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EFFECT OF PULSING TREATMENTS ON PETAL TURGIDITY, MEMBRANE INTEGRITY AND FLOWER QUALITY OF CUT DAFFODIL

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SUMMARY

Effect of different pulsing treatments on physiological behaviour and quality of cut daffodil was studied. Uniform scapes of daffodil at goose-neck stage were pulsed in 11 different pulsing solutions for 2, 3 and 6 hours duration. Pulsing treatments comprised of sucrose 6% alone and in combination with different levels of aluminium sulphate (25, 50 and 75 mg L^{-1}), sodium benzoate (30, 60 and 90 mg L^{-1}) and ascorbic acid (20, 40 and 60 mg L^{-1}). Distilled water without any chemical served as control. After pulsing scapes were transferred into other vases containing distilled water for assessment of their various post harvest attributes. Results indicate that pulsing of daffodil scapes in sucrose (6%) helped in improving the flower turgidity, membrane integrity and vase life as compared to control. Increased pulsing duration positively improve these parameters. Addition of different biocides further improves these parameters with best results in aluminium sulphate, followed by ascorbic acid and sodium benzoate.

***Key words*:Biocide, daffodil, membrane integrity, petal turgidity, sucrose pulsing, vase life**

INTRODUCTION

Daffodil is one of the most popular flowers of the gardens world wide due to their unmatched beauty. In temperate climate daffodils are symbol of spring because they flower among the earliest blooms in spring. It is very much liked for its majestic scapes having attractive, elegant and delicate flowers. However, unfortunately these flowers senesce quickly due to sugar starvation and exhibit very short vase life. Senescence in bulbous flowers has also been largely attributed to oxidative stress which leads to membrane damage and collapse of petals (Jones and McConchie 1995). Early senescence poses difficulties in transport and long distance marketing of flowers. The quality and vase life of cut flowers can be improved by loading them with sugars immediately after harvest as pulsing treatment. Different biocides/ antioxidants have also been used as supplement to the pulsing solutions (Singh *et al*. 2007). However, meagre work has been done in this regard with daffodil. Therefore, in order to delay the senescence and reduce the post harvest losses the present work was planned to find out the effective pulsing treatments for prolonging the vase life and quality of cut daffodil.

MATERIALS AND METHODS

The investigation was conducted in the Division of Floriculture, Medicinal and Aromatic Plants, SKUAST-K, Shalimar during 2006-07. Uniform scapes of daffodil cv. “Pheasants Eye” were harvested at goose-neck stage, plunged immediately into cold water and brought to the laboratory with their basal ends remained in the water. The scapes were then given a slant re-cut to uniform length of 25 cm under distilled water to remove any surface embolism and transferred to vases containing different pulsing solutions comprised of sucrose (Suc 6%) alone, and in different combinations of aluminium sulphate (AS: 25, 50, 75 mg L^{-1}), sodium benzoate (SB: 30, 60, 90

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mg L^{-1}) and ascorbic acid (AA: 20, 40 60 mg L^{-1}) for different durations viz., 2, 4 and 6 hours. Scapes kept in distilled water were served as control. After pulsing the scapes were transferred to vases containing distilled water for recording various observations. The vases were kept in the laboratory at a room temperature of 20 ± 2^0C with a relative humidity of 70 ± 5% under cool light of 2000 lux (12 h). Relative water content (RWC) and membrane stability index (MSI) were measured at full flower open (day 4) and flower senescence (day 12) stages. RWC was measured following the method of Weatherly (1950). The MSI was calculated from the per cent ion leakage in the petal cells as per the method of Health and Parker (1968).

A vase life of flower was measured from the period when cut daffodil scapes were transferred from pulsing solution to distilled water. Sign of wilting on the petals marked the end of vase life. Data obtained were analysed for the critical differences between the means of treatments as per the method of Gomez and Gomez (1984). However, data with regard to only outstanding treatments are outlined and discussed.

RESULTS AND DISCUSSION

Petal RWC and MSI: Pulsing of daffodil scapes in sucrose 6% (P_1) maintained significantly higher petal RWC (84.95 and 34.00%) and MSI (78.07 and 36.09%) both at full open and senescence stages, respectively as compared to minimum RWC (68.44 and 32.03%) and MSI (78.07 and 26.83%) in control (P_{11}) (Table 1). Addition of other preservatives further improved these attributes and P_3 (sucrose 6% + AS 50 mg L^{-1}) was established as the most effective treatment in maintaining the maximum petal turgidity of 85.72% and 37.50% along with the highest membrane stability index of 78.07 and 36.09% at both the respective stages followed by P_9 - sucrose 6% + AA 40 mg L^{-1} (85.670% and 35.29% - RWC; 75.36 and 34.24% - MSI) whereas sodium benzoate (sucrose 6% + SB 60 mg L^{-1} – P_6) showed smallest effects on both RWC (85.04% and 34.25%) as well as MSI (70.83 and 31.11%). As far as pulsing duration is concerned, T_3 (6 hours pulsing) recorded highest RWC (85.03% and 34.77%) with maximum MSI (74.27 and 32.27%) at both the stages, respectively followed by T_2 (4 hours) and T_1 (2 hours). Data also signify that there were sharp and similar decrease in petal turgidity as well as membrane stability when flower pass through developmental stages from full open to senescence.

Table 1. Effects of pulsing treatments on relative water content (RWC) and membrane stability index (MSI) of cut daffodil

Treatment	RWC (%)		MSI (%)	
	Flower open	Flower senescence	Flower open	Flower senescence
Pulsing chemicals				
P_1-Suc 6%	84.95	34.00	70.01	28.68
P_3-Suc 6% + AS (50 mg L^{-1})	85.72	37.50	78.07	36.09
P_6-Suc 6% + SB (60 mg L^{-1})	85.04	34.25	70.83	31.11
P_9-Suc 6% + AA (40 mg L^{-1})	85.67	35.29	75.36	34.24
P_{11}-Distilled water (control)	80.08	32.03	68.44	26.83
CD (*P*=0.05)	0.019	0.082	0.147	0.108
Pulsing duration				
T_1-2 hour	84.75	34.25	70.37	31.03
T_2-4 hour	84.78	34.33	71.77	31.71
T_3-6 hour	85.03	34.77	74.27	32.27
CD (*P*=0.05)	0.010	0.043	0.077	0.057

Suc: Sucrose; AS: Aluminium sulphate; SB: Sodium benzoate; AA: Ascorbic acid

Analyses of the data in terms of interaction effects (Table 2) confirmed that 6 hours pulsing duration (T_3) was superior for all the pulsing treatments as compared to other pulsing durations and as such P_3 x T_3 (sucrose 6% + AS 50 mg L^{-1} with 6 hours of pulsing duration) offered the highest petal RWC (86.22% and 36.82%) along with greatest MSI (82.38 and 37.05%) both at full flower open and senescence stages, respectively. However, interactions of other pulsing treatments with T_3 did not show identical effects at two developmental stages (day 4 and day 12) with respect to both RWC and MSI. The second highest value of RWC (35.92%) and MSI (37.05) at day 12 was recorded with P_2 x T_3 (sucrose 6% + AS 25 mg L^{-1} and 6 hours pulsing)

Table 2. Interaction effects of pulsing treatments and pulsing duration on relative water content (RWC) and membrane stability index (MSI) of cut daffodil

Treatment	RWC (%)		MSI (%)	
	Flower open	Flower senescence	Flower open	Flower senescence
Pulsing chemicals x Pulsing duration				
$P_1 \times T_3$	84.97	34.02	71.43	29.08
$P_2 \times T_3$	85.92	35.92	79.40	36.13
$P_3 \times T_3$	86.22	36.82	82.38	37.05
$P_4 \times T_3$	85.25	35.21	76.03	34.00
$P_5 \times T_3$	85.04	34.17	71.66	30.15
$P_6 \times T_3$	85.04	34.27	73.07	31.53
$P_7 \times T_3$	85.01	34.05	72.24	29.75
$P_8 \times T_3$	85.13	34.35	70.38	32.11
$P_9 \times T_3$	86.51	35.78	77.56	35.20
$P_{10} \times T_3$	85.16	34.65	74.36	33.12
$P_{11} \times T_3$	81.09	31.23	68.43	26.90
CD (*P*=0.05)	0.021	0.067	0.101	0.089

followed by $P_9 \times T_3$ (sucrose 6% + AA 40 mg L^{-1} and 6 hours pulsing) having RWC and MSI values of 35.78 and 35.20%, respectively in opposing to the minimum RWC (31.23% and MSI (26.90%) in $P_{11} \times T_3$ i.e. 6 hours pulsing in distilled water (control).

RWC, also known as relative turgidity is the amount of water present in the tissue in relation to the water content present at full turgidity. Maintenance of higher petal turgidity in sugar treated scapes may be attributed to its role in improving the water uptake by lowering the osmotic potential of flower tissues and decreasing the water loss by closer of stomata (Halevy and Mayak 1974). Further improvement of RWC due to addition of other preservatives may be due to their effects on preventing microbial growth and cleaning the path of water due to xylem blockage (Singh *et al*. 2001). Comparatively better results with increasing pulsing duration may simply be attributed to the accumulation of more amount of sugar in the flower tissues (Halevy and Mayak 1974).

Cellular membranes are selective and dynamic barriers that play an essential role in regulating biochemical events and thus developmental processes in living systems. During senescence there is a progressive loss of membrane integrity resulting in an increased leakage of solutes. AS (Aluminium sulphate) maintained the membrane integrity probably by maintaining a better water balance and thus reduced level of ABA as abscisic acid is reported to stimulate lipoxygenase enzymes and cause high lipid peroxidation, which ultimately deteriorate membrane system (Lynch and Thompson 1984). Improved membrane stability due to SB (sodium benzoate) and AA (ascorbic acid) may be attributed to their role as free radical scavengers as many studies have shown that vase life of cut flowers can be modulated by free radical scavengers suggesting that free radicals are involved in senescence (Singh and Jegadheesan 2003). Deterioration of membrane proteins, that posses special transport capabilities may also be one of the reasons for loss of membrane permeability and higher leakage of ions in untreated spikes (Singh *et al.* 2005).

Flower size and scape length: Data recorded on cup diameter, cup depth and scape length revealed that various treatments do not put forth any significant impact on these parameters hence the data are not given. Nevertheless, among the pulsing treatments Suc 6% + AS 50 mg L^{-1} (P_3) with 6 hours pulsing duration (T_3) alone as well as in combination ($P_3 \times T_3$) still gave better results with a cup diameter of 0.94, 0.86 and 0.98 cm, cup depth of 0.65, 0.51 and 0.69 cm and scape length of 26.63, 25.82 and 26.96 cm, respectively. The increased growth in terms of cup diameter, cup depth and scape length could be attributed to increased volume of fully turgid petal cells. Two of the basic requirements for growth to occur are the carbohydrate source and fully turgid tissues. Sucrose fulfils these two requirements firstly by supplying the tissue with carbohydrates and secondly improving the cell turgidity by decreasing the water potential (Halevy and Mayak 1974, Kofranek and Halevy 1976). Sucrose availability might have facilitated higher rate of respiration necessary for cell division, cell enlargement and providing skeleton for tissue structure, formation of cell constituents and thus caused increased flower and scape growth. Improved membrane integrity might have also contributed in increased growth of

flower and scape by protecting the ion leakage and thus maintaining the optimum metabolic activities.

Vase life: Various pulsing treatments (pulsing chemical or/ and pulsing duration) conspicuously influenced the vase life of cut daffodil (Fig. 1) by shifting the water relation and membrane properties of the flower. Among different pulsing chemicals the maximum influence was put forth by sucrose 6% + AS 50 mg L^{-1} (P_3) which resulted in a vase life of 10.66 days whereas among various pulsing durations a maximum vase life of 10.22 days was recorded with 6 hours pulsing (T_3). However, interactions of pulsing chemical with pulsing duration showed a synergistic influence on vase life of cut daffodil and yielded an enhanced vase life of 11.25 days in case of P_3 x T_3 (sucrose 6% + AS 50 mg L^{-1} plus 6 hours pulsing duration) followed by a vase life of 10. 7 days and 10.13 days in P_9 x T_3 (sucrose 6% + AA 40 mg L^{-1} with 6 hours pulsing) and P_6 x T_3 (sucrose 6% + SB 60 mg L^{-1} with 6 hours pulsing) against the minimum vase life of 7.51 days in P_{11} x T_3 (distilled water with 6 hours pulsing).

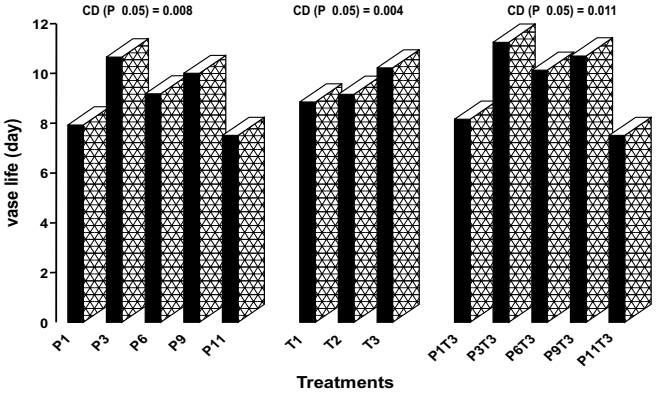

Fig. 1. Effect of pulsing treatments and pulsing duration on vase life of cut daffodil

Vase life of cut flowers is the result of all metabolic activities minus any stress during the pre- and post-harvest period of a particular flower species. An improved vase life of cut daffodil may be the result of higher RWC and membrane integrity throughout the vase period as vase life of cut flowers are depends on the water balance and food reserves. Improved RWC helpful in keeping petals turgid and fresh while addition of sucrose replaced the depletion of carbohydrates from cut stems and maintained respiratory pool there by prolongs vase life (Marousky 1971). In the present study it was also found that vase life of cut daffodil was positively correlated with RWC (r = 0.75**; 0.88**) and membrane stability index (r = 0.85**; 0.94**) at both day 4 (full flower open) and day 12 (near or at senescence) stages which further signify the role of RWC and MSI in maintaining the vase life of cut flowers. Although, sucrose significantly improved vase life of cut daffodil but in absence of biocide it was not so effective in prolonging the vase life. Sucrose in fact encouraged the microbial growth which is inhibited by the presence of biocides. Similar observations were also recorded by Rameshwar (1974) and Khan *et al.* (2007).

It can be summed up that pulsing of scapes in sucrose 6% helped in improving the petal turgidity, membrane integrity and thereby keeping quality (vase life) of cut daffodil. Addition of different biocides further improves these parameters with best results in aluminium sulphate, followed by ascorbic acid and sodium benzoate.

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