Effect of Pulsing with Sucrose in Prolonging the Vase Life of Goldenrod Flowers

Vinodhini G, Ajish Muraleedharan, P. K. Karthikeyan, J. L. Joshi and C. Praveen Sampath Kumar

Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 12
Issue: 06

Res. Jr. of Agril. Sci. (2021) 12: 2120–2123

CARAS

Res. Jr. of Agril. Sci. (Nov-Dec 2021) 12(6): 2120–2123
www.rjas.org

Full Length Research Article

Effect of Pulsing with Sucrose in Prolonging the Vase Life of Goldenrod Flowers

Vinodhini G[1], Ajish Muraleedharan*[2], P. K. Karthikeyan[3], J. L. Joshi[4] and C. Praveen Sampath Kumar[5]

Received: 26 Aug 2021 | Revised accepted: 01 Nov 2021 | Published online: 29 Nov 2021
© CARAS (Centre for Advanced Research in Agricultural Sciences) 2021

ABSTRACT

Goldenrod belongs to Asteraceae family, is a genus of about 100 to 120 species of flowering plants. Most of them are herbaceous perennial growing from woody caudices or rhizomes. In floriculture industries, post-harvest losses of flowers are the major problem due to its highly perishable nature and it ultimately affects the quality and vase life of flowers. To overcome these issues proper post-harvest practices are essential. Sugars play a vital role in keeping the quality of cut flowers, by adding sugars such as sucrose to the vase water is effective in improving the post-harvest life of cut flowers. The present experiment on the "Effect of pulsing with sucrose in prolonging the vase life of goldenrod Cv. Tara gold" was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar during 2018-2020. The experiment was repeated three times with five replicates in completely randomized design. Cut flower spikes treated with sucrose at concentrations of 2, 4, 6 and 8% along with control (distilled water) were used for the study. The results showed that all treatments had improved the keeping quality and vase life of cut flowers when compared to control. Among all these treatments, sucrose @ 4% (T_3) recorded maximum water uptake, transpirational loss of water, water balance, loss of water and water uptake ratio, fresh weight, cumulative physiological loss in weight and vase life which was extended.

***Key words*:** *Solidago canadensis*, Sucrose, Goldenrod flowers, Vase life, Pulsing

Goldenrod (*Solidago canadensis*) a member of the Asteraceae family and also an important landscape weedy plant. Most of the invasive species of *solidago* is native to North America, though a few species are grown in Europe, Asia, and Africa. some *Solidago* species utilized for medicinal purposes originates in Bulgaria, Hungary, Poland, and other eastern European countries. At earlier goldenrod is cultivated by many farmers under small scale, even though it has not yet been commercialized. But now it is considered as one among the popular commercial cut flowers and also an excellent filler material. Fillers add a textural contrast as well as it is said to be the backbone of floral decorations. The flowers are used in the preparation of bouquets, wreath, corsage, and various floral arrangements. The genus *Solidago* is derived from the Latin word solidus (whole) and ago (to make) which means "to make whole". It has an excellent healing property and also this plant is known as woundwort. All parts of the goldenrod have some medicinal property. Leaves and flowers are popularly used in the treatment of kidney stones, hay fever, diabetes, inflammation and urinary tract infections. Flowers are edible and they are usually used for the preparation of tea. Goldenrod is a rhizomatous herbaceous perennial plant have a branched inflorescence with numerous yellow small capitula. Harvesting at the optimum stage of maturity is the most important feature in the ornamental species. In *solidago*, spikes are harvested at bud stage when the basal florets just start to change color. The right stage, proper method, and time of harvesting is an important factor to ensure their long vase-life. Nearly 20 to 40 percent of losses in the production of flower crops due to improper post-harvest handling [1].

For the exporting of cut flowers, quality and shelf life are the predominant factor. In floriculture industries, post-

* **Ajish Muraleedharan**
✉ ajishm1000@gmail.com

[1-2] Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar - 608 002, Tamil Nadu, India

[3] Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalainagar - 608 002, Tamil Nadu, India

[4-5] Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalainagar - 608 002, Tamil Nadu, India

harvest losses are the major problem due to its highly perishable nature and it ultimately affects the quality and vase life of flowers. Vase life is determined based on attributes such as, rate of water uptake and transpirational loss, changes in fresh weight, water balance, diameter or length of stem, senescence pattern, colour of petals, total longevity and flower freshness. To overcome these issues proper post-harvest practices are the essential criteria. In the cut flower industries, various techniques of post-harvest handling are carried out to maintain the flower freshness and natural color of the flowers, for a maximum period of time after harvesting from the mother plant. Senescence is the terminal stage of plant development that follows the physiological maturity consequently leading to the death of cells, organ or the whole plant [2]. Floral senescence is the most serious problem regarding the post-harvest management of cut flowers. Flowers are attracted by their appearance, quality and freshness. The longevity of cut flowers is also an essential factor that makes sure that the customers will be attracted and satisfied to purchase more flowers [3]. Hence keeping the above points in view, the present work "Effect of pulsing with sucrose in prolonging the vase life of goldenrod Cv. Tara gold" has been carried out to evaluate the postharvest life as well as quality.

MATERIALS AND METHODS

The present investigation on the "effect of pulsing with sucrose in prolonging the vase life of goldenrod Cv. Tara gold" was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar during 2018-2020. The experiment was repeated three times with five replicates in completely randomized design. Cut flower spikes treated with sucrose at concentrations of 2, 4, 6 and 8% along with control (distilled water). Uniform sized spikes of goldenrod (*Solidago canadensis*) cv. Tara Gold free from mechanical injury, diseases and insect injuries were obtained from "Grace and flora" wholesale distributer in Hosur, Tamil Nadu were used for the experimentation. The selected flowers were harvested at proper maturity stage, the flowers were carefully brought to the laboratory without causing any damage and they were kept in clean water.

In this experiment, flowers were held in the laboratory at 85-90 per cent relative humidity with ambient room temperature under 40 W cool white fluorescent lights to maintain 12 hours of photoperiod. Distilled water was used to reduce experimental variability; therefore, all the solutions were prepared with distilled water and such freshly prepared solutions were used for the experimentation. The spikes were trimmed to 60 cm under water. In each glass bottle one flower was placed and considered as one replication. After recording fresh weight, the individual flower spikes were placed randomly in the glass bottles containing 200 ml of aqueous test solutions of different treatments. The weight of each container and solution/distilled water with and without flower spikes were recorded once in two days, while recording weights re-cutting the base of floral stems of about 0.5 cm was done. The details of various concentrations of sucrose solution used in the experiment are described here, T_1-control (distilled water), T_2-sucrose @ 2%, T_3- sucrose @ 4%, T_4-sucrose @ 6% and T_5-sucrose @ 8%.

RESULTS AND DISCUSSION

The use of sucrose in vase solution influenced the rate of water absorption. Among the varied concentrations of sucrose, the flower spikes held in sucrose @ 4% (T_3) recorded highest uptake of water, while the lowest uptake of water was recorded in control (T_1). Sucrose decreases water loss in flowers and increases the uptake of water, by inducing the closure of stomata and by increasing the osmotic concentration of the flowers. Increased energy added from sucrose helps to maintain the stem steady over a longer period, resulting in increased water uptake and corresponding water loss. The results of present studies were found to be in accordance with the findings of [4] in cut roses [5] in calendula, [6] in tuberose. Higher water uptake was obtained in sucrose treated with carnation flowers [7]. Maximum water uptake and transpiration loss of water in cut gerberas held in optimum concentration of sucrose [8] and the results are in agreement with [9] in anthurium, [10] in daffodil and in cut *Hippeastrum* flower [11].

Table 1 Effect of pulsing with sucrose on goldenrod flowers

Treatments	Uptake of water (g/flower)				Transpirational loss of water (g/flower)				Ratio between water loss and water uptake				Water Balance (g/flower)			
	2nd day	4th day	6th day	8th day	2nd day	4th day	6th day	8th day	2nd day	4th day	6th day	8th day	2nd day	4th day	6th day	8th day
T_1: Distilled water	13.84	12.28	11.57	10.57	14.29	13.77	12.86	11.64	1.03	1.12	1.11	1.10	-0.45	-1.49	-1.29	-1.07
T_2: Sucrose @ 2%	20.57	18.62	17.82	16.59	20.37	18.54	17.20	15.91	0.99	0.99	0.96	0.95	0.20	0.08	0.62	0.68
T_3: Sucrose @ 4%	22.15	20.06	19.22	17.98	21.76	19.59	18.13	16.83	0.98	0.97	0.94	0.93	0.39	0.47	1.09	1.15
T_4: Sucrose @ 6%	18.96	17.05	16.18	14.88	18.99	17.51	16.25	15.01	1.00	1.02	1.00	1.00	-0.03	-0.46	-0.07	-0.13
T_5: Sucrose @ 8%	16.65	15.18	14.14	13.48	17.04	15.92	14.76	13.85	1.02	1.04	1.04	1.02	-0.39	-0.74	-0.62	-0.37
SED	0.75	0.68	0.67	0.65	0.67	0.49	0.44	0.42	0.004	0.007	0.005	0.009	0.025	0.10	0.18	0.11
CD (5%)	1.51	1.37	1.34	1.31	1.35	0.99	0.89	0.86	0.008	0.015	0.01	0.004	0.05	0.21	0.37	0.22

By adding the optimum concentration of sucrose (4%) to the vase solution minimum Transpirational loss of water has been reported, perhaps higher the water uptake to reduce the moisture stress in cut flowers by affecting stomatal closure and also prevents the water loss due to transpiration. It is apparent from the study the total quantity of water uptake and transpirational loss of water was significantly greater in these treatments, the water uptake dominated over TLW thereby improving the water retention in the goldenrod spikes. From the observations, it was found that increased water uptake, reduction in TLW helps in improving water balance and is essential for extending the vase life of cut flowers. The concluded results have found to be findings of [12] in cut gerbera, [13] in tuberose cv. Pearl Double. Addition of sucrose to the holding solution has attributed to the increase in the rate of water uptake [14], this could be due to exogenous application of sucrose which might have increased the ability of cut flowers to absorb

water by influencing the water potential and osmotic potential [15-16].

In the present investigation, the highest water balance was recorded in sucrose @ 4% concentration. Sucrose is widely used in floral preservatives, which acts as a food source or respiratory substrate and delays the degradation of protein and improves the water balance of cut flowers [17]. Sucrose helps to maintain water balance and also delays turgidity loss as inhibit flower senescence [18]. Sucrose enhanced better water relations thereby improved fresh weight of the flower [19], same in the case observed in cut carnation flowers [20].

Table 2 Effect of pulsing with sucrose on goldenrod flowers

Treatments	Fresh weight of cut flower (g/s)				Vase life (days)	Cumulative physiological loss in weight (%)	Ornamental value
	2nd day	4th day	6th day	8th day			
T_1: Distilled water	21.60	21.00	19.89	19.02	6.89	36.01	3.84
T_2: Sucrose @ 2%	26.61	25.20	24.19	23.07	8.82	26.97	6.94
T_3: Sucrose @ 4%	27.75	26.16	25.52	24.24	9.57	22.24	2.07
T_4: Sucrose @ 6%	25.16	24.04	23.16	21.60	8.37	30.25	6.34
T_5: Sucrose @ 8%	23.91	22.98	21.73	20.66	7.98	33.23	2.66
SED	0.52	0.43	0.46	0.43	0.17	1.29	8.21
CD (5%)	1.05	0.86	0.93	0.87	0.35	2.58	3.29

In cut flowers, beginning of the senescence phase is characterized by decrease in fresh weight [21-22]. Cut flowers treated with sucrose promoted unfolding of petals, suppressed the decrease in fresh weight [23]. Sucrose may have a potential effect to sustain higher fresh weights in cut flowering stems by inducing stomata closure in the leaves so that water loss can be minimized [24]. In this study, results revealed that maximum fresh weight was recorded in 4% sucrose, while the minimum weight was noticed in control (distilled water). Maintaining the higher fresh weight of cut flowers by the inclusion of sucrose resulting in longer vase life. Increase in the fresh weight of cut flowers was most probably due to increase in the water uptake, hence these two positive correlation factors resulted in lower physiological loss in weight of cut flowers. Significant influence of sucrose as pulsing agent resulted in lower physiological loss in weight of goldenrod flowers [25].

Among the different concentrations of sucrose, goldenrod spikes held in 4% sucrose (T_3) recorded the highest vase life followed by sucrose @ 2% (T_2) while spikes held in control (distilled water) T_1 recorded the lowest vase life. It has been reported that main effect of applied sugars to the vase solution improve the mitochondrial structure and functions, thereby prolonged the vase life of cut flowers. The termination of vase life was observed when petals started wilting, falling and discolouration. Addition of sucrose replaces the depletion of carbohydrates from cut stems and maintains respiratory pool there by prolongs vase life [26]. It was reported that senescence process of cut flowers was delayed by the application of sucrose [27]. The percentage of sucrose to be used differs depending on the species of flowers being treated and often ranges between 5 to 20%. Treatment of cut flowers with solutions containing sucrose (5-15%) improves the vase life of carnation and *Gladiolus sp*. Sucrose as a pulsing treatment has been found to improve the vase-life of anthurium [28-29]. Sucrose acts as a preservative material, exogenous supply of sucrose balanced the depletion of carbohydrate and improved the vase life and quality of many cut flowers [30]. The shelf life of gerbera cultivar can be increased with optimal concentrations of sucrose was due to better water relations, and also probable use of sucrose as a repairable substrate [31-32]. The result was corroborated with findings of [33] on *Gerbera jasmesonii* cv. Dune indicated that flowers was significantly increased by addition of sucrose in preservative solution. Varied concentrations of sucrose ranging from 0 to 7.5%, found that 5.0% sucrose recorded the best vase life and delayed the climacteric ethylene in petals on cut spray carnation [34]. Sucrose application was results in a positive effect in rose cut flowers and also enhanced the vase life of lisianthus flowers [35]. Different levels of sucrose concentrations which was significantly enhanced the maximum vase-life of gladiolus spikes (*Gladiolus grandiflorus* L.) in comparison to other treatments [36] also reported the similar observation in tuberose flowers [37].

CONCLUSION

It can be concluded that among the different concentrations of sucrose, goldenrod spikes held in 4% sucrose recorded the highest quality and vase life followed by sucrose @ 2% while spikes held in control recorded the lowest values. Preservative solutions containing sucrose extended the vase life by inhibiting senescence of cut flowers, which lead to improving the postharvest quality of the flowers. Supply of sucrose to the holding solution act as a source of nutrition for tissue approaching carbohydrate starvation, and also dissolved sugars in the cells of the petals may act as osmotically active molecule thereby vase life of cut flowers has been prolonged.

LITERATURE CITED

1. Sharma S. 2017. Effect of different chemicals on vase life of gladiolus varieties (*Gladiolus hybridus* Hort.). *Jr. Pharmacogn. Phytochem.* 6(6): 498-501.
2. Sudaria MA, Uthairatanakij A, Nguyen HT. 2017. Postharvest quality effects of different vase-life solutions on cut rose (*Rosa hybrida* L.). *Int. Jr. of Agric. Forestry and Life Sci*. 1(1): 12-20.
3. Kumar A, Kumar S, Chandra S. 2010. Vase life studies in tuberose (*Polianthes tuberosa*) cv. Shringar as affected by postharvest handling treatments. *The Asian Jr. of Hort*. 5: 7-10.
4. Shobha K. 1992. Effect of sucrose pulsing and metallic salts on the vase-life of cut flowers. *Ph. D. Thesis*, University of Agricultural Sciences, Bangalore, Karnataka.
5. Gowda JVN. 1994. Prolonging cut flower life. *Rose News* 12: 3-5.

6. Reddy BS, Singh K. 1996. Effects of aluminium sulphate and sucrose on vase life of tuberose. *Jr. Maharashtra Agric. University* 21: 201-203.
7. Behera PK. 1993. Senescence in cut leafy flowering shoot: role of sucrose. *Plant Physiol. and Biochemistry* 20: 59-59.
8. Prasanth P. 2006. Studies on the role of physiological and biochemical components with floral preservatives on the vase life of cut gerbera (*Gerbera Jamesonii* Bolus Ex. Hook.) Cv. Yanara. *Ph. D. Thesis*, submitted to Acharya N. G. Ranga Agricultural University, College of Agriculture, Rajendranagar, Hyderabad.
9. Maitra S, Roychowdhury N. 2005. Effect of pulsing and holding solutions on postharvest life of cut flowers in *Anthurium andraeanum* Lind. cv. Nitta. *Jr. of Ornamental Horticulture* 8(3): 186-190.
10. Ali S, Khan FU, Khan FA, Wani SA. 2008. Post-harvest behaviour of cut daffodil as influenced by certain pulsing treatments. *Jr. of Ornamental Horticulture* 11(2): 81-90.
11. Jamil MK, Rahman MM, Hossain MM, Hossain MT, Karim AJMS. 2016. Effect of potting media on growth, flowering and bulb production of hippeastrum (*Hippeastrum hybridum* Hort.). *Int. Jr. Appl. Sci. Biotechnology* 4(3): 259-271.
12. Pobudkiewicz A, Nowak J. 1992. The effect of gibberellic acid on growth and flowering of *Gerbera jamesonii* Bolus. *Folia Horticulturae* 2(4): 35-42.
13. Kumar J, Singh D. 2004. Postharvest life of tuberose cultivar pearl double spike as affected by GA_3, NAA and sucrose. *Journal of Ornamental Horticulture* 7(2): 188-191.
14. Rogers MN. 1973. An historical and critical review of postharvest physiology research on cut flowers. 69. Reunion Anual de la Sociedad Americana de Ciencias Horticolas, St. Paul, Minn. (USA), 29 Aug 1972.
15. Halevy AH, Mayak S. 1981. Senescence and post-harvest physiology of cut flowers-part 11. *Horticulture Review* 3: 59-143.
16. Paulin A. 1977. Métabolisme glucidique et protéique de la fleur d'oeillet alimentée ou non avec une solution de saccharose. *Acta Horticulturae* 71: 241-257.
17. Moon-Soo C, Fisun GC, Linda D, Michael SR. 2001. Sucrose enhances the postharvest quality of cut flowers of *Eustoma grandiflorum* (raf.) Shinn. *In*: Proc. VII Int. Symp. Postharvest Physiol., Ornamentals Eds. *Acta Hortic*. pp 543.
18. Verlinden S, Garcia JJV. 2004. Sucrose loading decreases ethylene responsiveness in carnation (*Dianthus caryophyllus* cv. White Sim) petals. *Postharvest Biol. and Technology* 31(3): 305-312.
19. Bhattacharjee SK. 1998. Effect of different chemicals in holding solution on postharvest life and quality of cut roses. *Ann. of plant Physiology* 12: 161-163.
20. Luo H, Jing H, Li J, Luo S. 2003. Effects of different preservatives on fresh keeping of cut carnation flower. *Plant Physiology Communications* 39(1): 27-28.
21. Adachi M, Kawabata S, Sakiyama R. 2000. Effect of temperature and stem length in carbohydrate content in summer grown chrysanthemums during development and senescence. *Postharvest Biol. Thencnology* 20: 63-70.
22. Ichimura K, Kawabata Y, Kishimoto M, Goto R, Yamada K. 2003. Shortage of soluble carbohydrates is largely responsible for short vase life of cut 'Sonia' rose flowers. *Jr. of the Japanese Soc. for Hort. Sciences* 72(4): 292-298.
23. Ichimura K, Kojima K, Goto R. 1999. Effects of temperature, 8-hydroxyquinoline sulphate and sucrose on the vase life of cut rose flowers. *Postharvest Biol. and Technology* 15(1): 33-40.
24. Marousky FJ. 1971. Inhibition of vascular blockage and increased moisture retention in cut roses induced by pH, 8-hydroxyquinoline citrate, and sucrose. *Jr. Amer. Soc. Hort. Sciences* 96: 38-41.
25. Atiqullah S, Gopinath G. 2012. Post-harvest longevity of golden rod cut flowers as influenced by vase solution containing metallic salt and sucrose. *Mysore Jr. of Agric., Sciences* 46(1): 177-180.
26. Gupta VN, Chakrabarty D, Datta SK. 2007. Influence of holding solution on postharvest quality of cut flowers of rose cultivars. *Jr. of Ornamental Horticulture* 10(2): 122-124.
27. Chung BC, Lee SY, Oh SA, Rhew TH, Nam HG. 1997. The promoter activity of sen 1, a senescence-associated gene of Arabidopsis, is repressed by sugars. *Jr. of Plant Physiology* 151(3): 339-345.
28. Mor Y, Hardenburg RE, Kofranek AM, Reíd MS. 1981. Effect of silver-thiosulphate pretreatment on vase life of cut standard carnations, spray carnations, and gladiolus after a transcontinental truck shipment. *Hort Science* 16(6): 766-768.
29. Paull RE. 1982. Pulse treatment with silver nitrate extends vase life of anthuriums. *Journal of American Society for Horticultural Science* 107(5): 842-844.
30. Van Doorn WG. 2004. Is petal senescence due to sugar starvation. *Plant Physiology* 134(1): 35-42.
31. Bhattacharjee SK. 1972. Sucrose and water uptake from concentrated sucrose solutions by gladiolus shoots and the effect of these treatments on floret life. *Canadian Journal of Botany* 32: 1271-1281.
32. Paulin A, Droillard MJ, Bureau JM. 1986. Effect of a free radical scavenger, 3, 4, 5-trichlorophenol, on ethylene production and on changes in lipids and membrane integrity during senescence of petals of cut carnations (*Dianthus caryophyllus*). *Physiologia Plantarum* 67(3): 465-471.
33. Mousa S, Mosen K, Toktam ST, Roohangiz N. 2009. Essential oils and silver nanopartirles (SNP) as novel agents to extend vase- life of gerbera (*Gerbera jomesonii* cv. Dune) flowers. *Postharvest Biology* 53(3): 155-158.
34. Pun UK, Shimizu H, Tanase K, Ichimura K. 2003. Effect of sucrose on ethylene biosynthesis in cut spray carnation flowers. *VIII International Symposium on Postharvest Physiol. of Ornamental Plants* 669: 171-174
35. Halevy AH, Kofranek AM. 1984. Evaluation of lisianthus as a new flower crop. *HortScience* 19(6): 845-847.
36. Gupta S, Kumar A. 2018. Effect of different levels of pulsing concentrations on vase life of gladiolus (*Gladiolus grandiflorus* L.). *Int. Jr. Curr. Microbiol. App. Science* 7(9): 330-334.
37. Kumar A, Deen B. 2017. Effect of eco-friendly vase solution on maximum buds opening and longer vase-life of tuberose (*Polianthes tuberosa* L.) cv. Hyderabad Double. *Jr. of Pharmacognosy and Phytochemistry* 6(4): 1233-1236.