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EFFECT OF BIOCIDES ONVASELIFE OF CARNATION CUT FLOWER (*DIANTHUS CARYOPHYLLUS* L.) CV. DONA

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ABSTRACT

The present investigation entitled "Effect of biocides on vase life of carnation cut flower (*Dianthus caryophyllus* L.) cv. Dona under ambient conditions" was carried out in the Floriculture lab, College of Horticulture, Mojerla, S. K. L. T. S. Horticultural UniversityTelangana , India. Experiment was conducted in a Completely Randomized Design with 10 treatments with 3 replications. The treatments consisted of 3 preservative chemicals *viz.*, Aluminium sulphate @ 50, 100 and 150 ppm, Calcium hypochlorite @ 30, 50 and 70 ppm and 8-Hydroxy quinoline sulphate @ 200, 300 and 400 ppm and control (deionised water) along with 4% of sucrose in all treatments was also maintained. The results of the experiment revealed that the best treatment was T_9 (8-HQS at 400 ppm + sucrose @ 4%) recorded significantly maximum WU (Water uptake), TLW (Transpirational loss of water), WB (Water balance), FWC (Fresh weight change), minimum ODVS (Optical density of vase solution) as compared to other treatments. From the above results, it has been concluded that the use of vase solution containing 8- HQS @ 400 ppm + sucrose 4% was found better for increasing the vase life of carnation cv. Dona.

***Key words*:** Carnation, treatment solutions, water uptake, transpirational loss of water, water balance, fresh weight change, optical density and vase solution.

Introduction

Carnation (*Dianthus caryophyllus* L.) belonging to the family Caryophyllaceae, is one of the most important cut flower in the world for its beauty, diversity of colors, excellent keeping quality and wide flower range of forms (Kharrazi *et al.*, 2011). Some of its varieties are used for bedding, pots, rock gardens and window boxes Tah, J and Mamgain A., (2013). Besides aesthetic value, carnation flowers are also considered to be cardio tonic, diaphoretic, alexiteric and nervine (Yasaswini *et al.*, *2011*).

Nowadays, Carnation is one of the most important cut flower and therefore it is important to ensure their longest vase life. Various factors influence the postharvest performance and vase life of cut flowers (Shabanian *et al.*, 2018). To increase the vase life of carnation flowers, several chemicals have been used previously and among them, biocides play an important role. Once the flower gets detached from their mother plant, their ageing process accelerates, hence to delay their ageing process and to increase their vase life, postharvest treatment is crucial (Tsegaw *et al.*, 2011).

Biocides prevents the microbial growth in the solution and prevent blockage of xylem by microorganisms and they have to be added in the vase solution if sugars are added, as the sugar themselves will promote bacterial growth, which results in xylem occlusion (Pranuthi *et al*., 2018). Once flowers are purchased, consumers would enjoy the aesthetic qualities, fragrance and appearance, when they exhibit maximum vase life in various flower arrangements, will be encouraged to buy them again. Hence, there is a need to explore possibilities of extending vase life by using different biocides solutions (Tsegaw *et al*., 2011).

Fig. 1: F.R.S., Rajendranagar, Hyderabad.

Keeping into the comprehensive view of constraints and present market demand, the present investigation entitled "Studies on the effect of biocides and on extension of vase life of carnation cut flower (*Dianthus caryophyllus*. L.) cv. Dona"

Materials and Methods

The present investigation was carried out in the Floriculture lab (Fig. 2), College of Horticulture, Mojerla. The study was taken up in a completely randomized design with 10 treatments replicated thrice. The treatments consisted of T_1 (Aluminium sulphate @ 50 ppm + sucrose 4%), T_2 (Aluminium sulphate @ 100 ppm + sucrose 4%), T_3 (Aluminium sulphate @ 150 ppm + sucrose 4%), T_4 (Calcium hypochlorite -@ 30 ppm + sucrose 4%), T_5 (Calcium hypochlorite @ 50 ppm + sucrose 4%), T_6 (Calcium hypochlorite @ 70 ppm + sucrose 4%) T_7 (8-Hydroxy quinoline sulphate @ 200 ppm + sucrose 4%), T_8 (8-Hydroxy quinoline sulphate @ 300 ppm + sucrose 4%), T_9 (8-Hydroxy quinoline sulphate @ 400 ppm + sucrose 4%) and T_{10} – Control (Deionized water + sucrose 4%).

Carnation (*Dianthus caryophyllus* L.) cv. Dona flowers free from diseases and pests obtained from Floriculture Research Station, Hyderabad (Fig. 1) were used for the experimentation. The stalks were recut under distilled water for a uniform length of 40 cm and the basal three pairs of leaves were removed. 4 flowers are placed in each of 500 ml of conical flasks containing 300 ml of solutions of different treatments. The weight of each container and solution with and without flowers were recorded once on two days, while recording the weights re-cutting the base of floral stems (about 0.5 cm) was done. The observations of flower were recorded in alternate days. Water uptake (WU), Transpirational loss of water (TLW), Water balance (WB) was observed and expressed as gram per flower (g flower^{-1}) and fresh weight change (FWC) was recorded as percentage of initial weight. Optical density of vase solution was measured at every alternate day using spectrophotometer at 480 nmand vase life was observed and expressed in days.

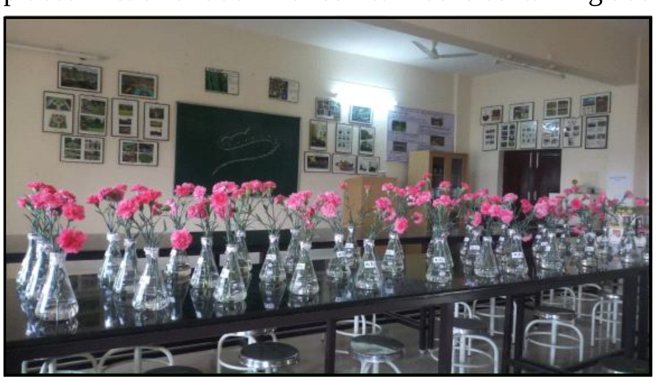

Fig. 2: Floriculture lab, College of Horticulture, Mojerla.

Results and Discussion

Water uptake of carnation cut flowers *cv*. Dona preserved in various preservative solutions varied significantly among all treatments; the flowers preserved in T_9 treatment (8 - HQS @ 400 ppm + sucrose 4%) showed the greatest variation (11.50g flower^{-1}) from the 2nd to the 10th day (10.91 g flower^{-1}) of the vase life period while control (T_{10}) on preservative solution had the lowest water uptake (5.15 g flower^{-1}) on the second day of vase life period (Table 1) (Fig. 4). The combined action of the preservative solution (8-HQS @ 400 ppm + sucrose 4%), may be the cause of the improved water uptake. The enhanced and continuous WU by this treatment might be responsible for delaying of senescence. Sucrose acts as a respiratory substrate for the maintenance of osmotic potential in flowers and improves ability of the tissue to absorb water, hence maintain the turgidity (Halevy *et al*., 1978). Pranuthi *et al.*, (2018) gave better results and found that 8-HQS has germicidal and chelating properties might have reduced the stem blockage and maintained the water conductivity in carnation. Hwang and Kim, (1995) also reported that four per cent of sucrose + 8-HQS @ 200 ppm is known for improvement of mineral salt up take through their

Fig. 3: Maximum vase life-On 10th day.

Table 1. Effect of biocides on water uptake (g $flower^{-1}$) and transpirational loss of water (g $flower^{-1}$) during postharvest vase life of cut carnation cv.

Treatments	Water uptake (g $flower^{-1}$)					Transpirational loss of water (g $flower^{-1}$)				
	Days (D)					Days (D)				
	2	4	6	8	10	2	4	6	8	10
T_1 - Aluminium sulphate @ 50 ppm	9.3	10.95	12.33	10.16	8.38	7.1	9.07	10.92	8.85	7.23
T_2 - Aluminium sulphate @ 100 ppm	8.61	10.2	11.38	9.33	6.68	6.69	8.63	10.03	8.05	5.59
T_3 - Aluminium sulphate @ 150 ppm	7.2	8.65	9.57	7.7	4.93	5.57	7.38	8.51	6.84	4.21
T_4 - Calcium hypochlorite @ 30 ppm	6.58	7.65	8.74	6.66	4.5	5.2	6.38	7.81	5.82	3.86
T_5 - Calcium hypochlorite @50 ppm.	5.61	6.55	7.62	5.4	3.05	4.52	5.57	7.7	5.52	3.45
T_6 - Calcium hypochlorite @ 70 ppm	6.34	7.53	8.6	6.51	4.32	5.16	6.44	7.68	5.74	3.67
T_7 - 8-Hydroxy quinoline sulphate @ 200 ppm	7.98	9.43	10.6	8.61	6.05	6.24	8	9.4	7.62	5.16
T_8 - 8-Hydroxy quinoline sulphate @ 300 ppm	10.6	12.62	14.05	11.81	9.55	8.23	10.35	12	10	8.09
T_9 -8-Hydroxy quinoline sulphate @ 400 ppm.	11.5	13.7	15.21	13.11	10.91	8.65	11.15	12.8	10.75	9.041
T_{10} – Control	5.15	5.4	4.19	2.44	-	3.85	5.5	4.5	2.82	-
Mean	7.89	9.27	10.23	8.17	6.48	6.12	7.85	9.13	7.2	5.59
SEm±	0.067	0.063	0.063	0.064	0.028	0.1	0.05	0.07	0.06	0.04
CD at 5 %	0.19	0.18	0.18	0.18	0.14	0.31	0.17	0.21	0.18	0.12
Note: Sucrose (4%) is substrate for all above treatments										

influence on metal ions which might have resulted in maximum solution uptake in gladiolus. Similar results were also reported by Lol *et al*., (1990) in gladiolus, Reddy and Singh (1996) and Bhasker *et al*., (1999) in tuberose.8-HQS prevented the accumulation of microorganisms in xylem vessels and suppressed the xylem occlusion and increasing vase life, El-gimabi and Siliai (2013). Sucrose might be needed as an osmolyte for flower opening and substrate for cell wall synthesis and respiration (Elhindi, 2012).

The flowers kept in T_9 (8 - HQS @ 400 ppm + sucrose 4%) had the highest transpirational loss of water (8.65 g $flower^{-1}$) from the 2nd to 10th day (9.04 g $flower^{-1}$) (Fig. 5), while the control (T_{10}) had the lowest transpirational loss of water (3.85 g $flower^{-1}$) on second day of the vase life period (Table 1). The highest TLW in T_9 treatment (8-HQS @ 400 ppm + Sucrose @ 4%) was due to adequate and controlled TLW in response of enhanced WU (Halevy *et al.,* 1978). These results are in accordance with the findings of Hema *et al*., (2015) in gerbera and Laxminarayana and Prashanth (2020) in gladiolus.

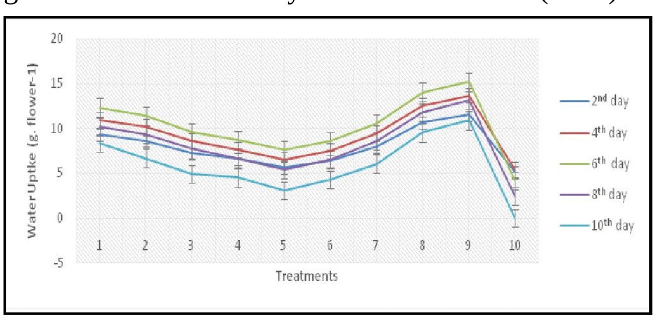

Fig. 4: Effect of biocides on water uptake (g $flower^{-1}$) during postharvest vase life of cut carnation cv. Dona.

The water balance varied greatly between the treatments; flowers in the T_9 treatment (8-HQS @ 400 ppm + sucrose 4%), out of all the treatments, had the highest water balance (4.85 g $flower^{-1}$) and from the 2nd to the 10th day (3.87 g $flower^{-1}$) of the vase life period (Fig. 6), while the control (T_{10}) on preservative solution recorded the lowest water balance (2.95 g $flower^{-1}$) on second day of vase life period (Table 2). Kwon and Kim (2000) reported that 8-HQS plays an important role in improving the water balance of cut freesia by preventing the growth of micro-organisms in xylem and thus maintained water uptake by flower stems. Sucrose which acts as a food source or respiratory substrate and delays the degradation of proteins and improves the water balance of cut flowers (Moon-Soo *et al*., 2001). The present findings are comparable with that of Fahmy (2005) in flower crops, Eligimabi and Ahmed (2009) in rose and Asrar (2012) in snapdragon.

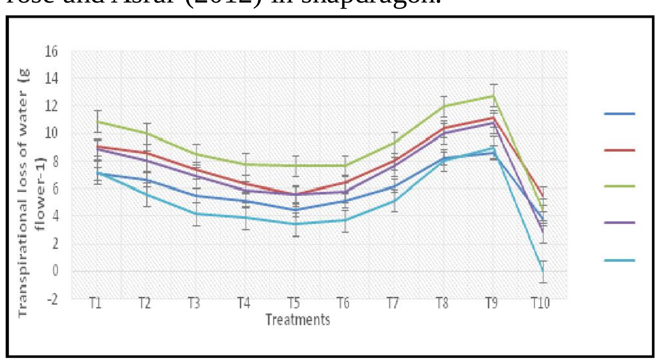

Fig. 5: Effect of biocides on transpirational loss of water (g $flower^{-1}$) during postharvest vase life of cut carnation cv. Dona.

Table 2. Effect of biocides on water balance (g flower^{-1}) and fresh weight change (%) during postharvest vase life of cut carnation cv. Dona.

Treatments	Water balance (g flower^{-1})					Fresh weight chage (%)				
	Days (D)					Days (D)				
	2	4	6	8	10	2	4	6	8	10
T_1 - Aluminium sulphate @ 50 ppm	4.15	3.88	3.41	3.30	3.15	106.98	111.56	116.56	111.75	102.43
T_2 - Aluminium sulphate @ 100 ppm	3.92	3.57	3.35	3.27	3.09	105.13	109.71	114.93	109.99	99.09
T_3 - Aluminium sulphate @ 150 ppm	3.55	3.27	3.05	2.85	2.71	103.70	105.53	109.30	104.45	97.73
T_4 - Calcium hypochlorite @ 30 ppm	3.38	3.26	2.92	2.84	2.63	102.87	105.50	107.91	103.16	95.66
T_5 - Calcium hypochlorite @50 ppm.	3.09	2.97	1.91	1.87	1.60	101.81	103.52	105.85	99.22	93.33
T_6 - Calcium hypochlorite @ 70 ppm	3.17	3.09	2.91	2.77	2.65	102.32	104.55	106.19	100.94	94.88
T_7 - 8-Hydroxy quinoline sulphate @ 200 ppm	3.74	3.42	3.20	2.99	2.89	104.23	107.38	112.35	108.21	98.63
T_8 - 8-Hydroxy quinoline sulphate @ 300 ppm	4.36	4.27	4.04	3.81	3.45	108.45	114.77	123.62	113.79	105.17
T_9 -8-Hydroxy quinoline sulphate @ 400 ppm.	4.85	4.55	4.41	4.35	3.87	110.60	117.26	126.84	117.40	108.08
T_{10} – Control	2.95	1.89	1.691	1.62	-	100.59	101.55	95.03	88.51	-
Mean	3.71	3.42	3.09	2.99	2.89	104.67	108.13	111.86	104.94	94.41
SEm±	0.04	0.03	0.03	0.02	0.02	0.79	0.73	0.74	0.45	0.43
CD at 5 %	0.14	0.09	0.08	0.08	0.07	2.33	1.17	1.15	1.33	1.27

Note: Sucrose (4%) is substrate for all above treatments

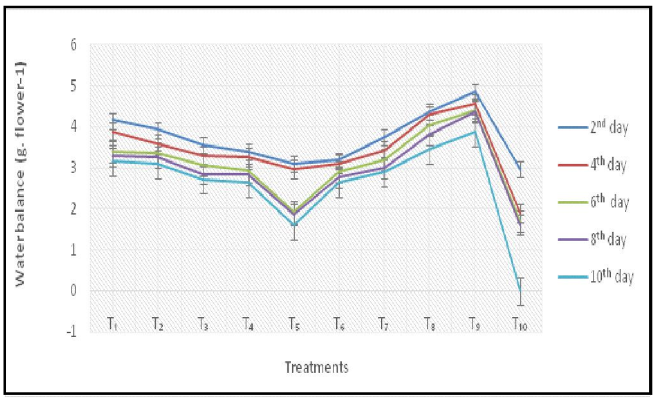

Fig. 6: Effect of biocides on water balance (g flower^{-1}) during postharvest vase life of cut carnation cv. Dona.

The flowers retained in T_9 treatment (8 - HQS @ 400 ppm + sucrose 4%) had the largest fresh weight change (110. 60%) from the 2nd to the 10th day (108.08%), whereas the control group had the lowest fresh weight change (100.59%) on second day of vase life period (Fig. 7) (Table 2). The T_9 treatment (8-HQS @ 400 ppm + Sucrose @ 4%), which had higher fresh weight content than the other treatments, of the flowers at paint brush stage and the synergistic effect of sucrose and 8-HQS might have improved the water uptake, maintained normal levels of transpirational loss of water, improved water balance, thereby increased fresh weight of the flowers as compared to others. The other reason

Table 3: Effect of biocides on optical density of vase solution (ODVS) (at 480 nm) during postharvest vase life of cut carnation cv. Dona.

Treatments	Days				
	2	4	6	8	10
T_1 - Aluminium sulphate @ 50 ppm	0.017	0.023	0.032	0.049	0.06
T_2 - Aluminium sulphate @ 100 ppm	0.018	0.025	0.035	0.051	0.068
T_3 - Aluminium sulphate @ 150 ppm	0.024	0.03	0.041	0.058	0.073
T_4 - Calcium hypochlorite @ 30 ppm	0.027	0.033	0.044	0.06	0.075
T_5 - Calcium hypochlorite @5 0 ppm.	0.031	0.036	0.061	0.074	0.087
T_6 - Calcium hypochlorite @ 70 ppm	0.028	0.034	0.046	0.063	0.078
T_7 - 8-Hydroxy quinoline sulphate @ 200 ppm	0.022	0.028	0.037	0.053	0.07
T_8 - 8-Hydroxy quinoline sulphate @ 300 ppm	0.015	0.02	0.03	0.044	0.053
T_9 - 8-Hydroxy quinoline sulphate @ 400 ppm.	0.012	0.018	0.027	0.038	0.046
T_{10} – Control	0.043	0.053	0.074	0.095	-
Mean	0.024	0.03	0.043	0.058	0.068
SEm±	0.0004	0.0008	0.0004	0.0008	0.0005
CD at 5 %	0.001	0.002	0.001	0.002	0.001

Note: Sucrose (4%) is substrate for all above treatments

Table 4: Effect of biocides on number of days taken to flower opening (days) during post harvest vase life of cut carnation cv. Dona.

Treatments	Days (D)
T_1 - Aluminium sulphate @ 50 ppm	5.83
T_2 - Aluminium sulphate @ 100 ppm	5.50
T_3 - Aluminium sulphate @ 150 ppm	4.83
T_4 - Calcium hypochlorite @ 30 ppm	4.50
T_5 - Calcium hypochlorite @ 50 ppm.	4.16
T_6 - Calcium hypochlorite @ 70 ppm	4.33
T_7 - 8-Hydroxy quinoline sulphate @ 200 ppm	5.16
T_8 - 8-Hydroxy quinoline sulphate @ 300 ppm	6.00
T_9 - 8-Hydroxy quinoline sulphate @ 400 ppm.	6.67
T_{10} – Control (Deionised water)	2.67
Mean	4.96
SEm±	0.13
CD at 5 % or (p = 0.05)	0.41
Note: Sucrose (4%) is substrate for all above treatments	

might also be that the same treatment was registered higher values up to 8th day in terms of WU, TLW and WB led to expand floral organs completely. Other reason might also be due to nonpresence of micro-organisms in the xylem vessels. Prashant (2006) in cut gerbera reported that combination of 8-HQS @ 200 ppm + sucrose increased cut flower longevity by increasing the water uptake and maintaining maximum fresh weight. Similar results also obtained by Sudhagar *et al*., (2018) in gladiolus.

Flowers kept in T_9 treatment (8 - HQS @ 400 ppm + sucrose 4%) had the lowest optical density of vase solution (0.012) on the 2nd day to the 10th day (0.046) (Fig. 8), whereas flowers kept in T_{10} control had the highest ODVS (0.043) on the 2nd day (Table 3). The T_9 treatment (8-HQS @ 400 ppm + Sucrose @ 4%), which had the lowest ODVS value, may have resulted from a low bacterial count because it registered higher WU, TLW, WB, and FWC than the other treatments. According to Witte Y.D. *et al*., (2014), there was a negative link between the number of bacteria and water conductivity in the stem of the cut flower.

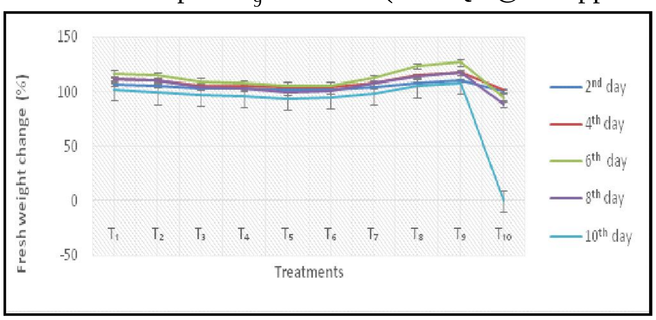

Fig. 7: Effect of biocides onfresh weight change (%) during postharvest vase life of cut carnation cv. Dona.

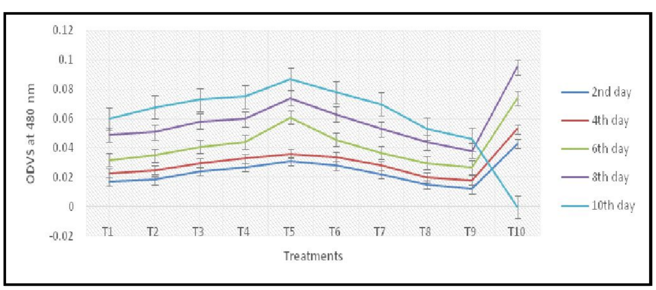

Fig. 8: Effect of biocides on optical density of vase solution (ODVS) (at 480 nm) during postharvest vase life of cut carnation cv. Dona.

Table 5: Effect of biocides on vase life (days) of cut carnation cv. Dona.

Treatments	Days (D)
T_1 - Aluminium sulphate @ 50 ppm	9.66
T_2 - Aluminium sulphate @ 100 ppm	9.16
T_3 - Aluminium sulphate @ 150 ppm	8.00
T_4 - Calcium hypochlorite @ 30 ppm	7.50
T_5 - Calcium hypochlorite @ 50 ppm.	6.33
T_6 - Calcium hypochlorite @ 70 ppm	7.33
T_7 - 8-Hydroxy quinoline sulphate @ 200 ppm	8.33
T_8 - 8-Hydroxy quinoline sulphate @ 300 ppm	10.33
T_9 - 8-Hydroxy quinoline sulphate @ 400 ppm.	11.16
T_{10} – Control (Deionised water)	4.83
Mean	8.26
SEm±	0.23
CD at 5 % or (p = 0.05)	0.69
Note: Sucrose (4%) is substrate for all above treatments	

The highest number of days taken to flower opening

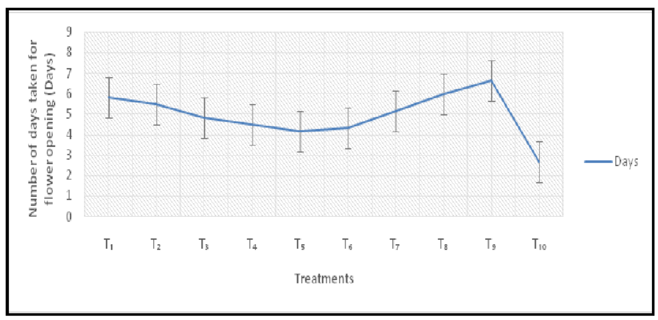

Fig. 9: Effect of biocides on number of days taken for flower opening during postharvest vase life of cut carnation cv. Dona.

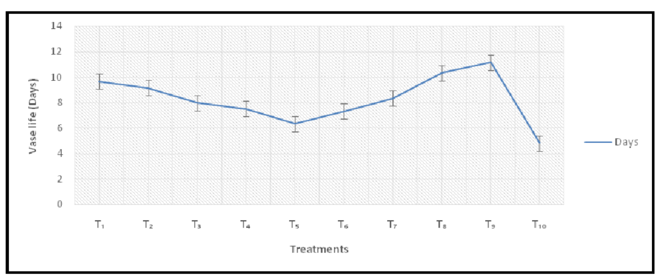

Fig. 10: Effect of biocides on vase life during postharvest vase life of cut carnation cv. Dona.

in (8-HQS @ 400 ppm + Sucrose @ 4%) might be due to the same treatment recorded the best values with respect to WU, TLW, WB, ODVS, floret opening percentage and fresh weight change, ultimately delayed petal withering and resulted in higher number of days taken for flower opening (Table 4). The similar result was also obtained by Elhindi (2012) in sweet pea.

The maximum flower diameter in T_9 (8-HQS @ 400 ppm + Sucrose @ 4%) was due to the same treatment registered maximum number of days 6.66 days to flower opening (Fig. 9) as compared to rest of the treatments (Table 4). Similar results were also reported by Chandrasekhar (1999) in carnation who reported that increasing the trend of diameter of cut flowers during initial period may due to the availability of respiratory substances for flower buds to fully open, similar trend of increasing diameter in carnation cut flowers during initial period and decreased during later days.

Due to varying biocide treatments, cut carnation's vase lives varied greatly. Vase life has been considerably increased by all treatments above control. When compared to other treatments, the flowers kept in 8-HQS @ 400 ppm + Sucrose @ 4% (T_9) (Fig. 3) recorded the highest value (11.16 days) (Table 5), while the control treatment (T_{10}) recorded the lowest value (4.83 days). The T_9 treatment (8-HQS @ 400 ppm + Sucrose @ 4%), which had the longest vase life (Fig. 10), was the cause of the greatest figures WU, TLW, WB, FWC, and lowest ODVS relative to the other treatments. It is clear that, among the treatments T_9 (8-HQS @ 400 ppm + Sucrose @ 4%) recorded the highest vase life was due to the same treatment registered the best figures *viz*., WU, TLW, WB, FWC, ODVS, number of days taken to flower opening and flower diameter over others. The other reason might that 8-HQS itself reduced the transpiration and improved water balance due to stomatal closure might have added to keep the flowers fresh for a longer duration. The present results are in accordance with the findings of Jeenbuntug *et al*., (2007) in tuberose, Abdul and Asrar (2012) in snapdragon, Banaee *et al*., (2013) in gerbera, Kamaran *et al*., (2014) and Davood *et al*., (2015a) in carnation. Sucrose act as an osmotically active molecule, thereby having a role in subsequent water relations (Kuiper *et al*., 1995) the use of sucrose (with or without certain biocides and preservatives) as pulsing solutions could be of practical significance in prolonging the vase life of cut flowers (Cameron and Reid, 2001). The other possibility is that 8-HQS itself helped to keep the blooms fresher for longer by reducing transpiration and improving water balance as a result of stomatal closure. The current results are consistent with those of Abdul and Asrar (2012) in snapdragon and (Banaee *et al*., 2013) in gerbera.

Conclusion

It is possible to draw the conclusion from the study's findings that every chemical employed in it extended the vase life of the carnation flowers. According to the current study, treatments with 8-HQS at 400 ppm and 4% sucrose have improved floral quality by lengthening the vase life through better water uptake, transpirational water loss, water balance, and fresh weight change by inhibiting microbial development in the solution. Consequently, a commercial cut flower preservative solution containing 8-HQS @ 400 ppm and 4% sucrose has the potential to be employed to extend the vase life and postharvest quality of carnation cut flowers.

Future Scope

It is possible to replicate this investigation with different kinds. The vase life, quality, and biochemical parameters of the flowers may be examined with an increased quantity of preservative solutions. It is possible to examine how natural preservatives affect the flowers' biochemical characteristics, vase life, and quality. To prolong vase life, metallic nanoparticles possibly produced sustainably can be incorporated. Eco-friendly holding or pulse solutions made with creative methods that include the use of coconut water, lemon extract, etc.

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