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Efficacy of 5-sulpho salicylic acid to improve vase life of gladiolus

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ABSTRACT

Gladiolus is one of the most important bulbous cut flowers in domestic and international market. The commercial cultivation of gladiolus in India is increasing in terms of area, production and market. Due to rapid urbanization, change in life style, mall culture consumption of flowers has increased significantly. The longevity of cut flowers is one of the main challenges of florists today. Because, one the most important factors for consumers, apart from its external quality, is vase life of cut flower. The longevity of gladiolus cut flowers is very short. The typical vase life of individual spike is just 4 to 6 days depending upon cultivar. Therefore, the present study was carried out at the Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi with an objective of identifying new eco friendly chemical for increasing the vase life of gladiolus cv. Gunjan. The experiment consisted of eight treatments (three chemicals in different combinations) and replicated thrice. From the present studies it was observed that 5 sulpho salicylic acid @ 1 mM SAA+ 4% Sucrose (T_4) increased the vase life of cut flowers up to 9.11 days as compared to control (5 days) and the treatment T_4 was statistically at par with T_7 (400 ppm 8-HQC). So, it can be concluded that 5 sulpho salicylic acid is a very good alternative of 8HQC, as it is a cost-effective chemical, easily available and environmental friendly.

Keywords: Ascorbic acid, Cut flower, Gladiolus, MSI, 5-Sulpho salicylic acid, Vaselife

Gladiolus (*Gladiolus×hybrida*) commonly known as sword lily is a popular cut flower crop known for its attractive spikes. It belongs to the family *Iridaceae* and is also known as queen of bulbous flowers. Gladiolus is cultivated in an area of 11.67 thousand ha with cut flower production of 92.89 thousand metric tonnes in India (Indian Horticulture Database 2014).The domestic consumption has increased significantly but the longevity of cut flowers is one of the major challenges faced by the florists today. Cut flower longevity generally ranged between 5–7 days depending upon cultivar. Higher moisture content tends ornamentals to be highly perishable, more susceptible to mechanical and physical damage, infection by diseases and pests during and after harvest. Cut flowers carry on all the life processes at the expense of stored reserve foods in the form of carbohydrates, proteins and fats for their longevity (Salunkhe *et al.* 1990, Jain *et al.* 2007, Jain *et al*. 2017). Use of sucrose in preservative solution replaces the depleted endogenous carbohydrates utilized during post-harvest life of flowers. Chemical preservatives used for extending vase life of cut flowers have their own merits and demerits. Some of effective preservatives used widely in holding solutions are not eco-friendly, quite expensive and possess serious disposable issues after use. To ensure our environment safe, there is an urgent need to develop eco-friendly formulations and evaluate their efficacy in comparison with extant floral preservatives. Therefore, present investigation was carried out to identify suitable environmentally safe formulations to increase the vase life of gladiolus cut flowers.

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MATERIALS AND METHODS

The present experiment was conducted at the post-harvest laboratory of ICAR-IARI, New Delhi during 2017–18. Spikes of gladiolus cv. Gunjan of similar maturity were harvested from experimental field when basal two to three florets showed visible colour during morning h and brought to the laboratory in plastic container containing deionized water. Uniform stems of 60 cm in length were recut under deionized water and lower 1/3rd leaves were removed. Clean test tubes of 150 ml capacity were filled with holding solutions (80 ml), viz. T_1- Ascorbic acid 100 ppm+4% Sucrose (*p*H 4.5), T_2- Ascorbic acid 200 ppm+4% Sucrose (*p*H 4.0), T_3-Ascorbic acid 300 ppm+4% Sucrose (*p*H, 3.9), T_4-5-sulpho salicylic acid 1.0 mM + 4% Sucrose (*p*H, 3.4), T_5- 5-sulpho salicylic acid 2.0 mM + 4% Sucrose (*p*H, 3.2), T_6- 5-sulpho salicylic acid 3.0 mM + 4% Sucrose (*p*H, 3.1), T_7- 8-HQC (hydroxyquinoline citrate) 400 ppm+

4% Sucrose, (*p*H 3.3), T_8-Control (Distilled Water- *p*H, 6.0). The experiment was laid out in completely randomized design with three replications for each treatment and again three stems per replication were maintained. Single cut stem was immersed in holding solution separately in each test tube. Experiment was set up under controlled laboratory conditions of 21^0C temperature, 70±5% relative humidity and 16 h illumination of cool white fluorescent lamps.

The observations were recorded for physiological parameters, viz. initial spike weight (g), final spike weight (g), physiological loss of weight (PLW%), solution uptake (ml), number of florets open at one time (after 5 days), florets remain closed at one time, per cent floret opening at one time, total number of florets wilted, floret size (cm) and vase life (days). Membrane Stability Index (MSI) was calculated on the basis of electrolyte leakage of petals. Leakage of ions from the florets was estimated according to Sairam *et al*. (1997) and expressed as MSI percentage. Ion leakage was determined by recording the electrical conductivity of petal leachates in double distilled water at 40°C and 100°C. The electrolyte leakage was measured by taking five petal discs (1 cm^2) of the third floret from the basal end of the spike. Petal discs were placed in test tubes containing 10 ml of double distilled water in two sets. One set was kept in water bath at constant temperature of 40°C for 30 min and another set was kept in a boiling water bath at 100°C for 15 min and their respective conductivity's C_1 and C_2 were measured using a conductivity meter (ECtestr11+ multi range conductivity meter). MSI was calculated as: $[1–(C_1/C_2)] \times 100$.

Recorded data were subjected to analysis of variance using Web Agri Stat Package 2.0 of ICAR Research Complex for Goa, India.

RESULTS AND DISCUSSION

Data (Table 1) revealed that the effect of floral preservatives was non-significant with respect to initial spike weight and the number of florets per spike which indicates that the flower spikes used for the present experiment were of uniform quality. It is evident (Table 1) that preservatives had significant effect on change in spike weight at the termination of vase life. It was observed that there was gain in spike weight in flowers kept in holding solution of T_4, T_5, T_6, and T_7 while spikes lost weight in rest of the treatments. Maximum weight gain (5.60±1.38 g) was observed in treatment T_4 (5-sulpho salicylic acid 1.0 mM + 4% Sucrose) and was statistically at par with T_5, T_6 and T_7, while maximum weight loss (-9.07±3.20g) was observed in T_3. Least physiological loss in weight (7.71%) was observed in spikes held in 5-sulpho salicylic acid 1.0 mM + 4% sucrose (T_4) and it was at par with T_5, T_6 and T_7, whereas highest loss of spike weight (26.73%) was observed under control (T_8).

Data pertaining to gradual opening of florets on spike showed that there was significant effect on number of florets opened at one time, number of florets remain closed and per cent floret opening (Table 2). The maximum number (9.80±0.10) of opened florets at one time was observed in spikes held in solution containing 8HQC 400 ppm + 4% sucrose (T_7) and it was at par with T_4 and T_5, whereas minimum number of florets opened (7.43±0.43) was recorded inT_1. The minimum number of florets (1.83±0.20) remained closed in spikes held in T_7 and was at par with T_2, T_3, T_4 and T_5. Per cent floret opening at one time was found to be maximum (84.26%) in T_7 and it was statistically at par with T_4 and T_5, while minimum percentage of floret opening (67.36%) was observed in solution containing ascorbic acid 100 ppm + 4% sucrose (T_1). Data (Table 2) reveals that floret size did not vary significantly across treatments due to uniform quality and growth of spikes. Number of flowers wilted at the termination of vase life was noticed more (7.43±0.13) in T_6 (5-sulpho salicylic acid 3.0 mM + 4% Sucrose) and it was at par withT_7 and T_8. The preservative solutions significantly influenced the vase life of gladiolus spikes. Maximum vase life (9.11±0.11days) was recorded in treatment T_4 (5-sulpho salicylic acid 1.0 mM + 4% Sucrose) and it was statistically at par with T_1, and T_7 while minimum vase life (5.00±0.00days) was recorded under control (T_8).Salicylic acid stimulates production of hydrogen peroxide and oxygen free radicals in cells to induce resistance in plants in the early stages of stress. These compounds are gradually eliminated by the enzymatic and

Table 1 Effect of floral preservatives on floral attributes of gladiolus cv. Gunjan cut flowers

Treatment	Total number of florets per spike	Initial spike weight (g)	Final spike weight (g)	Change in spike weight (g)	Physiological loss in weight (%)	No. of florets opened at one time	No. of florets closed at one time	Per cent floret opening at one time
T_1	11.03	40.57±2.05	32.50±2.16	-8.03±0.35	19.51±0.74	7.43±0.43	3.60±0.10	67.36
T_2	12.23	42.57±0.92	38.93±0.87	-3.50±0.66	20.53±0.75	8.67±0.20	2.56±0.30	77.20
T_3	11.23	42.10±1.11	33.30±2.56	-9.07±3.20	13.18±1.05	8.67±0.38	2.56±0.59	77.20
T_4	11.67	41.13±2.32	46.67±3.45	5.60±1.38	7.71±0.32	9.53±0.39	2.14±0.13	81.66
T_5	10.63	43.47±2.18	44.23±2.47	1.24±1.17	8.32±0.39	9.43±0.10	2.20±0.29	81.08
T_6	11.87	42.67±1.19	40.87±3.70	2.80±2.53	9.45±0.44	8.90±0.29	2.97±0.13	74.98
T_7	12.63	45.83±0.62	50.23±0.94	4.43±1.24	9.69±0.32	9.80±0.10	1.83±0.20	84.26
T_8	12.67	44.10±1.29	36.33±1.08	-8.77±0.92	26.73±0.63	8.30±0.00	3.37±0.52	71.12
$CD_{0.05}$	NS	NS	7.22	5.11	2.11	0.85	1.01	4.53

Table 2 Effect of floral preservatives on physiological attributes of gladiolus cv. Gunjan cut flowers

Treatment	Floret size (cm)	Number of flowers wilted	Vase life (days)	Solution uptake (ml)	MSI (%)
T_1	9.13±0.69	6.13±0.30	8.66±0.19	35.33±2.40	78.57 (62.41)
T_2	9.60±0.17	5.90±0.20	8.30±0.00	43.67±1.99	78.52 (63.35)
T_3	9.23±0.29	5.90±0.42	7.33±0.33	37.87±2.23	79.87 (62.36)
T_4	9.87±0.37	6.20±0.10	9.11±0.11	65.20±5.27	84.47(65.46)
T_5	9.57±0.32	6.77±0.23	7.83±0.23	57.80±2.10	82.74 (66.77)
T_6	8.93±0.07	7.43±0.13	7.33±0.33	48.90±3.94	80.51(63.84)
T_7	9.77±0.24	6.90±0.10	9.00±0.00	63.53±1.89	86.35 (70.95)
T_8	9.40±0.31	7.00±0.00	5.00±0.00	42.20±0.90	64.48 (53.40)
$CD_{0.05}$	NS	0.67	0.61	8.62	3.33

Figures in parenthesis are transformed values

non-enzymatic defense systems of the plant (Rohi *et al.* 2010). Similar to our findings Bayat and Aminifard (2017) reported that 300 ppm salicylic acid extended the vase life of alstroemeria, gerbera, asiatic lily, tuberose and rose by 40, 67, 21, 71 and 56%, respectively, in comparison to control. Salicylic acid application at the concentration of 150 mg/L and 2 mM enhanced vase life of rose (Geriloo and Ghasemnezhad 2011) and lisianthus (Kazemi *et al*. 2011), respectively. Salicylic acid has been reported to involve directly or indirectly in activating antioxidant enzymes against plant stresses (Tian *et al*. 2007).

The effect of solution uptake was found significant, maximum solution uptake (65.20±5.27ml) was recorded in flowers kept in T_4 (1.0 mM 5-sulpho salicylic acid + 4% Sucrose) and was at par with T_7. However, minimum volume of solution was taken up in treatment T_1 (Table 2).Vase solution was found to be better in treatments which contained both sucrose and preservatives. In the present study, sucrose might have synergized the effect of preservatives by increasing their osmotic concentration, thereby improving water absorbing ability and turgidity levels in cut stems. Sucrose also maintains the extra carbohydrate levels and helps to sustain high respiratory rate in cut stems (Kuiper *et al*. 1995). Data (Table 2) showed that the highest MSI (86.35%) was recorded in T_7 and was at par with T_4. MSI value was lowest (64.48%) under control. There is a direct relationship between the MSI and vase life, the treatment which was having maximum MSI had highest vase life. Lower values of MSI indicate rise in electrolyte leakage from petal tissues which proportionately decreases fresh weight of stems and their solution uptake. Similar results were observed in cv. White Prosperity by Sairam *et al.* (2011).

It can be concluded from the current study that keeping the flowers in 200 ppm 8-HQC + 4% Sucrose or 1.0 mM 5-sulpho salicylic acid + 4% sucrose is helpful in increasing the vase life and other post-harvest attributes. Therefore, it can be concluded that the 5-sulpho salicylic acid is a cost effective and eco-friendly alternative of 8-HQC for improving the post-harvest attributes of gladiolus.

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