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EFFECT OF COLD STORAGE TECHNIQUES ON FLOWER QUALITY AND VASE LIFE OF ROSE VAR 'SUN KING'

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ABSTRACT

Investigation was conducted to study the influence of cold storage(2°C) techniques comprising of seal packaging with polypropylene (PP 24μ), butter paper (52μ), holding in 200 mgL^{-1}$Al_2(SO_4)_3$ vase solution, holding in vase (distilled water) and without any packaging and without holding in vase water in rose cut flowers var. Sun King. After ten days of cold storage, the stored flowers were held in distilled water and compared with fresh flowers as control. Among all the treatments, the polypropylene packaged cold stored cut roses showed promising result with highly retained post harvest quality at the end of 10days storage period that were at par with fresh flowers. The PP packaged cold stored rose cut flowers were almost at par with fresh cut roses and showed significantly higher water uptake (58.7mL) and retained fresh weight (8.76 %) along with retained carotene pigment content (3.76 mg/g fw) in the petal tissue as over other treated stored flowers. Further, the same treatment showed higher bud length (5.23 cm) and flower diameter (6.37cm) with higher membrane stability index (57.07%) of the petal tissue as well as higher post storage vase life (4.73 days) as compared to all treatments (1.07 to 3.03 days vase life) and these cold stored flowers were at par with the fresh flowers in terms of flower diameter (6.53 cm) and vase life (4.83 days).

INTRODUCTION

Rose occupies the top position in all the international cut flower markets with peak demands is particular festive times and seasons. A fierce competition exists in the international flower market, where Indian roses suffer from poor prices due to improper pre and post harvest handling techniques (Kumar *et al.*, 2012). Further, roses at times face the problem of price crash during market gluts owing to the fluctuating National flower market. The optimum quality for export of cut roses can be achieved by adopting proper pre and post harvest handling techniques (Goszczynska and Rudnicki 1988, Hashemabadi and Zarchini, 2010). Further, effective storage technique can contribute in developing better market strategy for roses (Singh *et al.*, 2013). However, cold storage is known to cause deterioration in flower quality (Mor *et al.*, 1989, Van Doorn and d' Hont, 1994) and chilling injury (Pompodakis *et al.*, 2010) as well as promote ethylene production that further triggers early senescence in rose (Faragher *et al.*,1986, Devechhi *et al.*, 2003). Seal packaging of fresh produce with polyfilms at low temperature is known to create modified atmospheric conditions with high CO_2, O_2 and H_2O (Farber *et al.*, 2003) that plays important role in retaining quality after storage. Further, Polyfilm packaging has resulted into improved flower quality with better opening ability during the post storage phase in stored flowers like gladiolus (Grover *et al.*, 2005, Singh *et al.*, 2007) and *Solidago canadensis* (Zeltzer *et al.*, 2001). Research on storage aspects in roses is meagre (Mor *et al.*, 1986, Devechhi *et al.*, 2003, Pompodakis *et al.*, 2010, Singh *et al.*, 2013) and needs further study. Hence, this experiment was planned to evaluate proper cold storage technique for rose cut flower that would retain optimum flower quality and vase life of cut rose that is comparable with fresh flowers. Such technique would contribute in the development of better market strategy and market accessibility for higher price.

MATERIALS AND METHODS

Rose cut flowers var. Sun King were obtained from greenhouse complex, Navsari Agricultural University, Navsari and were brought to the Floriculture laboratory, College of Horticulture and Forestry, NAU Navsari at an ambient temperature (18-21°C). The experiment was conducted in completely randomized design. There were five treatments with one control and each treatment was replicated four times. Cut roses at uniform bud size, fresh weight (10$\pm$2 gm) and stem length (50$\pm$5 cm) were selected and sorted to make five groups comprising of bunches where each bunch consisted of ten flowers. Bunches from each group were packed and subjected to respective treatments*viz.*, seal packaging with polypropylene 24 microns (PP) (T_1), seal packaging with butter paper 52 microns (T_2), holding in 200 mgL^{-1}$Al_2(SO_4)_3$solution (T_3), holding indistilled water (T_4) and without any packaging or holding in water (T_5). All bunches were stored at 2°C temperature in cold storage for 10 days. After 10 days of cold storage, the flowers were taken out from cold storage, removed from respective packaging treatments and were held in distilled vase water at ambient conditions in the laboratory for recording of different observations. Fresh flowers of var. Sun King were bought from the same greenhouse complex were also held in distilled water in order to use these flowers as control for comparing the treatment effects. Observations on vase life and different postharvest parameters at different intervals in vase were recorded during vase life. Water uptake, fresh weight, bud length and flower diameter were recorded on 2nd, 4th and 6thday of vase life. Membrane stability index (MSI) was recorded on 2nd, 4th and 6th day of vase life. MSI was calculated on the basis of electrolyte leakage (ion leakage) of the petal tissue according to the earlier method (Singh *et al.*, 2008). Carotene pigment content in the petals was recorded on 4th day after ten days of cold storage. Total carotene pigment in the petals was determined by DMSO (Dimethylsulphoxide) method (Hiscox and Israelstam, 1979). The vase life of cold stored and fresh flowers was recorded as per the method suggested by Halevy and Mayak (1979). The vase life of cut flower was evaluated daily by counting the number of days taken for the symptom of shriveling and wilting. The statistical analysis was done by adopting the standard procedures of Panse and Sukhatme (1985) and the results were interpreted accordingly.

RESULTS AND DISCUSSION

Among all the treatments, significantly higher water uptake and fresh weight retention was observed in fresh flowers and cold stored PP packaged flowers (Table 1) over different storage techniques *viz.* wet storage in $Al_2 (SO_4)_3$, water and dry storage in butter paper and dry stored flowers (without any packaging). Cold stored PP packed (T_1) flowers recorded maximum water uptake (58.70 ml) followed by fresh flowers (T_0 53.20 ml) on 2nd dayof vase life whereas , fresh flowers (T_0) recorded maximum water uptake (49.63 ml and 36.80 ml) followed by the cold stored flowers that were PP packed (T_0 48.93 ml and 36.33 ml) on 4th and 6thday after storage (DAS). Fresh weight retention was found to be maximum (9.38, 2.37 and -6.62%) in fresh rose flowers (T_0), which was at par with the cold stored cut flowers packed in polypropylene (T_1, 8.76, 1.62 and -7.46 %) on 2nd, 4th and 6th DAS of vase life. Seal packaging of fresh produce in poly films is known to create modified internal gaseous components passively (Farber *et al.*, 2003), that helps in minimizing metabolic activities during storage and retains fresh produce in normal condition (Zeltzer *et al.*, 2001, Singh *et al.*, 2013). Thus, PP packaging might have contributed in retaining conditions (similar to fresh flowers) that would have thereby resulted into higher water uptake as well as fresh weight retention. Packaging with poly films have been earlier known to enhance water uptake after cold storage as well as retain fresh weight in gladiolus cut spikes (Singh *et al.*, 2007 and Grover *et al.*, 2005), gerbera (Patel and Singh, 2009) and solidago (Zeltzer *et al.*, 2001). Enhanced fresh weight in fresh flowers and cold stored (2°C) PP packaged cut flowers was due to minimal cell damage during storage as evident from higher water uptake.

Maximum pigment content (carotenes 3.89 mg/g fresh weight) in the petals of rose was observed in fresh flowers T_0, which was at par with rose cut flowers packed in polypropylene T_1 (carotenes 3.76 mg/g fresh weight) as recorded on 4th day of vase life (Table 1). Membrane stability index (MSI) was observed maximum in the fresh flowers(T_0 88.47%, 58.73% and 36.67%) which was at par with cut flowers packed in polypropylene, (T_1 87.73%, 57.07% and 35.83%) on 2nd, 4th and 6th DAS as compared to all other storage techniques like butter paper packaging, wet storage in $Al_2(SO_4)_3$ solution and

Table 1: Effect of different storage techniques (wet and dry) on qualitative parameters of rose var. Sun King

Storage Technique	Water uptake (mL)			Fresh weight (%)			Carotenes content (mg/g fresh weight)
Day After Storage	2nd day	4th day	6th day	2nd day	4th day	6th day	4thday
T_0 (Control, Fresh Flowers, no storage)	53.2	49.63	36.80	9.38	2.37	-6.62	3.89
T_1 (Polypropylene)	58.7	48.93	36.33	8.76	1.62	-7.46	3.76
T_2(Butter paper)	9.6	6.43	1.30	-25.84	-33.46	-42.57	1.37
T_3(200mg/l $Al_2(SO_4)_3$)	43.1	38.72	21.33	7.96	-7.89	-12.42	2.28
T_4 (Water)	33.3	27.30	17.17	6.68	-13.30	-13.07	2.16
T_5 (Without any packaging)	6.3	4.40	0.93	-37.39	-42.46	-49.92	1.32
S.E.m ±.	0.525	0.243	0.200	0.216	0.202	0.308	0.101
C.D. at 5 %	1.53	0.71	0.58	0.63	0.59	0.9	0.31
CV %	6.32	3.39	4.17	5.41	5.21	6.25	7.09

Table 2: Effect of different storage techniques (wet and dry) on quantitative parameters and vase life of rose var. Sun King

Storage Technology	Bud size (cm)			Flower diameter (cm)			MSI (%)			Vase life
Day After Storage	2nd day	4th day	6th day	2nd day	4th day	6th day	2nd day	4thday	6thday	
T_0 (Control, Fresh Flowers, no storage)	4.97	5.37	5.13	4.93	6.53	7.10	88.47	58.73	36.67	4.83
T_1 (Polypropylene)	4.93	5.23	4.94	4.77	6.37	6.77	87.73	57.07	35.83	4.73
T_2(Butter paper)	4.13	3.43	3.13	3.07	3.40	3.53	32.70	25.17	22.03	1.03
T_3[200 mg/l $Al_2(SO_4)_3$]	4.83	4.57	3.90	6.30	5.77	5.94	73.97	47.70	23.57	3.03
T_4 (Water)	4.60	4.13	3.83	5.93	5.53	5.83	67.60	37.97	20.83	2.17
T_5 (Without any packaging)	4.07	3.87	3.00	3.13	3.17	3.30	31.47	24.53	21.17	1.07
S.E.m ±.	0.061	0.057	0.06	0.05	0.06	0.06	0.36	0.40	0.28	0.05
C.D. at 5 %	0.18	0.17	0.19	0.16	0.18	0.19	1.05	1.18	0.83	0.14
CV %	6.46	6.30	7.98	5.45	5.63	5.67	2.37	3.94	4.36	7.10

holding in water (Table 2). Further, maximum bud size in terms of length (4.97, 5.37 and 5.13cm) as well as flower diameter (4.93, 6.53 and 7.10 cm) was observed in fresh flowers T_0, which was at par with cut flowers packed in polypropylene T_1 (length 4.93, 5.23 and 4.94 cm) and(diameter 4.77, 6.37 and 6.77cm) on 2nd, 4th and 6th DAS, Table 2. Higher pigment content can be attributed to the retention of higher fresh weight and petal tissue integrity as evidenced from retained MSI level. The enhanced water uptake by fresh rose cut flowers and in cut roses that were PP packaged might have increased the cell-turgidity and cell enlargement leading to petal expansion as also observed earlier in gladiolus (Grover *et al.,* 2009) and gerbera (Patel and Singh, 2009).

Storage techniques significantly influenced vase life after cold storage in cut roses. Maximum vase life was recorded in fresh flowers ,T_0 (4.83 days) which was at par with cut flowers that were packed in polypropylene and stored in cold storage for ten days (T_1,4.73 days). There was minimal cell damage in PP packed rose cut flowers during storage as indicated by higher water uptake and maximum retained fresh weight. One of the positive effects of modified atmosphere conditions during low temperature storage is the reduction of water loss from the produce (Saltveit, 1997). A strong relationship of water imbalance with electrolyte leakage and shortened vase life in rose has been earlier indicated (Mayak and Halevy, 1974, Izumi *et al.*, 1997, Singh *et al.*, 2013). Thus, reduced water stress in PP packaged cold stored roses with maintained cellular structure indicated with higher MSI of the petal tissue ultimately delayed petal senescence and increased vase life as compared to roses stored with other treatments.

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