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Studies on postharvest life of carnation, *Dianthus caryophyllus* L

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ABSTRACT

The present investigation was carried out at the farm laboratory of the Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during 2011-2012. The three experiments on standardization of pulsing solutions, wrapping materials, storage durations and holding solutions were conducted under completely randomized design (CRD). Cut stems of carnation pulsed in solution comprising sucrose (10%) + 8-HQC (300 ppm) + GA_3 (50 ppm) for 12 hours stored, wrapped in cellophane for 48 hours in cool chamber at 4^oC and finally packed in CFB (outer size 1000 × 415 × 220 mm and inner size 980 × 395 × 220 mm) of 5 ply strength exhibited a vase life of 8.00 days at Solan and 7.00 days at Chandigarh when kept in $Al_2(SO_4)_3.16\ H_2O$ (300 ppm) + BA (50 ppm) as holding solution.

Keywords: Carnation; pulsing solutions; holding solutions; wrapping material; CFB; storage duration

INTRODUCTION

Due to high perishability cut flowers are vulnerable to large postharvest losses up to 50 per cent of the farm value (Singh et al 2007). Carnations are more susceptible to mechanical and physical damages and microbial infections by diseases and pests during and after harvest. Floral preservatives affect the quality of cut flowers by extending the vase life, increasing flower size and maintaining the colour of leaves and petals. Commonly most preservative solutions consist of carbohydrates, germicides, ethylene inhibitors, growth regulators and some mineral compounds. Carbohydrates are the main source of nutrition for cut flowers thus help in prolonging vase life ie maintenance of mitochondrial structure and function and improvement in water balance by regulating transpiration.

Appropriate packaging of cut flowers for optimum duration offers potential advantage of extending their vase life and maintaining flower quality. It is often an advantage to wrap bunches of cut flowers within a suitable material and then to place these flower bunches in corrugated fiberboard boxes (CFBs) for protecting them against physical damage, water loss and external environmental conditions. Cut flowers respond differently for various storage durations depending upon species, growing conditions and postharvest handling. Storage of flowers beyond the optimum period leads to a considerable loss of vase life and flower quality. It is immensely important to determine the optimum duration for storage of cut flowers that keeps the quality and potential vase life at its best. Following harvest, cut carnations open fast and loose quickly their value. Use of preservative solutions in association with appropriate wrapping material for optimum duration are becoming common for enhancing flower vase life and to keep the leaves green for longer durations (Reid 1992). The cultivation of carnation has picked very fast. In the past decade the cultivated area under cut flowers has increased manifold and at present these are being grown over more than 40 ha (Anon 2014). Improvement of keeping quality and enhancement of vase life of carnation are important areas of research in the flower industry. Keeping in view the above facts the present studies were undertaken to standardize the pulsing, holding solutions, wrapping material, storage durations and fabrication of a suitable CFB for packaging of cut flowers for carnation.

MATERIAL and METHODS

Cut flowers of carnation cv Master about 45 cm long or more with paintbrush stage were procured from the research farm of the Department of Floriculture and Landscape Architecture for conducting the experiments and placed immediately in tap water. These cut stems were first put in buckets containing eight pulsing solutions viz P_1 (distilled water as control), P_2 (sucrose 10% + 8-HQC 300 ppm), P_3 (sucrose 10% + 8-HQC 300 ppm + BA 25 ppm), P_4 (sucrose 10% + 8-HQC 300 ppm + GA_3 25 ppm), P_5 (sucrose 10% + 8-HQC 300 ppm + GA_3 50 ppm), P_6 (sucrose 10% + 8-HQC 300 ppm + kinetin 25 ppm) and P_7 (sucrose 10% + 8-HQC 300 ppm + alar 500 ppm) for 12 hours and then tested for their longevity in measured amount of distilled water in test tubes. Cut stems after treating in best pulsing solution were wrapped in different wrapping materials viz newspaper, cellophane, butter paper, polyethylene, LDPE and HDPE film for storage for zero, 48 and 96 h in cool chamber at 4^{o}C to find out the best wrapping material and storage duration for testing their shelf-life during transit to distant markets. Simultaneously another experiment was conducted to select a suitable CFB out of 3, 5 and 7 ply strength (outer size 1000 × 415 × 220 mm and inner size 980 × 395 × 220 mm) for packaging of cut stems of carnation in them to local and distant markets. CFB of 3, 5 and 7 ply strengths were got fabricated locally to accommodate the maximum number of cut stems of carnation to be packed in them (Table 1, Plate 1).

Further in another experiment cut carnations treated in the best pulsing solution and wrapped in best wrapping material and then kept for best storage duration in cool chamber at 4°C were tried to test their longevity in different holding solutions viz H_1 (distilled water as control), H_2 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm), H_3 (GA_3 25 ppm), H_4 (GA_3 50 ppm), H_5 (BA 25 ppm), H_6 (BA 50 ppm), H_7 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + GA_3 25 ppm), H_8 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + GA_3 50 ppm), H_9 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + BA 25 ppm, H_{10} ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + BA 50 ppm). Finally cut flowers of carnation cv Master treated in the best pulsing solution and then wrapped with best wrapping material and kept for best storage duration in cool chamber at 4°C were further held in best holding solution to enhance the overall longevity of cut carnations both for local market at Solan and distant market at Chandigarh. All the experiments were conducted in CRD with three replications.

RESULTS and DISCUSSIONS

Pulsing solution

It is evident from the data given in Table 2 that the cut flowers of carnation held in pulsing solution comprising of sucrose 10% + 300 ppm 8-HQC + GA_3 50 ppm were noticed with maximum size of flowers (7.31 cm), freshness and color ie appearance (4.40) and amount of solution consumed (57.33 ml) and proved significantly superior to other treatments and control as well. Vase life of the cut flowers (11.80 days) treated in the same solution was found to be higher in comparison to control and proved to be statistically at par with treatments P_4, P_6 and P_7. Cut flowers of carnation pulsed with solution comprising of sucrose 10% + 300 ppm 8-HQC+ GA_3 50 ppm for 12 hours resulted in improvement in the size of flower, vase life, amount of solution consumed and appearance. This may be ascribed to the fact that cut flowers consumed highest amount of solution that helped them to stay longer in the vase as the volume of solution absorbed is directly correlated with the vase life (Joti and Balakrishnamoorthy 1999). This can be justified from the fact that once vascular blockage is avoided by 8-HQC, the GA_3 with sucrose further facilitated the better intake of water and accumulation of total soluble sugars in the petal cells probably by enhancing the osmotic driving force for the solution uptake by making the cell's water potential more negative (Emongor and Tshwenyane 2004) that might help to have longer vase life. The increase in flower size might be due to the fact that sucrose is used as substrate (Rogers 1973) while 8-HQC avoided vascular blockage and it ultimately lead to increase in flower diameter. Cut flowers treated in solutions containing sucrose and 8-HQC showed poor appearance even less

Table 1. Size of the CFB

Ply strength	Outer size	Inner size
3 Ply	1000 × 415 × 220	980 × 395 × 220
5 Ply	1000 × 415 × 220	980 × 395 × 220
7 Ply	1000 × 415 × 220	980 × 395 × 220

Plate 1. An overview of the CFB of different ply strengths

than cut stems held in distilled water. The results of these findings are in conformity with the findings of Marousky (1971) who reported that foliage on chrysanthemum stem held in sucrose plus 8-HQC developed severe chlorosis that resulted in poor appearance of cut flowers. From the investigation it can be further explained that inclusion of GA_3 in holding solutions significantly improved the appearance of cut stems. This is because of the fact that GA_3 prevented flower fading and leaf yellowing by delaying the onset of senescence associated with proteolysis (Kelley and Schlamp 1964, Eason 2002, Ranwala and Miller 2002). It seemed from the study that the negative affect of sucrose and 8-HQC causing foliage chlorosis was amended by the inclusion of GA_3 in the holding solution. This result is in accordance with the findings of Finger and Barbosa (2006), Kumar et al (1999) in carnation, Song et al (1996) and Sindhu and Pathania (2003) in various cultivars of Asiatic hybrid lily.

Wrapping materials and storage durations

It is clear from the data embodied in Table 3 that cut stems of carnation wrapped in cellophane resulted in best appearance (3.50) that was significantly superior to all other wrapping materials used and it was minimal (2.72) in cut stems being wrapped in W_0, W_1 and W_6. Fresh cut flowers resulted in best appearance (4.50) and it was found minimum (1.38) in cut flowers being stored for 96 hours. Fresh cut flowers stored for zero hour and without any wrapping, in cellophane and in butter paper for zero hour W_0D_0, W_2D_0 and W_3D_0 respectively exhibited best appearance (4.50) and proved significantly superior to other treatments followed by W_2D_1 (4.00) and minimal (1.00) each in W_1D_2 and in W_4D_2. Cut flowers of carnation wrapped in cellophane for zero hour resulted in best appearance and minimal in unwrapped cut stems, newspaper and HDPE film. It was all due to the moisture retentive nature of the cellophane that prevented moisture loss and increased the relative humidity inside the wrapped cut stems. This helped to maintain turgidity of cut stems by retaining the moisture level in the tissues even after harvest. Normally cut stems deteriorate from the original appearance when there is excessive loss of moisture apart from lack of photosynthates. When moisture loss is minimized using these wrapping materials there is better maintenance of appearance (Goszczynska and Rudnicki 1988).

Cut flowers stored for zero periods and without any wrapping exhibited the best appearance and it was minimal in newspaper and polyethylene when stored for 96 hours. Fresh cut flowers resulted in best appearance and it deteriorated in the cut flowers stored for 96 hours. The appearance of cut stems got deteriorated with increase in the storage period. This explained that flowers storage for longer duration cannot score good with respect to freshness and colour as compared to short term stored flowers. The results also get the support from the findings of Sharma et al (2008) and Dastagiri et al (2014) in lilium and ornithogalum respectively.

Holding solutions

A perusal of Table 4 reveals that cut flowers of carnation treated in solution containing $Al_2(SO_4)_3.16\ H_2O$ (300 ppm) + BA (50 ppm) were noticed with largest size of flowers (7.20 cm) and vase life (12.10 days) and also absorbed maximum amount of holding solution (85.00 ml) as compared to other treatments including control as well. The cut flowers showed their best appearances (4.50) in the same treatment as compared to control and it was at par with comprising $Al_2(SO_4)_3.16\ H_2O$ (300 ppm) + BA (25 ppm). Improvement in the size of flower, vase life, appearance and amount of holding solution consumed got the support from the findings of various

Table 2. Effect of different pulsing solutions on postharvest life of cut carnation cv Master

Treatment	Amount of solution consumed (ml)	Vase life (days)	Size of flower (cm)	Appearance (freshness and colour)
P_1	45.00	8.13	6.11	2.60
P_2	46.00	9.66	6.49	2.93
P_3	50.00	10.47	6.81	4.06
P_4	47.00	10.60	6.77	4.00
P_5	57.33	11.80	7.31	4.40
P_6	47.00	11.47	7.15	3.93
P_7	47.33	11.13	6.79	3.69
$CD_{0.05}$	7.31	1.71	0.17	0.15

P_1 (distilled water as control), P_2 (sucrose 10% + 8-HQC 300 ppm), P_3 (sucrose 10% + 8-HQC 300 ppm + BA 25 ppm, P_4 (sucrose 10% + 8-HQC 300 ppm + GA_3 25 ppm), P_5 (sucrose 10% + 8-HQC 300 ppm + GA_3 50 ppm), P_6 (sucrose 10% + 8-HQC 300 ppm + kinetin 25 ppm) and P_7 (sucrose 10% + 8-HQC 300 ppm + alar 500 ppm)

Table 3. Effect of different wrapping materials and storage durations (h) on appearance of cut carnation cv Master

Storage duration (D) in h	Wrapping material (W)							Mean
	Without wrapping (W_0)	News paper (W_1)	Cellophane sheet (W_2)	Butter paper (W_3)	Polyethylene sheet (W_4)	LDPE film (W_5)	HDPE film (W_6)	
Zero (D_0)	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
48 (D_1)	2.33	2.67	4.00	2.67	1.67	3.00	2.33	2.67
96 (D_2)	1.33	1.00	2.00	1.33	1.00	1.67	1.33	1.38
Mean	2.72	2.72	3.50	2.83	2.39	3.06	2.72	

$CD_{0.05}$	
W	0.41
D	0.27
W × D	0.70

Table 4. Effect of different holding solutions on post-harvest life of carnation cv Master

Treatment	Amount of solution consumed (ml)	Vase life (days)	Size of flowers (cm)	Appearance
H_1	76.10	8.30	5.50	2.70
H_2	77.60	8.90	5.70	3.00
H_3	78.50	8.90	6.10	3.10
H_4	79.30	9.33	6.20	3.40
H_5	80.00	9.90	6.30	3.50
H_6	80.70	10.00	6.40	3.70
H_7	82.00	10.70	6.70	4.00
H_8	83.30	11.20	6.80	4.20
H_9	84.00	11.50	7.00	4.30
H_{10}	85.00	12.10	7.20	4.50
$CD_{0.05}$	0.90	0.43	0.11	0.28

H_1 (distilled water as control), H_2 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm), H_3 (GA_3 25 ppm), H_4 (GA_3 50 ppm), H_5 (BA 25 ppm), H_6 (BA 50 ppm), H_7 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + GA_3 25 ppm), H_8 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + GA_3 50 ppm), H_9 ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + BA 25 ppm), H_{10} ($Al_2(SO_4)_3.16\ H_2O$ 300 ppm + BA 50 ppm)

workers namely Cho and Lee (1979), Patil and Singh (1995), Bhattacharjee (1999), Tiwari and Singh (2002), Karki et al (2004), Divya et al (2004) and Singh and Mirza (2004). Cut flowers in this treatment consumed largest amount of solution that helped them to stay longer in the vase as the volume of solution absorbed is directly correlated with the vase life (Joti and Balakrishnamoorthy 1999) and finally improved the appearance grade. BA may prevent ethylene-induced vascular occlusions (physiological blockage) at the base of the cut stem (Halevy and Mayak 1981). An addition of BA in this solution increased the water uptake of cut carnation thereby reduced weight loss. These results are in accordance with the work of Manikrao (2007) in alstroemeria.

Fabrication of CFB

CFB (outer size 1000 × 415 × 220 mm and inner size 980 × 395 × 220 mm) of 5 ply strength was selected on the basis of cost and bulging criterion by accommodating equal number of cut flowers out of three ply strengths (Plate 2). About 700 cut flowers of carnation could be accommodated in this CFB.

REFERENCES

Anonymonus 2014. Status of floriculture in Himachal Pradesh. Directorate of Horticulture, Nav Bahar, Shimla, Himachal Pradesh, India.

Bhattacharjee SK 1999. Postharvest life and biochemical constituents of Sonia Meilland cut roses as affected by chloride salts. Indian Agriculturist **43(1/2):** 1-10.

Cho HK and Lee JM 1979. Studies on extending the life of cut flowers of rose and carnation with various chemical preservatives. Journal of the Korean Society for Horticultural Science **20(1):** 106-107.

Cosy cz ynska DM and Rudnicki R 1988. Storage of cut flowers. Horticultural Review **10:** 35-62.

Dastagiri D, Sharma BP and Dilta BS 2014. Effect of wrapping materials and cold storage durations on keeping quality of cut flowers of chincherinchee (*Ornithogalum thyrsoides* Jacq). Indian Journal of Applied Research **4(2):** 73-75.

Divya BC, Vijayakumar M, Jawaharlal M, Sathiyamurthy VA and Srinivasan M 2004. Effect of pulsing treatment on postharvest life and quality of cut rose (*Rosa hybrida*) cv First Red. In: Abstracts of National Symposium on Recent Trends and Future Strategies in Ornamental Horticulture, Indian Society of Ornamental Horticulture, 1-4 December 2004, University of Agricultural Sciences, Dharwad, Karnataka, India, 131p.

Eason JR 2002. *Sanderonia aurantiaca*; an evaluation of postharvest pulsing solutions to maximize the flower quality. New Zealand Journal of Crop and Horticultural Science **30(4):** 273-279.

Emongor VE and Tshwenyane SO 2004. Effect of Accel on the postharvest life of Easter lily. Journal of Agronomy **3(3):** 170-174.

Finger F and Barbosa JG 2006. Postharvest physiology of cut flowers. In: Advances in postharvest technologies for horticultural crops (B Noureddine and S Norio eds). Research Signpost, Trivandram, Kerala, India, pp 373-393.

Goszczynska DM and Rudnicki R 1988. Storage of cut flowers. Horticultural Review **10:** 35-62.

Halevy AH and Mayak MS 1981. Senescence and postharvest physiology of cut flowers- Part II. Horticultural Review **3(2):** 59-43.

Joti LJ and Balakrishnamoorthy G 1999. Effect of pulsing and packing materials on postharvest life of rose cv Happiness. South Indian Horticulture **47(1-6):** 361-363.

Karki K, Kumar S, Shrivastava R and Jauhari S 2004. Effect of floral preservatives on the vase life of cut roses grown under low cost polyhouses. Journal of Ornamental Horticulture **7(1):** 121-123.

Kelley JD and Schlamp AL 1964. Keeping quality, flower size and flowering response of three varieties of Easter lilies to gibberellic acid. Journal of the American Society for Horticultural Science **85:** 631-634.

Kumar PN, Singh B and Voleti SR 1999. Effect of chemicals on the vase life of standard carnations affected by $GA_{3,}$ NAA and sucrose. Journal of Ornamental Horticulture **7(2):** 188-191.

Manikrao DR 2007. Studies on possible alternatives of silver thiosulphate in the postharvest handling of *Alstroemeria* and carnation cut flowers. PhD thesis, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP, India.

Marousky FG 1971. Inhibition of vascular blockage on increased moisture retention in cut rose induced by 8-hydroxyquinoline citrate and sucrose. Journal of the American Society for Horticultural Science **96:** 38-41.

Patil MT and Singh BR 1995. Post harvest studies in rose. Journal of Maharashtra Agricultural Universities **20(1):**124-125.

Ranwala AP and Miller B 2002. Effect of gibberellin treatments on flowers and leaf quality of cut hybrid lilies. Acta Horticulturae **570:** 205-210.

Reid MS 1992. Postharvest handling systems: ornamental crops. In: Postharvest technology of horticultural crops. Publication 3311, University of California, Oakland, CA, pp 201-209.

Rogers MN 1973. An historical and critical review of postharvest physiology research on cut flowers. HortScience **8(3):** 189-193.

Sharma BP, Beshir HM, Dilta BS and Chaudhary SVS 2008. Effect of various wrapping material and storage durations on postharvest life of Asiatic hybrid lily cv Apeldoorn. 4th National Symposium on Scenario of Agriculture in Changing Climatic Conditions, 18-19 Oct 2008, University of Agriculture and Technology, Modipuram, Meerut, UP, India, pp 69-7C4.

Sindhu SS and Pathania NS 2003. Effect of pulsing, holding and low temperature storage on keeping quality of Asiatic lily hybrids. Acta Horticulturae **624:** 389-394.

Singh A, Dhaduk BK and Desai JR 2007. Postharvest technology and value addition in cut flowers. Floriculture Today, Sept 2007, pp 40-52.

Singh PV and Mirza AA 2004. Postharvest life and quality of cut rose cultivar Super Star as influenced by packaging material. Journal of Ornamental Horticulture **7(1):** 58-63.

Song CV, Bang CS, Chung SK, Kim YJ, Lee JS and Roh MS 1996. The effect of postharvest pre-treatments and preservative solution on vase life and flower quality of Asiatic hybrid lily. Acta Horticulturae **37(1):** 396-400

Tiwari AK and Singh R 2002. Effects of certain chemicals on postharvest life of rose. Journal of Ornamental Horticulture **5(2):** 39-40.

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