VASE LIFE EXTENSION ON CUT FLOWERS OF *Solidago canadensis* AS INFLUENCED BY DIFFERENT SUCROSE CONCENTRATIONS

Ajish Muraleedharan[1]*, J.L. Joshi[2], A. J. Nainu[2] and P.K. karthikeyan[3]

[1]Department of Horticulture, Faculty of Agriculture, Annamalai University,

[2] Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University,

[3] Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalai nagar, Tamil nadu, India - 608002.

*Author for correspondence- Dr. Ajish Muraleedharan, ajishm1000@gmail.com

ABSTRACT

Solidago, commonly called goldenrods, is a genus of about 100 to 120 species of flowering plants in the aster family, Asteraceae. Most are herbaceous perennial species growing from woody caudices or rhizomes. The present investigation on the "vase life extension on cut flowers of *Solidago canadensis* cv. Tara gold as influenced by different chemicals" was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar during 2015 to 2016. 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, 8 % and control (distilled water) were used in 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, the 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 on the sucrose concentration of 4 %.

Keywords: Goldenrod, sucrose, vase life.

INTRODUCTION

Goldenrod (*Solidago canadensis* L.) 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. 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. At earlier goldenrod is cultivated by many farmers under a 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.

In modern days floriculture industry plays a vital role in an economically developed and developing nations. Flowers are attracted by the customers due to 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 (Kumar *et al*., 2010). But the flowers remain fresh for a certain period of time. 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 (Sudaria *et al*., 2017). Floral senescence is the most serious problem regarding the post-harvest management of cut flowers. 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. (Rogers, 1973) (Halevy and Mayak, 1974; Paulin *et al*.,

1986) Opined that 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. Sucrose used in the vase solution influenced the water uptake, transpiration loss of water, and also maintained better water relation of cut flowers (Bhattacharjee, 1998). Therefore more research regarding the post-harvest management of solidago for extending the vase life and quality is an essential factor. Keeping the above points in view, the present work has been carried out to evaluate the postharvest life as well as quality of goldenrod flowers.

MATERIALS AND METHOD

The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during 2015 to 2016. Uniform sized spikes of goldenrod (*Solidago canadensis* L.) 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 and the flowers were carefully brought to the laboratory without causing any damage and they were kept in clean water. 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, 8 % and control (distilled water) were used in the study. Treatment details are T1 -control (distilled water), T2 -sucrose @ 2%, T3 -sucrose @ 4%, T4 -sucrose @ 6% and T5 -sucrose @ 8%. Parameters recorded are 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.

RESULTS AND DISCUSSION

Among the varied concentrations of sucrose, the flower spikes held in sucrose @ 4% (T3) recorded highest Water Uptake, while the lowest uptake of water was recorded in control (Table 1). The results of present studies were found to be in accordance with the findings of Shobha (1992) in cut roses and Gowda (1994) in calendula and Reddy and singh (1996) in tuberose. According to (Ichimura *et al.*, 2003 & Elhindi, 2012) Sucrose decreases water loss in petals and increases the uptake of water, by inducing the closure of stomata and increasing the osmotic concentration of the flowers respectively. Increased energy added from sucrose helps to maintain the stem steady over a longer period, resulting in increased water uptake and corresponding water loss. These results are in agreement with Maitra and Roychoudhury (2005) in Anthurium and Ali *et al*., (2008) in Daffodil. Behera (1993) also reported higher water uptake was obtained in sucrose treated carnation flowers. These results were in confirmation with the findings Prashanth (2006) in cut gerbera, who observed maximum water uptake and transpiration loss of water in cut gerberas held in optimum concentration of sucrose.

The inclusion of Sucrose to the vase solution significantly reduce the water loss from the flower tissues by transpiration during the experimental period. A water deficit will develop only when the rate of water uptake is lower than the rate of transpiration, hence the onset of water stress can be delayed by reducing the rate of transpiration. Moreover, sucrose acts in stomatal closure and reduces water loss in cut flowers (Van Doorn, 2001). Among the different concentrations of sucrose used, the maximum water loss was observed in vase solution containing distilled water (control), whereas the minimum water loss was found in solution containing 4% sucrose. The findings of the experiment corroborate the results of Khondakar and Mozumder (1985) in tuberose and Gowda (1986) in China aster.

By adding the 4 per cent concentration of sucrose 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. The concluded results has found to be findings of Pobudkiewicz and Nowak (1992) in cut gerbera, kumar and singh (2004) in cut tuberose cv. Pearl Double. From the observations, it was reported that besides increased water uptake, reduction in TLW helps in improving water balance and is essential for extending the vase life of cut flowers. The present results were corroborate with the findings of Gupta *et al*., (1994) who reported that 4% sucrose solution significantly reduced the ratio in gladiolus. (Jamil *et al*., 2016) concluded that lowest transpiration loss and water uptake ratio was found in sucrose solution because it increased water uptake and decreased water loss due to transpiration by regulating stomatal opening.

Sucrose play an important role in improving the water balance of cut flowers by affecting the osmotic potential of cut flowers and the water holding capacity of the tissues allowing less water to be transpired (Halevy *et al*., 1978). The use of sugars in the pulsing solution effectively influences the water balance in comparison to control. Sucrose enhances absorption of water from the vase solution which made a better water balance by maintaining turgidity and flower freshness (Reddy and Singh, 1996) and saves the cut flowers from early wilting resulted in prolong the vase life. The results are in confirmation with Harish (2012) in Anthurium. In the present investigation, the highest water balance (WB) recorded in sucrose @ 4% concentration (Table 1). Moreover, 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 (Moon-soo *et al.,* 2001). Sucrose helps to maintain water balance and also delays turgidity loss as inhibit flower senescence (Verlinden and Garcia, 2004).

The results revealed that maximum fresh weight was recorded in 4% sucrose, while the minimum weight was noticed in control (distilled water) as shown in the Table 1. Maintaining the higher fresh weight of cut flowers by the inclusion of sucrose resulting in longer vase life. The present investigation, concluded that influence of sucrose in the vase solution increased the mechanical rigidity of the stem by inducing cell wall thickening and lignification of vascular tissue thereby physiological loss in weight can be reduced. 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. Atiqullah and Gopinath (2012) noticed that significant influence of sucrose as pulsing agent resulted in lower physiological loss in weight of goldenrod flowers.

The termination of vase life was observed when petals started wilting, falling and discolouration etc. vase-life of cut flower depends on various factors such as water uptake, reduction in transpiration rate, improved water balance etc. Addition of sucrose replaces the depletion of carbohydrates from cut stems and maintains respiratory pool there by prolongs vase life (Marousky, 1971). It was reported that senescence process of cut flowers was delayed by the application of sucrose (Chung *et al*., 1997). In this study, the experiment was designed to assess the effects of different concentrations of sucrose on vase life and quality of *Solidago canadensis* L. and to find out optimum concentration which enhances and prolongs vase life. Among that, goldenrod spikes held in 4% sucrose (T3) recorded the highest vase life followed by sucrose @ 2% while spikes held in control (distilled water) (Fig 2) 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. Sucrose acts as a preservative materials, exogenous supply of sucrose balanced the depletion of carbohydrate and improved the vase life and quality of many cut flowers (Van Doorn, 2004). 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 Bhattacharjee, 1972 and Paulin, 1977).

Table 1- Effect of different sucrose concentrations on *solidago canadensis* cut flowers

Treatments	Uptake Of Water (g/flower)	Transpirational loss of water (g/flower)	Fresh weight of cut flower (g/s)	Ratio between water loss and water uptake	Water Balance (g/flower)
T1 : Distilled Water	10.57	11.64	19.02	1.10	-1.07
T2 : Sucrose @ 2%	16.59	15.91	23.07	0.95	0.68
T3 : Sucrose @ 4%	17.98	16.83	24.24	0.93	1.15
T4 : Sucrose @ 6%	14.88	17.01	24.60	1.00	-0.13
T5 : Sucrose @ 8%	13.48	13.85	20.66	1.02	-0.37
T6 : Sucrose @ 10%	15.65	15.29	23.92	0.99	0.75
SED	0.65	0.42	0.43	0.004	0.11
CD (5%)	1.31	0.86	0.87	0.009	0.22

Fig. 1 - Effect of Sucrose on physiological loss in weight (%) of *solidago canadensis* cut flowers

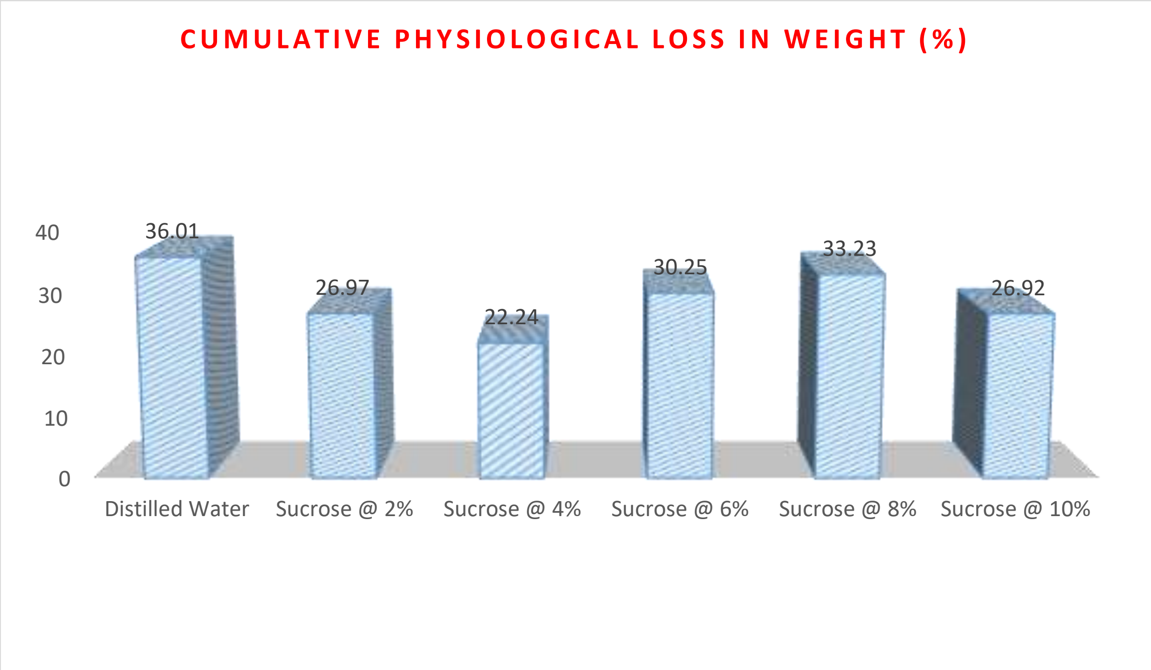
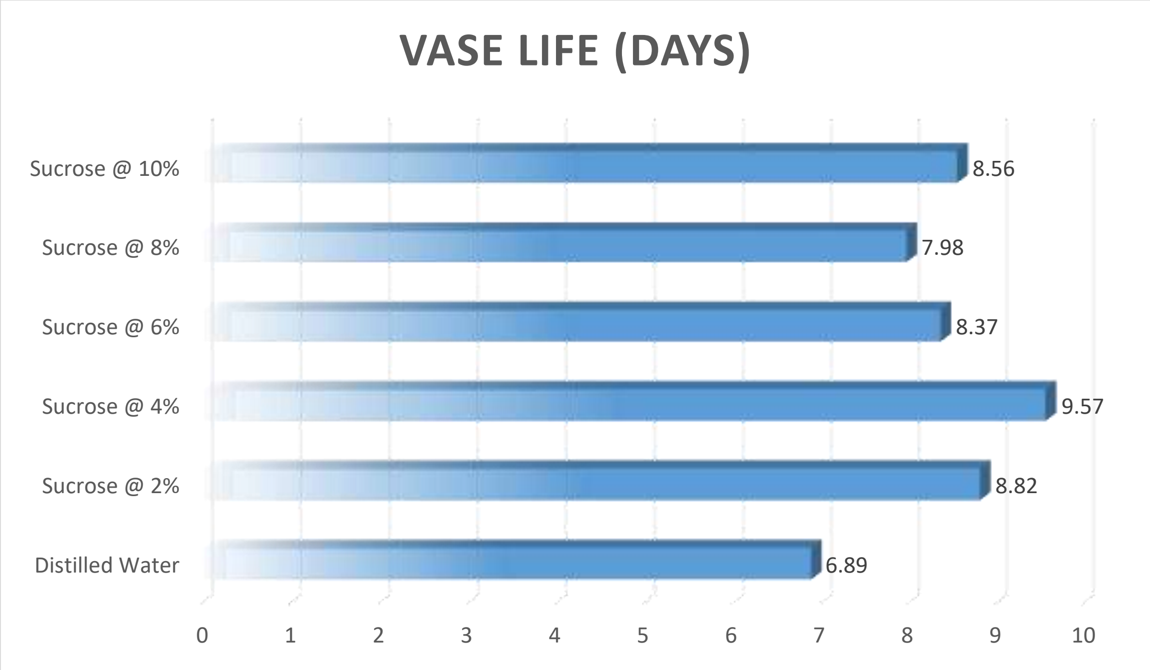


Fig. 2 - Effect of Sucrose solution on vase life (days) of *solidago canadensis* cut flowers



CONCLUSION

From the above results it can be concluded that, the 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 of cut flowers was increased by sucrose concentration of 4%. This is because the preservative solutions containing sucrose extended the vase life by inhibiting senescence which lead to improving the postharvest quality of the flowers. Adding sucrose to the holding solution it 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 longevity of many cut flowers has been prolonged.

REFERENCES

Ali, S., F.U. Khan, F.A. Khan and S.A. Wani. 2008. Post-harvest behaviour of cut daffodil as influenced by certain pulsing treatments. **J. of Ornamental Hort., 11(2):** 81–90.

Behera, P.K. 1993. Senescence in cut leafy flowering shoot: role of sucrose. **Plant Physiol. and Biochemistry, New Delhi, 20:** 59–59.

Bhattacharjee, S. K. (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.

Bhattacharjee, S.K. 1998. Effect of different chemicals in holding solution on postharvest life and quality of cut roses. **Ann. of plant Physiol., 12:** 161–163.

Chung, B.C., S.Y. Lee, S.A. Oh, T.H. Rhew and H.G. Nam. 1997. The promoter activity of sen 1, a senescence-associated gene of Arabidopsis, is repressed by sugars. **J. of plant Physiol., 151(3):** 339–345.

Gowda, J.V.N. 1986. Post-harvest life of China aster as influenced by chemical preservations. **Curr. Sci., 15(12):** 138–139.

Gupta, A. K., B. S. Reddy and K. Singh. 1994. Post- harvest physiology of cut gladiolus cv. sylvia as affected by cobalt and sucrose. **In: Floriculture Technology, Trades and Trends.** (Eds).

Halevy, A.H. and S. Mayak. 1981. Senescence and post-harvest physiology of cut flowers-part 11.**Horticulture Review 3:** 59–143.

Halevy, A.H., T.G. Byrne, A.M. Kofranek, D.S. Farnham and J.F. Thompson. 1978. Evaluation of postharvest handling methods for transcontinental truck shipments of cut carnations, chrysanthemums, and roses. **J. of the Amer. Soc. for Hort. Sci., 103(2):** 151–155.

Harish S. 2012. Studies on effect of pulsing and holding solutions for extending vase life of Anthurium (Anthurium andreanum L.) cv. Tropical. M.Sc Thesis, **Univ. Hort. Sci.,** Bagalkot.

Ichimura, K., Y. Kawabata, M. Kishimoto, R. Goto and K. Yamada. 2003. Shortage of soluble carbohydrates is largely responsible for short vase life of cut 'Sonia' rose flowers. **J. of the Japanese Soc. for Hort. Sci., 72(4):** 292–298.

Jamil, M.K., M.M. Rahman, M.M. Hossain, M.T. Hossain and A.S. Karim. 2016. Influence of sucrose and aluminium sulphate vase life of cut Hippeastrum flower (*Hippeastrum hybridum* Hort.) as influenced. **Bangladesh J. of Agric., Res., 41(2):** 221–234.

Khondakar, S.R.K. and B.C. Mazumdar. 1985. Studies on prolonging the vase life of tuberose cut flowers. **South Indian Horticulture (India).**

Kumar, A., S. Kumar and S. Chandra. 2010a. Vase life studies in tuberose (*Polianthes tuberosa*) cv. Shringar as affected by postharvest handling treatments. **The Asian J. of Hort., 5:** 7–10.

Kumar, J., and D. Singh. 2004. Postharvest Life of Tuberose Cultivar Pearl Double Spike as Affected by GA3, NAA and Sucrose. **Journal of Ornamental Horticulture 7(2):** 188– 191.

Maitra, S. and N. Roychowdhury. 2005. Effect of pulsing and holding solutions on postharvest life of cut flowers in *Anthurium andraeanum* Lind. cv. Nitta. **J. of Ornamental Hort., 8(3):** 186–190.

Marousky, F.J. 1971. Inhibition of vascular blockage and increased moisture retention in cut roses induced by pH, 8-hydroxyquinoline citrate, and sucrose. **J. Amer. Soc. Hort. Sci., 96:** 38– 41.

Moon-Soo, C., G.C. Fisun, D. Linda and S.R. Michael. 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.,** p. 543.

Mor, Y., R.E. Hardenburg, A.M. Kofranek and M.S. Reíd. 1981. Effect of silver-thiosulphate pretreatment on vase life of cut standard carnations, spray carnations, and gladiolus after a transcontinental truck shipment. **HortScience 16(6):** 766–768.

Mousa, S., K. Mosen, S.T. Toktam and N. Roohangiz, 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.

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.

Paulin, A., M.J. Droillard and J.M. Bureau. 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.

Pobudkiewicz, A. and J. Nowak. 1992. The effect of gibberellic acid on growth and flowering of *Gerbera jamesonii* Bolus. **Folia Horticulturae** 2(04).

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.

Pun, U.K., H. Shimizu, K. Tanase and K. Ichimura. 2003. Effect of sucrose on ethylene biosynthesis in cut spray carnation flowers. **VIII International Symposium on Postharvest Physiol. of Ornamental Plants, 669.** p. 171–174.

Reddy, B.S. and K. Singh. 1996. Effects of aluminium sulphate and sucrose on vase life of tuberose. **J. Maharashtra Agric. Univ., 21:** 201–203.

Rogers, M.N. 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.

Shobha, K. 1992. Effect of sucrose pulsing and metallic salts on the vase-life of cut flowers. **PhD Thesis**, University of Agricultural Sciences, Bangalore.

Shree, B. (2011). Studies on the effect of holding solutions on vase life of cut gerbera (*Gerbera jamesonii* Bolus ex. Hook.) cv. Lamborgini. **PhD Thesis**, Andhra Pradesh Horticultural University. Venkataramannagudem.

Sudaria, M.A., A. Uthairatanakij, and H.T. Nguyen. 2017. Postharvest quality effects of different vaselife solutions on cut rose (*Rosa hybrida* L.). **Int. J. of Agric. Forestry and Life Sci., 1(1):** 12–20.

Van Doorn, W.G. 2001. Role of soluble carbohydrates in flower senescence: a survey. **Acta Horticulturae, (543):** 179–183. doi: 10.17660/ActaHortic.2001.543.21.

Van Doorn, W.G. 2004. Is petal senescence due to sugar starvation. **Plant Physiol., 134(1):** 35– 42.

Verlinden, S. and J.J.V. Garcia. 2004. Sucrose loading decreases ethylene responsiveness in carnation (*Dianthus caryophyllus* cv. White Sim) petals. **Postharvest Biol. and Technol. 31(3):** 305–312.