Applied Biological Research 18 (1): 16-22; (2016)
DOI: 10.5958/0974-4517.2016.00003.3

EFFECT OF FLORAL PRESERVATIVES ON VASE LIFE OF GERBERA CUT (*Gerbera jamesonii* L.) cv. "Dana Allen"

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(Received 1 October, 2015; accepted 14 December, 2015)

ABSTRACT

The present study, conducted in the Department of Horticulture, J.A.U., Junagadh (India) was aimed to assess the effect of floral preservatives on the vase life of cut gerbera (*Gerbera jamesonii* L.) cv. 'Dana Allen'. The experiment was laid out in a completely randomized design with three replications and nineteen treatment-combination comprising of five floral preservatives *viz.*, sucrose (2 and 3%), 8-HQC [8-hydroxy quinoline citrate] (150 and 200 mg L^{-1}), Al_2SO_4 (25 and 50 mg L^{-1}), $AgNO_3$ (15 and 25 mg L^{-1}) and $Co(NO_3)_2$ (180 and 270 mg L^{-1}) along with an untreated control. The vase solution of 8-HQC @ 200 mg L^{-1} + 2% sucrose enhanced all the qualitative parameters and improved vase life of gerbera. The vase life could be extended upto 13.6 days of cut gerbera. This treatment improved fresh flower weight by 112.3, 104.2, 88.2, 67.1% on 3, 6, 9 and 12th day of vase, respectively. The treatment of 8-HQC @ 200 mg L^{-1} + 2% sucrose resulted in maximum total solution uptake (61.26 mL), flower diameter on 3rd day of vase (11.39 cm) and 50% opening of disc florets (7.28 days), 75% opening of disc florets (8.95 days) and 100% opening of disc florets (11.52 days) in gerbera. It may be concluded that holding solution of 8-HQC along with sucrose may help in extending the vase life of gerbera cut flowers.

Key words: Al_2SO_4, $AgNO_3$, $Co(NO_3)_2$, gerbera, 8-HQC, sucrose, vase life

INTRODUCTION

Gerbera is a beautiful dwarf perennial plant which is used as cut/ garden flower in bouquet and exhibits, because of its variable colours and shapes. Gerbera (*Gerbera jamesonii)* belongs to the family Asteraceae. This group presently comprises of 45 species, native to tropical Asia and Africa. Among the different species of gerbera *viz., G. asplenifolia, G. aurantiaca, G. kunzeana* and *G. jamesonii*, the only species under cultivation is *Gerbera jamesonii* with chromosome number n = x = 25. There are two types of gerberas, one is single which has one or two rows of ray florets and the flower quality is good and another one is double type. Double type is commercially grown because of its more demand. They have more than two rows of ray florets and flower quality is better than single. The leaves are petioled, entire or pinnatly lobed, coarse or sometimes tubular and two lipped. Achenes are beaked; pappus or rough bristles in two or more rows. The daisy like flowers are available in wide range of colours including yellow, red, orange, cream, white, pink, brick red, scarlet, salmon peach, maroon and various other intermediate shades. Gerbera flowers are most susceptible to damage owing to their delicacy and tenderness. Further, cut stems of gerbera are highly prone to water stress due to hollow stem. Blockage of xylem due to bacterial plugging causes stem break thereby reduces flower vase life.

Nearly 30-50% losses of cut flowers occur due to improper post-harvest handling during entire market chain (Singh *et al.,* 2002). There are frequent price gluts and fluctuation in Indian flower market. Physiological, ultra structural and biochemical changes that occur during post harvest life influence the quality of cut flowers (Faragher *et al.,* 1986). Keeping quality of flowers is influenced by internal factors (hormonal balance, age, genetic makeup water balance, etc.) and external factors (environmental and mechanical). Post-harvest metabolic activities like expiration and transpiration influence the vase life of cut flowers. Water balance in flowers also plays an important role in maintaining flower turgidity, freshness, petal orientation and proper bed opening. Water affects the vase life in terms of quality. For instance the presence of fluoride ions in vase water is toxic to flowers of carnation, gerbera, gladiolus and chrysanthemum. The most common cause of termination of vase life in cut flowers was water stress.

The flower carries out its life process at the expense of stored reserve food materials. Due to respiration, flowering stem continues to loss carbohydrate considerably. The depletion of carbohydrate decreases its vase life. The deficiency can, however, be replenished by treatment of cut stem with preservatives containing sugar. Vase solution and pulsing treatments consisting of various chemicals with sugar source are known to improve post-harvest life in various flowers (Salunkhe *et al.,* 1990; Singh *et al.,* 2008). However, carbohydrates, especially sucrose induce growth and control bacterial populations, existing in preservative solution, which consequently tend to embolism of cut flower xylem vessels. Main constituents of vase solution are water, sugar and biocides. Pulsing is short duration treatment constituting of high concentration of sugars along with germicides and/or anti-ethylene chemicals (Bhaskar *et al.,* 2005). It is known to improve flower opening, flower size, shape, colour and longevity of cut flowers (Sankar *et al.,* 2007). Sucrose replaces the depleted endogenous carbohydrates utilized during post-harvest life of flowers. Translocated sugars accumulate in flowers, and increase their osmotic concentration and improve water absorption ability and maintain petal cell turgidity in cut flowers. Aluminum sulphate acts as an antimicrobial agent. 8-HQC (8-hydroxy quinoline citrate) is a germicide having antibacterial activity and acidifies holding solution (Larsen and Schole, 1965). Vascular blockage and water absorption is greatly influenced by 8-HQC. It is also retards the microbial growth. Cobalt Nitrate acts as an inhibitor of ethylene biogenesis (Lau and Yang, 1976) and is toxic to microbial and fungal growth (Mishra *et al.,* 1973). Silver nitrate is considered to possess antibacterial properties (Aarts, 1957). $AgNO_3$ extend the cut flowers longevity and counteracted the enhancing effect of ethephon on senescence and thus acted as antiethylene agent. Since silver ions function as potent bactericide, its flower preservative properties were attributed to reduced bacterial contamination of the flower stem (Halevy and Kofranek, 1977). The present study was aimed at to evaluate the effect of various chemicals and their effective concentrations on prolonging vase life of cut gerbera flower and to assess suitable chemical combinations for prolonging flower vase life and quality.

MATERIALS AND METHODS

To present study was conducted in P.G. Research Laboratory, Department of Horticulture, College of Agriculture, J.A.U., Junagadh (India) in the year 2015 to assess the effect of floral preservatives on keeping quality vase life of cut gerbera (*Gerbera jamesonii* L.) cv. 'Dana Allen'. The cut gerbera flowers were harvested at uniform stage (having two outer whorls of disk florets perpendicular to disk) from 'Shiv Shakti nursery' Greenhouse, Mendarda, Junagadh (Gujarat). These cut flowers were kept in water immediately. Flower stems were trimmed to 40 cm and placed in a 250 mL flask with 200 mL solution. Experiment was conducted in a completely randomized design with each treatment replicated three times. Cut gerbera flowers were placed in vase solution of different combinations as follows:- i) 2% sucrose 2%, ii) 3% sucrose, iii) 8-HQC @ 150 mg L^{-1} + 2% sucrose, iv) 8-HQC @ 150 mg L^{-1} + 3% sucrose, v) 8-HQC @ 200 mg L^{-1} + 2% sucrose, vi) 8-HQC @ 200 mg L^{-1} + 3% sucrose, vii) $Al_2(SO_4)_3$ @ 25 mg L^{-1}) + 2% sucrose, viii) $Al_2(SO_4)_3$ @ 25 mg L^{-1} + 3% sucrose, ix) $Al_2(SO_4)_3$ @ 50 mg L^{-1} + 2% sucrose, x) $Al_2(SO_4)_3$ @ 50 mg L^{-1} + 3% sucrose, xi) $AgNO_3$ @ 15 mg L^{-1} + 2% sucrose, xii) $AgNO_3$ @ 15 mg L^{-1} + 3% sucrose, xiii) $AgNO_3$ @ 25 mg L^{-1} + 2% sucrose, xiv) $AgNO_3$ @ 25 mg L^{-1} + 3% sucrose, xv) $Co(NO_3)_2$ @ 180 mg L^{-1} + 2% sucrose, xvi) $Co(NO_3)_2$ @ 180 mg L^{-1} + 3% sucrose, xvii) $Co(NO_3)_2$ @ 270 mg L^{-1} + 2% sucrose, xviii) $Co(NO_3)_2$ @ 270 mg L^{-1} + 3% sucrose, and xix) control (water alone).

The flowers stem were slightly recut at basal end at every 2 or 3 day during experimentation. The vase life of cut gerbera was considered over when the petals lost their turgidity and disk drooped. Observations on fresh weight, solution uptake and flower diameter were recorded on 3rd, 6th, 9th and 12th day while time take for open 50, 75 and 100% disc florets and vase life in days was recorded. The data was analyzed as per Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Vase life

The vase life of gerbera cut flowers was extended when the flowers were kept in a solution of 8 HQC 200 mg L^{-1} + 2% sucrose. The increased vase life of cut flowers was (13.6 days) due to role of 8-HQC which reduced physiological stem blockage in sterile tissues. It is suggested that the effect is related to the chelating properties of the quinoline esters which may chelate metal ions for enzyme activity in erecting the stem blockage (Marousky, 1972). Also, the bacteriostatic properties of 8-HQS may have helped in prolonging the vase life of gerbera cut flowers (Serini and Banfi, 1974). 8-HQC + sucrose solution has been reported to be more effective in prolonging the vase life in rose cv. 'Gladiator' (Patil and Singh, 1995). The $Al_2(SO_4)_3$ (@ 50-150 mg L^{-1}) in holding solutions increased vase life of orchid flowers (Ketsa *et al.*, 2001) and tuberose (Mohammadi *et al.*, 2012).

Disc floret opening

The maximum time taken to open 50, 75 and 100% disc florets was 7.28, 8.95 and 11.52 days, respectively, in 8-HQC 200 mg L^{-1} + 2% sucrose solution. The provision of artificial solution uptake appears to have triggered quick floret opening. The presence of higher amount of accumulated carbohydrates facilitated higher floret opening. The results are in conformity with Reddy *et al*. (1988) who reported that opening of rose flower was accelerated, completely prevented or greatly altered depending upon the cultivar flower maturity and ethylene concentration. According to Burdett (1970) the microbial growth can be checked by germicidal and bactericidal properties of these chemical substances and thereby maintain the water conductivity in cut rose. Bhattacharjee (1993) observed that for proper opening of florets, the maintenance of continuous solution uptake along with appropriate supply of respiratory substrate and turgidity is pre-requisite. Ketsa *et al*. (2001) observed that Al_2 $(SO_4)_3$ (@ 50 or 100 or 150 mg L^{-1}) in holding solutions increased bud opening of orchid flowers as effectively as the standard holding solution. Similar results were found in gerbera by Padiyar and Vihol (2008).

Fresh weight

The fresh weight of cut flowers was determined at two days interval for each treatment and expressed as per cent change in initial fresh weight. The results revealed that holding solutions had

Table 1: Effect of different floral preservative on vase life, disc florets opening and change in fresh weight of cut gerbera cv. 'Dana Allen'

Treatments	Vase life (days)	Disc floret opening (days)			Initial weight (g)	Change in fresh weight (% initial weight) of flowers in days			
		50%	75%	100%		3rd	6th	9th	12th
Sucrose 2% (A)	9.33	4.85	6.55	7.25	18.37	104.93	94.82	72.48	0.00
Sucrose 3% (B)	9.47	5.00	6.68	7.39	18.57	106.28	95.23	76.75	0.00
8-HQC (150 mg L^{-1}) + A	9.80	6.70	8.30	7.72	18.37	106.64	96.36	77.67	0.00
8-HQC (150 mg L^{-1}) + B	9.67	5.73	7.43	7.59	18.54	107.24	96.69	77.84	0.00
8-HQC (200 mg L^{-1}) + A	13.60	7.28	8.95	11.52	18.39	112.27	104.19	88.16	67.10
8-HQC (200 mg L^{-1}) + B	13.40	7.27	8.93	11.32	18.37	110.81	100.46	83.15	66.86
$Al_2(SO_4)_3$ (25 mg L^{-1}) + A	9.67	5.58	7.32	7.57	18.42	106.67	96.98	78.18	0.00
$Al_2(SO_4)_3$ (25 mg L^{-1}) + B	9.53	5.02	6.49	7.45	18.65	106.58	95.88	77.38	0.00
$Al_2(SO_4)_3$ (50 mg L^{-1}) + A	13.27	7.26	8.92	11.19	18.52	108.06	100.15	81.59	66.11
$Al_2(SO_4)_3$ (50 mg L^{-1}) + B	10.13	6.98	8.67	8.05	18.47	107.04	95.63	75.75	0.00
$AgNO_3$ (15 mg L^{-1}) + A	9.73	5.75	8.11	7.65	18.66	107.44	96.76	78.45	0.00
$AgNO_3$ (15 mg L^{-1}) + B	9.60	5.54	7.22	7.52	18.37	106.42	95.88	77.57	0.00
$AgNO_3$ (25 mg L^{-1}) + A	10.47	6.98	8.68	8.39	18.41	106.75	95.69	76.60	0.00
$AgNO_3$ (25 mg L^{-1}) + B	9.87	6.74	8.43	7.79	18.64	107.36	95.38	76.34	0.00
$Co(NO_3)_2$ (180 mg L^{-1}) + A	10.60	7.01	8.84	8.52	18.39	106.59	95.84	79.69	58.83
$Co(NO_3)_2$ (180 mg L^{-1}) + B	9.93	6.83	8.48	7.85	18.37	107.07	95.85	76.87	0.00
$Co(NO_3)_2$ (270 mg L^{-1}) + A	12.00	7.20	8.90	9.92	18.61	106.15	95.54	78.48	48.66
$Co(NO_3)_2$ (270 mg L^{-1}) + B	10.00	6.90	8.57	7.93	18.43	106.78	95.62	76.60	0.00
Control (water)	6.80	4.50	5.25	6.00	18.51	100.47	93.52	0.00	0.00
S.Em.±	0.126	0.06	0.07	0.06	0.113	1.643	1.437	1.38	0.56
$CD_{0.05}$	0.36	0.18	0.20	0.16	Ns	4.70	4.11	3.96	1.61
CV %	2.11	1.77	1.51	1.18	1.06	2.66	2.57	3.23	6.01

significant effect on change in fresh weight at 3rd, 6th, 9th and 12th day during vase life. The higher fresh weight was observed when flowers were kept in 8 HQC @ 200 mg L^{-1} + 2% sucrose solutions on 3rd, 6th, 9th and 12th day as compared to the other treatments. Sucrose helps in increasing the level of moisture retention in cut flowers thus increases their fresh weight as a consequence of improved water balance. Sucrose is also known to reduce the transpiration loss due to increased osmotic potential of cytoplasm. Further, it acts as an oxidizable respiratory substrate and as an anti-desiccant which helps in maintaining fresh weight of cut flowers (Marousky, 1969). 8-HQC is known to reduce transpiration loss of water and increases the fresh weight by partially closing the stomata's (Marousky, 1969). The minimum loss in fresh weight of chrysanthemum cut flowers was recorded due to sucrose and 8-HQS solution by Bhat *et al.* (1999). The beneficial effect of 8-HQC and metallic salts such as $Co(NO_3)_2$, $Al_2(SO_4)_3$ and $AgNO_3$ were presumably due to their antimicrobial properties in reducing xylem blockage and maintenance of water flow to the cut flowers (Marousky, 1971; Van Doorn and Perik, 1990).

Solution uptake

The solution uptake was significantly influenced by chemical treatments. When flowers were kept in 8 HQC @ 200 mg L^{-1} + 2% sucrose the solution absorption by stalks was maximum (61.26 mL). The higher solution uptake in gerbera stalk might be due to sucrose having carbohydrate and HQC reducing the stem blockage. Solution uptake in cut flowers takes place mainly to maintain water balance in cut flower against the transpiration loss of water. The addition of sucrose to the vase solution decreases water potential in tissues; thereby improves water uptake by cut stems (Kofranek and Halvey, 1976). Sucrose also limits transpiration by stomatal closure (Aarts 1957). Increase in water uptake due to various chemicals in vase solutions may be attributed to the reduction in vascular blockage of stem by preventing bacterial and fungal growth (Gowda 1986; Reddy, 1988).

Table 2: Effect of different floral preservative solution uptake and flower diameter of cut gerbera cv. 'Dana Allen'

Treatments	Solution uptake (mL) of flowers					Initial diameter (cm)	Flower diameter (cm)			
	3^{rd} day	6^{th} day	9^{th} day	12^{th} day	Final solution uptake		3^{rd} day	6^{th} day	9^{th} day	12^{th} day
Sucrose 2% (A)	11.40	11.00	8.00	0	30.4	9.53	9.83	8.40	6.19	0.00
Sucrose 3% (B)	12.33	12.13	9.00	0	33.46	9.58	9.85	8.46	6.25	0.00
8-HQC (150 mg L^{-1}) + A	13.60	13.46	10.66	0	37.73	9.84	10.18	9.30	6.66	0.00
8-HQC (150 mg L^{-1}) + B	12.80	12.73	10.33	0	35.86	9.81	10.07	9.13	6.55	0.00
8-HQC (200 mg L^{-1}) + A	18.00	17.13	15.80	10.33	61.26	9.76	11.39	10.66	8.74	7.87
8-HQC (200 mg L^{-1}) + B	17.53	16.73	15.53	10.20	60.00	9.79	11.30	10.49	8.62	7.68
$Al_2(SO_4)_3$ (25 mg L^{-1}) + A	12.66	11.33	9.66	0	33.66	9.74	10.01	9.02	6.54	0.00
$Al_2(SO_4)_3$ (25 mg L^{-1}) + B	12.33	11.33	9.33	0	33.00	9.62	9.89	8.74	6.29	0.00
$Al_2(SO_4)_3$ (50 mg L^{-1}) + A	17.40	16.60	15.33	10.13	59.46	9.87	11.16	10.38	8.57	7.72
$Al_2(SO_4)_3$ (50 mg L^{-1}) + B	14.60	14.00	11.33	0	39.93	9.92	10.18	9.51	6.95	0.00
$AgNO_3$ (15 mg L^{-1}) + A	13.00	12.66	10.33	0	36.00	9.82	10.09	9.27	6.56	0.00
$AgNO_3$ (15 mg L^{-1}) + B	12.53	11.33	9.33	0	33.20	9.73	9.91	8.81	6.46	0.00
$AgNO_3$ (25 mg L^{-1}) + A	14.33	14.00	11.66	0	40.00	9.94	10.20	9.53	7.06	0.00
$AgNO_3$ (25 mg L^{-1}) + B	13.66	13.33	10.66	0	37.66	9.86	10.22	9.37	6.75	0.00
$Co(NO_3)_2$ (180 mg L^{-1}) + A	15.33	14.33	11.66	6.66	48.00	9.95	10.36	9.55	7.26	0.00
$Co(NO_3)_2$ (180 mg L^{-1}) + B	14.00	13.33	11.00	0	38.33	9.87	10.28	9.39	6.85	0.00
$Co(NO_3)_2$ (270 mg L^{-1}) + A	15.40	15.20	12.33	7.66	50.60	9.96	10.43	9.64	7.42	7.62
$Co(NO_3)_2$ (270 mg L^{-1}) + B	14.00	13.66	11.00	0	38.66	9.89	10.27	9.49	6.89	0.00
Control (water)	10.66	10.33	0	0	21	9.50	9.81	8.04	0.00	0.00
S.Em.±	1.08	0.99	0.84	0.36	1.535	0.17	0.18	0.11	0.07	0.02
$CD_{0.05}$	3.08	2.83	2.41	1.03	4.40	NS	0.50	0.31	0.19	0.07
CV %	2.67	2.55	2.73	5.25	1.32	3.09	2.95	2.02	1.69	2.47

Flower diameter

The holding solutions had significant effect on flower diameter (Table 2). The maximum flower diameter at 3^{rd} day (11.3 cm), 6^{th} day (10.66 cm), 9^{th} day (8.74 cm) and 12^{th} day (7.87 cm) was observed in 8 HQC @ 200 mg L^{-1} + 2% sucrose solution. It appears that when exogenous sugars in the form of sucrose were supplied to the vase solutions flower diameter increased significantly upto the onset of senescence. Sucrose provides energy and HQC protects against bacteria resulting in healthy cut flowers which exhibits bigger size flowers. Addition of other chemicals with sucrose in vase solution also increased flower diameter significantly over the treatments containing sucrose only. These chemicals owing to biocidal properties prevent stem blockage so maintain water flow to the flower stem (Van Doorn and Perik, 1990). Bhattacharjee (1993) reported that 8-HQC @ 250 ppm concentration had maximum influence on flower diameter and quality in cut rose cv. 'Priyadharshini'. Michalczuk *et al*. (1989) reported that 200 ppm of 8-HQC + 2% sucrose had maximum effect on flower diameter in cut 'Sonia' rose. Similar findings have been reported in gladiolus (Nowak and Rudnicki, 1979), rose (De and Bhattacharjee, 1999) and chrysenthamum (Bhat *et al.*, 1999).

Conclusion: From the present study it may be concluded that holding solution containing 8-HQC along with sucrose has great potential to extend the vase life of gerbera cut flowers upto 13.6 days as it showed lesser fresh weight losses. It also increased solution uptake and flower diameter. Among all the treatments, preservative solutions comprising of 8-HQC @ 200 mg L^{-1} + 2% sucrose combination can be used for extending the vase life and for improving the quality of cut gerbera cv. "Dana Allen".

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