

Effect of pulsing and wet cool storage on postharvest life and quality of rose cultivars

Vinod Kumar, S.K. Bhattacharjee and Suchitra

Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi-110012, India

Abstract

An experiment was conducted to find out the effect of pulsing and wet cool storage on postharvest life and quality of rose cultivars. A pulse treatment of DMSO (2 per cent) was given for 15 minutes to cv. 'Noblesse' and 'Mercedes'. The stems were wet cool stored at 4°C for 1, 2, 3, 4 and 5 days. In 'Noblesse', at 5 days storage changes in fresh weight was found 1.72, 4.11 and -2.60g after cool storage, on 3rd day in vase and on senescence day, respectively while in case of 'Mercedes', it was 0.77, 1.83 (at 3 days storage) and -1.89g (at 4 days storage). Changes in dry weight after wet cool storage, on 3rd day in vase and on senescence day was found 0.34, 0.82 and -1.85g at 5 days storage in case of 'Noblesse' while in 'Mercedes' it was 0.15 (at 5 days storage), 0.36 (at 3 days storage) and -0.37g (at 4 days storage). Of the two cultivars 'Noblesse' was found best in respect to water uptake (58.66 ml) and flower diameter (7.73 cm) and vase life (18.33 days) under 1 day storage. Rose cultivars 'Noblesse' and 'Mercedes' can be wet cool stored at 4°C for a maximum period of 2 and 4 days, respectively without affecting their ultimate vase life and quality over the control.

Key words: Pulsing, DMSO, wet cool storage, postharvest life

Introduction

Rose is a major ornamental plant highly valued as cut flower crop and postharvest life of cut flowers can be enhanced by low temperature storage. It is considered best for its easy operation and better timeliness, which ultimately maintain the quality of the flowers by retarding physiological and biochemical deterioration. Pulsing treatment prevents vascular infections and inhibits ethylene production resulting prolonged storage period and higher quality flowers with increased vase life (Halevy and Mayak, 1974 a,b, 1981; Rudnicki *et al.*, 1981; Paulin 1986; Sankar Vidhya and Bhattacharjee, 2002)

The objective of our study was to determine the effects of pulse treatment of DMSO followed by wet cool storage on duration of vase life and quality of rose cut flowers.

Materials and methods

Rose cultivars 'Noblesse' and 'Mercedes' were procured from the greenhouse of Indo-Israel Project, IARI, New Delhi. After giving pulsing treatment with DMSO (2 per cent) for 15 min., the cut flowers were wet cool stored at 4°C for duration of 1, 2, 3, 4 and 5 days. The experiment was laid out in completely randomized design (CRD). Separate experiment was laid with both cultivars. There were six different treatments including control, replicated three times and six flowers kept for each replication. After different storage treatments, the cut ends of the cut flower stems were dipped individually in equal sized large test tubes (25 x 200 mm) containing 60 ml of tap water for vase life evaluation.

Results and discussion

Changes in fresh and dry weight of cut roses cv. Noblesse: It can be revealed from Table 1 that pulsing and wet cool storage had significant effects on changes in fresh and dry weight and vase

life of cut roses. The increase in fresh weight from 0.75 g (1 day storage) to 1.72 g (5 days storage) was recorded. Fresh weight changes on 3rd day in vase under 5 days storage (4.11 g) to 1 day storage (2.20 g). At senescence, the maximum loss (2.60 g) in fresh weight was recorded in 5 days storage. Dry weight of cut flowers after wet cool storage vary from 0.15 g to 0.34 g in 1 day to 5 days storage, respectively. Dry weight changes on 3rd day in vase under 5 days storage (0.82 g) to 1 day storage (0.46 g). At senescence, maximum loss in dry weight was recorded in 5 days storage (1.85 g) while at 2 days storage the dry weight loss was 0.15 g. With the increase in storage period there was marked reduction in vase life from 18.33 days (1 day storage) to 15.00 days (5 days storage).

Flower quality and vase life of cut roses cv. Noblesse: It is evident from Table 2 that on 3rd day in vase, the maximum water uptake (17.00 ml) was recorded in 1 day storage while minimum (11.75 ml) in 5 days storage. At senescence in vase, maximum water uptake (58.66 ml) in 1 day storage while minimum (50.00 ml) in 5 days storage was recorded. There is increase in the diameter of flowers after cool storage with increase in storage days. Maximum diameter (4.58 cm) was recorded in 5 days storage while minimum 3.60 cm in 1 day storage. Flower diameter on 3rd day in vase reveals that 2 days stored flowers possess maximum diameter (5.60 cm) while minimum (5.07 cm) in 5 days stored flowers. Flower diameter at senescence day in vase reveals that with increase in storage days there is subsequent reduction in flower diameter. Maximum flower diameter (7.73 cm) was recorded in 1 day stored flowers while minimum (6.00 cm) in 5 days stored flowers. It has been observed that cut flowers can be wet cool stored for 2 days after pulsing without affecting the vase life and quality.

Changes in fresh and dry weight of cut roses cv. Mercedes: Pulsing and wet cool storage had significant effects on changes in fresh and dry weight after cool storage, on 3rd day in vase and

Table 1. Effect of pulsing with DMSO (2 %) and wet cool storage (4°C) on changes in fresh and dry weight of cut roses cv. Noblesse

Storage days	Changes in fresh weight (g)			Changes in dry weight (g)			Vase life (days)
	After cool storage	On 3 rd day in vase	On senescence day in vase	After cool storage	On 3 rd day in vase	On senescence day in vase	
1	0.75	2.20	-0.66	0.15	0.46	-0.22	18.33
2	0.98	3.38	-0.41	0.18	0.65	-0.15	16.66
3	1.04	3.47	-0.96	0.20	0.70	-0.35	16.00
4	1.06	3.81	-0.68	0.21	0.76	-0.26	15.33
5	1.72	4.11	-2.60	0.34	0.82	-1.85	15.00
Control	-	2.19	-1.65	-	0.43	-0.34	15.25
SEm ±	0.02	0.06	0.03	0.01	0.01	0.01	0.29
CD ($p=0.05$)	0.06	0.19	0.09	0.05	0.04	0.05	0.93

- Indicate loss in fresh/dry weight over the fresh/dry weight at harvest

a Cut flowers neither pulsed nor stored

Table 2. Effect of pulsing with DMSO (2%) and wet cool storage (4°C) on flower quality and vase life of cut roses cv. Noblesse

Storage days	Water uptake (ml)		Flower diameter (cm)			Vase life (days)
	On 3 rd day in vase	On senescence day in vase	After cool storage	On 3 rd day in vase	On senescence day in vase	
1	17.00	58.66	3.60	5.37	7.73	18.33
2	16.50	53.33	4.00	5.60	6.86	16.66
3	13.75	52.00	4.00	5.35	6.46	16.00
4	12.50	51.66	4.18	5.25	6.23	15.33
5	11.75	50.00	4.58	5.07	6.00	15.00
Control	19.00	46.00	3.20	5.26	7.45	15.25
SEm ±	0.27	1.15	0.08	0.09	0.14	0.29
CD ($p=0.05$)	0.87	3.64	0.27	NS	NS	0.93

- Indicate loss in fresh/dry weight over the fresh/dry weight at harvest

a Cut flowers neither pulsed nor stored

** Highly significant

on senescence day (Table 3). Maximum gain in fresh weight after cool storage was recorded under 5 days storage (0.77 g) while minimum (0.28 g) under 1 day storage. Maximum gain in fresh weight on 3rd day in vase was recorded under 3 days storage (1.83 g) while minimum (1.34 g) under 1 day storage. Maximum loss in fresh weight of cut roses was recorded under 4 days storage (1.89 g) while minimum (0.58 g) under 1 day storage. There is marked increase in dry weight of cut roses after cool storage with increase in storage days. Maximum dry weight gain was recorded after cool storage (0.15 g) in 5 days storage while minimum (0.07 g) under 1 day storage. On 3rd day in vase, maximum gain in dry weight was recorded under 3 days storage (0.36 g) while minimum (0.25 g) under 1 day storage. At senescence day maximum loss in dry weight was recorded under 4 days storage (0.37 g) while minimum (0.15 g) under 1 day storage.

Flower quality and vase life of cut roses cv. Mercedes: Perusal of Table 4 indicate that pulsing and wet cool storage had significant effects on water uptake, flower diameter and vase life. On 3rd day in vase, maximum water uptake was recorded under 1 day storage (16.00 ml) while minimum (8.50 ml) under 5 days storage. At senescence day, maximum water uptake was recorded under 1 day storage (55.66 ml) while minimum (47.00 ml) under 4 days storage. Flower diameter increased after cool storage with the increase in storage duration. After cool storage maximum diameter

was recorded under 3 days storage (4.12 cm) while minimum under 1 day storage (3.14 cm). Maximum diameter on 3rd day in vase, was recorded under 5 days storage (6.15 cm) while minimum (5.12 cm) under 1 day storage. At senescence day, maximum flower diameter was recorded under 1 day storage (7.10 cm) while minimum (6.54 cm) under 5 days storage. Pulsing of cut roses with DMSO (2 %) and storing the same for 4 days at (4°C) did not affect the ultimate vase life and quality over the control.

Increasing wet cool storage period from 1 to 5 days at 4°C increased fresh weight after storage duration. During storage period the flowers were handled in water (wet cool storage) so that the turgidity of the flowers might have increased. Moreover the flowers were in continuous development stage. This may be the reason for the increased fresh weight after storage. Rajan (1993) found that a gradual increase in fresh and dry weight of cut roses immediately after storage over eight days of storage which could be due to water uptake during storage. This may be due to reduced transpiration (Faragher *et al.*, 1984) and increased stem resistance to water flow (De Stigter, 1980). Both fresh and dry weight of all cut rose cultivars reduced at senescence stage irrespective of storage treatments and cultivars. This may be due to loss in petal water content and excessive transpiration at ambient temperatures. Sultan and Farooq (1997) had observed similar trend in loss of fresh and dry weight in *Hemerocallis fulva* and Coorts (1973) in roses.

The variation in the vase life, water uptake and flower diameter

Table 3. Effect of pulsing with DMSO (2 %) and wet cool storage (4 °C) on changes in fresh and dry weight of cut roses cv. Mercedes

Storage days	Changes in fresh weight (g)			Changes in dry weight (g)			Vase life (days)
	After cool storage	On 3 rd day in vase	On senescence day in vase	After cool storage	On 3 rd day in vase	On senescence day in vase	
1	0.28	1.34	-0.58	0.07	0.25	-0.15	15.66
2	0.44	1.54	-0.92	0.08	0.31	-0.19	14.33
3	0.47	1.83	-1.46	0.09	0.36	-0.27	14.33
4	0.56	1.41	-1.89	0.11	0.28	-0.37	13.66
5	0.77	1.37	-1.38	0.15	0.27	-0.27	13.00
Control	-	1.08	-0.74	-	0.21	-0.15	12.25
SEm ±	0.01	0.03	0.03	0.01	0.02	0.01	0.30
CD (p=0.05)	0.04	0.11	0.09	0.03	0.05	0.03	0.97

- Indicate loss in fresh/dry weight over the fresh/dry weight at harvest

Table 4. Effect of pulsing with DMSO (2%) and wet cool storage (4 °C) on flower quality and vase life of cut roses cv. Mercedes

Storage days	Water uptake (ml)		Flower diameter (cm)			Vase life (days)
	On 3 rd day in vase	On senescence day in vase	After cool storage	On 3 rd day in vase	On senescence day in vase	
1	16.00	55.66	3.14	5.12	7.10	15.66
2	13.00	50.66	3.76	5.65	6.86	14.33
3	10.00	49.00	4.12	5.77	6.80	14.33
4	13.50	47.00	4.06	5.52	6.73	13.66
5	8.50	48.33	4.08	6.15	6.54	13.00
Control	6.80	35.75	3.12	5.20	5.45	12.25
SEm ±	0.21	0.89	0.07	0.12	0.16	0.30
CD (p=0.05)	0.69	2.80	0.22	0.37	0.51	0.97

among the cultivars under present investigation might be due to differences in the senescing behaviour by producing higher amount of ACC, ethylene forming enzymes and ethylene (Accati and Jona, 1989) and genetic make up of the cultivars (Abdel Kader and Roger, 1986 ; Gelder, 1989).

Wilkins (1983) reported that open carnation (*Dianthus caryophyllus* L.) flowers survived storage at -3°C for 15 days, after pulsing with DMSO (6 per cent) and still showed a vase life of 7.5 days. He attributed this to the cryoprotectant nature of DMSO. But the physiological mechanism by which DMSO influenced vase life is not clear (Xu *et al.*, 1998). Pulsing treatment with DMSO (2 per cent) for 15 minutes improved the vase life and quality of both cultivars under present investigation. This result is similar to the findings of Sankar Vidhya (2001). Plant cells contain considerable amounts of non-protein thiols which are involved in many molecular, metabolic and physiological functions via thiol/disulphide exchange reactions (Kunert and Foyer, 1993). Thiols are important antioxidants involved in DNA and protein synthesis as well as the activation and inactivation of enzymes. There was significant variation in their water uptake, changes in fresh and dry weight at different stages, longevity and quality. Maximum vase life of 18.33 days was recorded in cv. Noblesse in comparison to 'Mercedes' (15.66 days). Rose cv. Noblesse was found best in respect to water uptake (58.66 ml) and flower diameter (7.73 cm) in 1 day wet cool storage. Differences in flower longevity and quality among varieties may be due to difference in anatomical, physiological,

physical, biochemical and genetic make up. Variation in vase life among the two cultivars may be attributed to differences in number of thick walled supporting cells in the xylem element and phloem fibres and presence or absence of a complete ring of secondary thickening in the flower peduncle (Zamski *et al.*, 1991). Even stomatal activity especially poor closure of leaves can affect flower vase life (Mayak *et al.*, 1974). Variation in water uptake among different cultivars may be due to differences in leaf diffusive resistance of leaves in the field (Jodo *et al.*, 1989) or difference in bacterial or fungal species gaining predominance in vase water (De Stigter and Broekhuysen, 1986).

References

- Abdel Kadar, S. and M.N. Roger, 1986. Postharvest treatment of *Gerbera jamesonii*. *Acta Hortic.*, 181:169-176.
- Accati, E.G. and R. Jona, 1989. Parameters influencing gerbera cut flower longevity. *Acta Hortic.*, 261:63-68.
- Coorts, G.D. 1973. Internal metabolic changes in cut flowers. *Hort. Science*, 8(3):195-198.
- De Stigter, H.C.M. 1980. Water balance of cut and intact 'Sonia' rose plants. *Z. Pflanzenphysiol*, 99:131-140.
- De Stigter, H.C.M. and A.G.M. Broekhuysen, 1986. Role of stem cut surface in cut rose performance. *Acta Hortic.*, 181:359-364
- Faragher, J.D., S. Mayak, T. Tirosh and A.H. Halevy, 1984. Cold storage of rose flowers: effects of cold storage and water loss on opening and vase life of 'Mercedes' roses. *Scientia Hortic.*, 24:368-378.
- Gelder, A. De. 1989. Components of keeping quality used in the variety evaluation. *Acta Hortic.*, 261:233-240.

- Halevy, A.H. and S. Mayak, 1974a. Transport and conditioning of cut flowers. *Acta Hort.*, 43:291-306.
- Halevy, A.H. and S. Mayak, 1974b. Improvement of cut flower quality and longevity by pre-shipment treatments. *Acta Hort.*, 43:335-347.
- Halevy, A.H. and S. Mayak, 1981. Senescence and postharvest physiology of cut flowers. Part2. In: *Horticultural Reviews*, Vol.3 (Janick, J. ed.. AVI Publishing Westport, Conn., pp 59-143.
- Jodo, S., M. Kato, M. Fujioka and I. Fukuyama, 1989. Effect of pulsing and packing materials on postharvest life of roses cv. Happiness. *South Indian Horticulture*, 47:1-6, 361-363.
- Kunert, K.J. and C.H. Foyer, 1993. Thiol/disulphide exchange in plants. In: Sulphur Nutrition and Assimilation in Higher plants regulatory, Agricultural and Environmental Aspects. (L.T.De Dok, Stulen, I. rennerberg, H. Brunold.)
- Mayak, S., A.H. Halevy, S. Sagie, A. Bar-Yosef and B. Bravdo, 1974. The water balance of cut rose flowers. *Physiol. Pl.*, 32:15-22.
- Paulin, A. 1986. Influence of exogenous sugars on the evolution of some senescence parameters of petals. *Acta Hort.*, 181:183-193.
- Rajan, R. 1993. Senescence and postharvest physiology of cut flowers. *Ph. D. Thesis*. IARI, New Delhi.
- Rudnicki, R.M., D. Goszezynska and J. Nowak, 1981. Long storage of carnations: physiological and practical approaches. *Proc. XXI St. Internat. Hort. Cong.*, 2:829-835.
- Sankar Vidhya, M. 2001. Postharvest life and quality of cut roses as affected by storage and packaging. *Ph. D. Thesis*, IARI, New Delhi.
- Sankar Vidhya, M. and S.K. Bhattacharjee, 2002. Pulsing and low temperature storage studies on 'Raktagandha' cut roses. *Floriculture Research Trends in India*. ISOH, New Delhi, pp. 83-86.
- Sultan, M. and S. Farooq, 1997. Flower development and senescence in *Hemerocallis fulva* L. *Plant Physiol. Biochem.*, 24(2):108-109.
- Wilkins, H.F. 1983. The influence of dimethyl sulfoxide (DMSO) and sucrose on storage of carnation at -3 °C. *Scientia Hort.*, 18:391-395.
- Xu, X.D., S.Q. Zheng, J.H. Xu, J.M. Jing, J.S. Huang, and H.Y. Liu, 1998. Effect of smudging sulphur on physiological changes during the deteriorating process of peels picked longans. *J. Fujian-Academy Agric. Sci.*, 13:35-38.
- Zamski, E., F. Starkman, and N. Zieslin, 1991. Mechanical strength and anatomical structure of the peduncle of rose (*Rosa hybrida*) flowers. *Israel J. Bot.*, 40(1):1-6.