cut flowers.

Nanosilver concentration	Means			
	°Brix	Bacteria No	Water uptake (ml)	Anthocyanins (ΔA/g.Wt)
Control	4.43 a	2.84 a	3.72 b	33.5 b
5 mg/l NS	1.36 b	0.14 b	3.78 b	33.3 b
10 mg/l NS	2.12 b	0.20 b	4.37 a	37.5 a

Means with same letters in a column was not significant at P<0.05.

effect of nanosilver prevents over-respiration and improving water relations which ultimately inhibit fresh weight loss (Morones *et al*., 2005). These results confirm our findings. Based on the results (Table 3 and 4), the highest water uptake is approximately equal under simple effect of white color and 10 mg/l NS treatments.

CONCLUSION

As a general conclusion, it can be stated that cool colors such as white and blue are better than warm colors (red and brown) in cut carnation store's wall, of course combined with 5 mg/l nanosilver was obtained the highest vase life for carnation cv. Express. Further experiments are required to assess the best results with our trial parameters on various cut flowers.

ACKNOWLEDGEMENT

I would like to express my special thanks to my colleagues Dr. Davood Hashemabadi, Dr. Ali Mohammadi Torkashvand and Mrs. Samira Deravi which helped me in this research.

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