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Efficacy of floral preservatives on physiological changes and keeping quality of cut carnation (*Dianthus caryophyllus* L.) cv. Domingo

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ABSTRACT

The present study on the efficacy of certain floral preservatives on physiological changes of cut carnation (Dianthus caryophyllus L.) cv. Domingowas carried out at Floriculture complex, Annamalai University, Annamalainagar during 2017-18. The experiment was laid out in completely randomized design (CRD) with 13 treatments using different combinations of three chemicals viz., nano silver (10, 20, 30 and 40 ppm), sucrose (2, 4 and 6 %) and citric acid (50, 100, 150 and 200 ppm) along with control (distilled water). All the treatments with floral preservatives showed significant effect on physiological changes and keeping quality of cut carnation over control. The treatment having4 % sucrose + 40 ppmnano silver + 200 ppmcitric acidexcelled other treatments by recording the lowest cumulative physiological loss of weight (0.14 %), minimum cumulative transpirational loss of water (9.07, 17.35 and 24.99 g. flower^{-1} on 3, 5 and 7 day), the maximum increase in cumulative uptake of water (14.77, 26.31 and 36.92 g. flower^{-1} on 3, 5 and 7 day, respectively), the maximum days for flower freshness (7.88),the maximum number of days taken for flower discolouration (7.62), minimum percentage of wilted flowers (12.17, 48.67 and 73.85 on 3, 5 and 7 day, respectively), the maximum cut flower fresh weight of 12.90, 15.60 and 10.65 g.flower^{-1} on 3, 5 and 7 day, respectively and maximum vase life (7.87 days). The next best results on these parameters were obtained with 2 % sucrose + 30 ppmnano silver+ 150 ppmcitric acid. The maximum physiology loss of weight, maximum cumulative transpiration loss of water, minimum increase in cumulative uptake of percen tage of wilted flowers were recorded under control.

Key words: cut flower, carnation, nano silver, citric acid, sucrose, keeping quality

INTRODUCTION

Carnation (*Dianthus caryophyllus* L.), belongs to the family Caryophyllaceae is one of the important cut flowers in the world wide next to rose and gladiolus. Carnation is known as “The flower of god”. Carnation comes in numerous colours and each colour of carnation has a different meaning. Along with the red rose, the red carnation can be used as symbol of socialism and the labour movementand historically has often been used in demonstrations on international workers day (May Day). Addition of chemicals to the holding solution is recommended to prolong the vase life of cut flowers. All holding solutions must essentially contain components *viz.,* sugar, chemicals and germicides. The sugar and chemicals provide a respiratory substrate, while the germicides control harmful bacteria and prevent plugging of the conducting tissue (Nair *et al.*, 2003). Preservative solutions can be used for different purpose like pulsing, conditioning and holding. It also controls growth of bacteria and fungi in the vase solution mainly because of their germicidal property. Pulsing of flowers before storage helps to improve post storage life of cut flowers (Kumar *et al.,* 2020). One of the major preservative used to control bacteria is silver. Use of silver can reduce the development of bacteria in the vase solution. Nano silver are especially attractive for their antimicrobial sterilization features among the nanoparticles (Solgi, 2014). Because of their high surface area to volume ratio nanometer sized silver (Ag^{+}) particles are considered to inhibit bacteria and other microorganisms more strongly than Ag in various oxidation states. With the above facts in mind, the present investigation was carried out to study the efficacy of certain floral preservatives on physiological changes and keeping quality of cut carnation cv. Domingo.

MATERIALS AND METHODS

The present investigation was carried out at the Floriculture complex, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai nagar during 2017-2018. An experiment was laid out in completely

randomized design with three replications and 13 treatments. The treatments were: T_1 – Control (tap water), T_2 - Sucrose 2 % + nanosilver 10 ppm+ citric acid 50 ppm, T_3 - Sucrose 2 % + nanosilver 20 ppm+ citric acid 100 ppm, T_4 - Sucrose 2 % + nanosilver 30 ppm+ citric acid 150 ppm, T_5 -Sucrose 2 % + nanosilver 40 ppm+ citric acid 200 ppm, T_6 -Sucrose 4 % + nanosilver 10 ppm+ citric acid 50 ppm, T_7 - Sucrose 4 % + nanosilver 20 ppm+ citric acid 100 ppm, T_8 - Sucrose 4 % + nanosilver 30 ppm+ citric acid 150 ppm, T_9 - Sucrose 4 % + nanosilver 40 ppm+ citric acid 200 ppm, T_{10} - Sucrose 6 % + nanosilver 10 ppm + citric acid 50 ppm, T_{11} - Sucrose 6 % + nanosilver 20 ppm+ citric acid 100 ppm, T_{12} - Sucrose 6 % + nanosilver 30 ppm+ citric acid 150 ppm and T_{13} - Sucrose 6 % + nanosilver 40 ppm+ citric acid 200 ppm. The standard type cultivars of carnation Domingo (red) were used in this study. The stalks were cut to a uniform length of 30 cm and the basal two pairs of leaves were removed. Each flower was placed in a 500 ml bottle containing 250 ml of different holding solutions containing sucrose, nano silver and citric acid as described in treatment schedule. Two stalks were used per replications in this experiment. Observations were recorded on cumulative physiological loss of weight (CPLW), cumulative transpirational loss of water (CTLW), cumulative uptake of water (CUW), days taken for freshness of flowers, days taken for flower discolouration, percentage of wilted flowers, fresh weight of cut flowers and vase life of cut flowers. The data generated were subjected to statistical analysis. The data were tested for their level of significance at P=0.05as per method of Panse and Sukhatme (1985).

RESULT AND DISCUSSION

Cumulative physiological loss of weight (CPLW): Among the nano silver and other chemicals tested, CPLW differed significantly among all the treatments (Table 1). The treatment T_9 (4 % sucrose + 40 ppmnano silver + 200 ppmcitric acid)excelled other treatments by recording the lowest cumulative physiological loss in weight (0.14 %) followed by T_4 (2 % sucrose + 30 ppmnano silver+ 150 ppmcitric acid) with the value of 0.15 %, while the highest CPLW (0.22 %) was found in control. This may be due to antimicrobial characteristic of nano silver which prevent the flower from vascular occlusion, reduced water stress (Raffi *et al.*, 2008).

Cumulative transpirational loss of water (CTLW): The results (Table 1) revealed that all the treatments exhibited great variability for cumulative transpirational loss of water. Among the treatments, minimum cumulative transpirational loss of water of cut carnation was observed with T_9 treatment (9.07, 17.35 and 24.99 g flower^{-1} on 3, 5 and 7 day, respectively). This was followed by T_4-Sucrose 2% + Nanosilver 30 ppm + citric acid 150ppm (11.49, 21.24, 31.17 g.flower^{-1} on 3, 5 and 7 day, respectively). While, T_1- control recorded maximum values (11.72, 21.66 and 31.26 g flower^{-1} on 3, 5 and 7 day, respectively). This may be due to maintenance of cell integrity by salt present in the guard cell which might reduce the stomatal operture thereby resulting in lower cumulative transpirational loss of water (Hongmeili *et al.*, 2012). Distilled water used as vase solution has higher transpirational loss of water. The results are in conformity with the findings of Prashanth and Chandrasekar (2010) in cut gerbera cv. Yanara.

Cumulative uptake of water (CUW): The cumulative uptake of water differed significantly among all the treatments (Table 1) and the maximum cumulative uptake of water 14.77, 26.31 and 36.92 g. flower^{-1} on 3, 5 and 7day was recorded in the flowers treated with 4 % of sucrose + 40 ppm+ 200 ppm of citric acid. The least values were observed in control (8.04, 14.85 and 21.58 g flower^{-1} on 3, 5 and 7 day, respectively). This might be due to the application of nano silver and it acts as a bactericide which shows significant reduction in the microbial population and improved the water uptake (Koohkan *et al.,* 2014). Similar lines of findings were obtained by Sonia Baheehmand (2014) in tuberose.

Table 1: Efficacy of floral preservatives on cumulative physiological loss of weight, cumulative transpirational loss of water and cumulative uptake of water in cut carnation cv. Domingo

Treatments	Cumulative physiological loss of weight (%)	Cumulative transpiration loss of water (g.flower^{-1})			Cumulative uptake of water (g.flower^{-1})		
		3 day	5day	7 day	3 day	5day	7 day
T_1	0.22	11.72	21.66	31.26	8.04	14.85	21.58
T_2	0.18	10.06	19.26	28.03	10.40	18.74	25.08
T_3	0.17	10.40	19.25	27.08	11.91	21.25	29.84
T_4	0.15	11.49	21.24	31.17	13.60	24.68	34.63
T_5	0.20	9.50	18.42	26.43	8.44	15.63	21.27
T_6	0.16	11.06	21.37	30.65	12.12	22.09	30.66
T_7	0.18	10.81	20.02	28.26	11.86	21.87	30.04
T_8	0.16	9.72	18.08	26.74	9.57	17.97	25.14
T_9	0.14	9.07	17.35	24.99	14.77	26.31	36.92
T_{10}	0.17	10.65	20.35	28.78	11.43	21.46	29.87
T_{11}	0.18	10.15	19.78	28.95	9.31	18.22	25.74
T_{12}	0.16	9.93	18.45	26.57	9.54	16.98	24.13
T_{13}	0.21	9.31	17.81	25.65	8.32	15.41	21.34
SED	0.003	0.45	1.43	0.16	0.271	0.39	0.52
CD (p=0.05)	0.006	0.94	2.87	0.32	0.560	0.88	1.05

T_1 – Control (tap water), T_2 - Sucrose 2 % + nanosilver 10 ppm+ citric acid 50 ppm, T_3 - Sucrose 2 % + nanosilver 20 ppm+ citric acid 100 ppm, T_4 - Sucrose 2 % + nanosilver 30 ppm+ citric acid 150 ppm, T_5 -Sucrose 2 % + nanosilver 40 ppm+ citric acid 200 ppm, T_6 -Sucrose 4 % + nanosilver 10 ppm+ citric acid 50 ppm, T_7 -Sucrose 4 % + nanosilver 20 ppm+ citric acid 100 ppm, T_8 - Sucrose 4 % + nanosilver 30 ppm+ citric acid 150 ppm, T_9 - Sucrose 4 % + nanosilver 40 ppm+ citric acid 200 ppm, T_{10} - Sucrose 6 % + nanosilver 10 ppm + citric acid 50 ppm, T_{11} - Sucrose 6 % + nanosilver 20 ppm+ citric acid 100 ppm, T_{12} - Sucrose 6 % + nanosilver 30 ppm+ citric acid 150 ppm and T_{13} -Sucrose 6 % + nanosilver 40 ppm+ citric acid 200 ppm

Freshness of flowers: Thefreshness of flowers differed significantly among all the treatments (Table 2). The maximum days (7.88) for flower freshness in cv. Domingo was observed in the treatment T_9 (40 ppm nano silver + 4 % sucrose + 200 ppmcitric acid), followed by the treatment T_4 (30 ppm nano silver + 2 % sucrose + 150 ppm) which took 7.65 days. The minimum number of days (4.94) taken for flower freshness was observed in the control. This may due to the addition of silver and optimum concentration of sucrose which has a great influence on flower freshness (Mohammad Mahdi Jowkar *et al.,* 2013). Similar line of finding was reported by Khan *et al.* (2015) in cut roses.

Table 2: Efficacy of floral preservatives on freshness of flowers, flower discolouration, wilted flowers, fresh weight and vase life of cut carnation cv. Domingo

Treatments	Freshness of flowers (days)	Flower discolouration (days)	Wilted flowers (%)			Fresh weight(g.flower^{-1})			Vase life (Days)
			3 day	5day	7 day	3 day	5day	7 day	
T_1	4.94	5.40	31.63	79.23	97.25	10.77	13.19	8.39	5.94
T_2	6.17	6.34	22.67	67.45	87.50	11.33	14.42	9.65	6.81
T_3	6.64	6.71	19.28	64.37	83.60	11.83	14.73	9.94	7.09
T_4	7.65	7.45	14.15	57.34	75.80	12.69	15.34	10.40	7.67
T_5	5.43	5.79	27.72	74.80	93.35	11.02	13.93	8.73	6.64
T_6	7.41	7.27	16.47	59.79	77.75	12.48	15.23	10.18	7.49
T_7	7.16	7.08	17.45	61.78	79.70	12.32	15.10	10.09	7.40
T_8	5.66	5.97	25.28	68.40	91.40	11.08	14.99	9.22	6.72
T_9	7.88	7.62	12.17	48.67	73.85	12.90	15.60	10.65	7.87
T_{10}	6.90	6.88	26.25	72.40	81.65	12.06	14.99	9.97	7.32
T_{11}	6.41	6.53	20.94	66.78	85.55	11.56	14.69	9.72	6.99
T_{12}	5.92	6.14	24.54	70.38	89.45	11.25	14.29	9.43	6.73
T_{13}	5.19	5.60	28.67	78.72	95.30	10.93	13.28	8.59	6.15
SED	0.08	0.08	0.68	0.90	0.89	0.08	0.09	0.09	0.09
CD (p = 0.05)	0.18	0.18	1.40	2.54	1.95	0.17	0.18	0.18	0.18

Flower discoloration: Among all the treatments, the maximum number of days (7.62) was taken for flower discoloration in cv. Domingo was observed in the treatment T_9 (40 ppm nano silver + 4 % sucrose + 200 ppmcitric acid), followed by the treatment T_4 (30 ppm nano silver + 2 % sucrose + 150 ppm) which took 7.45 days (Table 2). The minimum number of days (5.40) taken for flower discoloration was observed in the control. This may due to the inhibition of ethylene synthesis, which has become an essential tool for delaying the senescence of cut flowers and also improves the postharvest quality (Mohy Eldeen, 2011). The results were confirmed by Wei *et al.* (2015) in cut gerbera cv. Good timing.

Percentage wilted flowers : Percentage of wilted flower differed significantly among all the treatments (Table 2) and minimum number of wilted flowers (12.17, 48.67 and 73.85 on 3, 5 and 7 day, respectively) was noticed with the flowers treated with 4 % of sucrose + 40 ppm+ 200 ppm of citric acid. The higher values were observed in control (31.63, 79.23 and 97.25 on 3, 5 and 7 day, respectively). This might be due to the proper supply of water and food source, relative water content and water uptake increased with allocation of sucrose treatments, thus resulted in decreased wilting percentage of cut flowers (Bleeksma and Doorn, 2003). These results are in line with the findings of Kader *et al.(*2012) in cut rose.

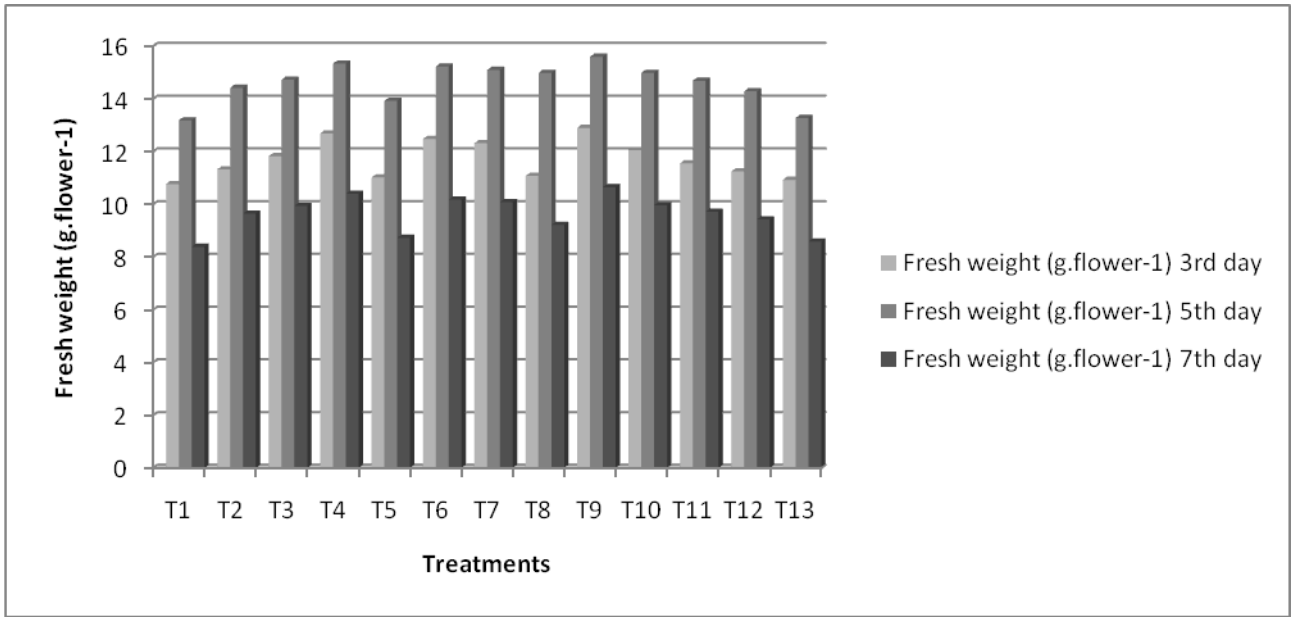

Figure 1: Efficacy of floral preservatives on fresh weight of cut carnation cv. Domingo

Fresh weight of cut flowers: All the treatmentsexhibited significant influence on fresh weight of cut flowers Domingo cultivar of carnation and maximum fresh weights of 12.90, 15.60 and 10.65 g.flower^{-1} on 3, 5 and 7 day, respectively were recorded with 40 ppmnano silver + 4 % sucrose + citric acid 200 ppm (Table 2, Fig. 1). This was followed by 30 ppmnano silver + 2 % sucrose + 150 ppm (12.69, 15.34 and 10.40 g.flower^{-1} on 3, 5 and 7 day, respectively) while the minimum was recorded in the control (10.77, 13.19 and 8.39 on 3, 5 and 7 day, respectively g.flower^{-1}). The beneficial effect of nano silver might have acted as antimicrobial agents, apart from nano silver, sugars acting as an acidifying and anti-ethylene agents resulting in the maximum fresh weight of flower. This increase in evaluations for fresh weight was possibly caused by the increased energy supply from sucrose and the regulation of water by nano silver (Nazemi Rafi *et al.*, 2013).

Vase life of cut flower: Vase life of cut carnation was significantly influenced by all the treatments and maximum vase life (7.87 days) was displayed with 40 ppmnano silver + 4 % sucrose +citric acid 200 ppm followed by 30 ppm nano silver + 2 % sucrose + 150 ppmcitric acid which recorded a vase life of 7.67 days. The lowest vase life (5.94 days) was noticed with

control (Table 2, Fig. 2). This may due to the action of silver attributed to the inhibition of bacterial growth in the vase solution and at the end of cut stems during the time of the post harvest period. Similar findings were made by (Seyed Hussian *et al.,* 2013) in lilium cv. Bouquet.

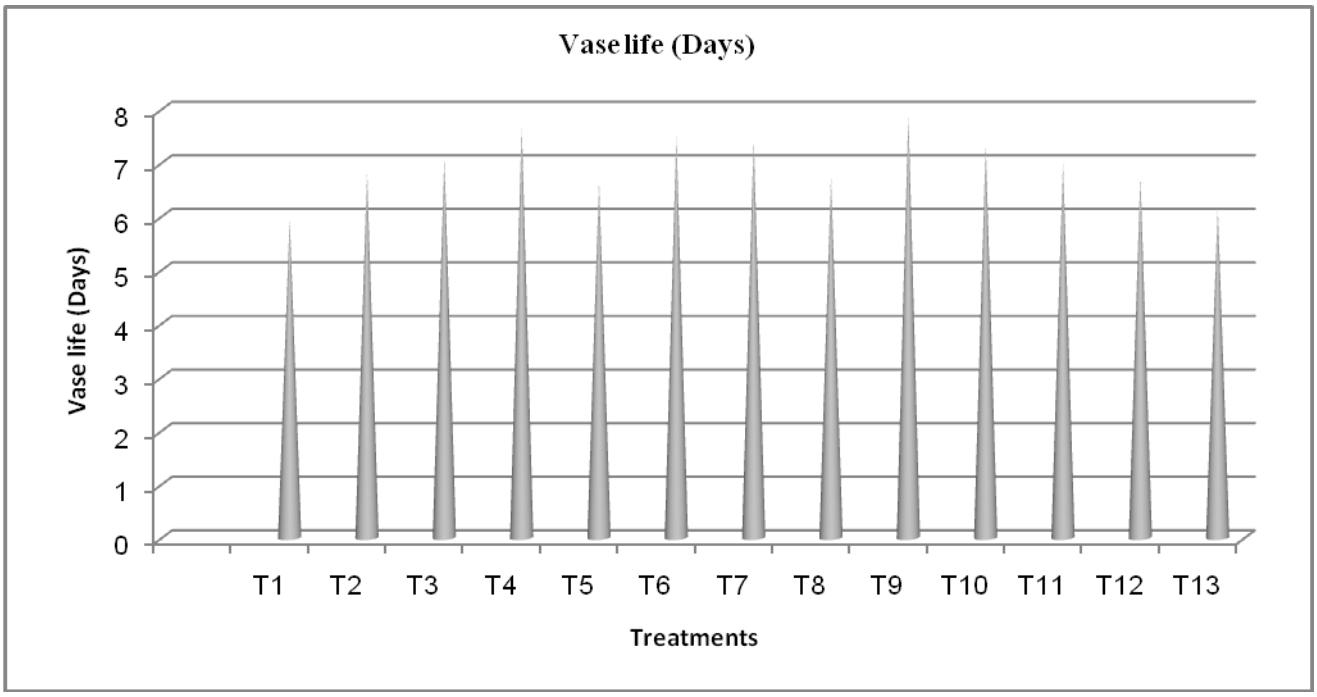

Figure 2: Efficacy of floral preservatives on vase life of cut carnation cv. Domingo

It may be concluded from the results that, the holding solution with 40 ppmnano silver + 4 % sucrose +citric acid 200 ppm the lowest cumulative physiological loss of weight, minimum cumulative transpirational loss of water (CTLW), the maximum increase in cumulative uptake of water, the maximum days for flower freshness, the maximum number of days taken for flower discolouration, minimum percentage of wilted flowers, maximum fresh weight of cut flowers and maximum vase life.

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