Research Article

Standardization of Pulsing Treatments for Improving the Vase life of Gladiolus (*Gladiolus grandiflorus* L.)

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Abstract

Gladiolus is one of the most important ornamental cut flower popular for its attractive spikes having florets of attractive forms, dazzling colors, and varying sizes. The longevity of cut flowers is one of the main challenges of florists to gain consumers attention towards its marketing. The typical vase life of individual florets is just 4 to 6 days and it falls very short. Therefore, the present investigation was carried out at the Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi with an objective to identify the suitable pulsing solution for increasing the vase life of gladiolus. Uniform cut spikes of gladiolus cv. Melody Open were pulsed with different pulsing solutions for 4 hours and after that, their vase life was evaluated in distilled water. It was observed that pulsing of cut spikes with 400 ppm $Al_2 (SO_4)_3$ +20 % sucrose (P_5) resulted in maximum weight gain (10.3g) and maximum solution uptake (11.11ml). Maximum number of floret opening (9.35), maximum floret size (9.09 cm) and maximum vaselife (12.77 days) was recorded in cut spikes pulsed with 8HQC 200 ppm+10% sucrose (P_2) and 400 ppm $Al_2 (SO_4)_3$ +20 % sucrose (P_5). Minimum physiological loss in weight (11.59g) and maximum water uptake (46.41 ml) was and were observed in flowers pulsed with 8HQC 200 ppm+10% sucrose (P_2). However pulsing of flowers 8HQC 200 ppm+20% sucrose (P_1) resulted in maximum membrane stability (79.38%) and was at par with P_2.

Keywords: Gladiolus, Pulsing, Sucrose, 8-HQC, Aluminium sulphate

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Introduction

Gladiolus commonly, known as “Sword lily” belongs to the family Iridaceae is a popular cut flower crop having great demand in domestic as well as international market. According to Indian Horticulture Database 2014 of National Horticulture Board, it ranks fourth in area followed by marigold, rose, and chrysanthemum and second in the cut flower production followed by Rose. The domestic consumption of gladiolus has increased significantly in recent times. The longevity of gladiolus cut flowers is one of the limiting factors very short just accounting four to six days. Higher moisture content tends ornamentals to high perishability, more susceptible to mechanical and physical damage, infection by diseases and pests during and after harvest. Although there has been boom in the production sector but there are enormous losses in value of cut flower all along the market channel and are estimated to be 30-40 per cent of farm value. The post-harvest behaviour of flowers is an outcome of the physiological processes, occurring in leaves, stem, flower bud, leafless peduncle or scape connecting bud to the stem. Some of these processes may act independently to affect the senescence and vase life of cut flowers but most of them are inter-related. Since, cut flowers carry on all the life processes after harvest at the expense of stored reserve foods in the form of carbohydrates, proteins and fats for their longevity [1]. Therefore, pulsing is essentially needed to supply the carbohydrates externally to stay flowers for a longer time. The effect of such a treatment lasts throughout the vase life of flowers. Pulsing refers to pre-shipment treatment beneficial for flowers destined for storage or long distance transport, even when flowers are held in water [2, 3]. Pulsing helps to prolong vase life, promote flower opening and improvement of color and size of rose petals through osmo-regulation [4]. During pulsing, the stem is placed in a solution containing sugars and germicides for a period of 12-24 hours at about 20-27 ^{0}C [5]. Sucrose replaces the depleted endogenous carbohydrates utilized during the post-harvest life of flowers [1]. Therefore, present studies were carried out with the objective to standardize the pulsing treatment for increasing the vase life of gladiolus cv. Melody.

Materials and Methods

The present study was carried out in the Division of Floriculture and Landscaping IARI, New Delhi during 2014-16. Uniform cut flowers of cv. Melody were harvested from the field early in the morning and were brought to the laboratory in a bucket containing pure water. The spikes were prepared by cutting them to a uniform length of 45 cm and were dressed by removing lower 1/3rd leaves. The cut stems were then placed in various pulsing solutions like 8HQC 200 ppm+20% Sucrose (P_1), 8HQC 200 ppm+10% Sucrose(P_2), 8HQC 300ppm+20% Sucrose(P_3), 8HQC 300 ppm+10% Sucrose (P_4), $Al_2(So_4)3$ 400 ppm+20% Sucrose (P_5), 20 % Sucrose (P_6) and were compared with control i.e. distilled water (P_7). The flowers were pulsed for four hours and after that, the cut stems were transferred to the test tubes containing distilled water. The experiment was laid out in completely randomized design, replicated thrice with three stems per replication. The observations for initial spike weight (g), spike weight after pulsing (g), change in weight after pulsing (g), volume of solution used (ml), total no. of florets, number of florets open, florets remained closed, total number of florets wilted, vase life (days), spike weight at termination of vase life(g), physiological loss of weight (g), water uptake (ml), floret size (cm), stem diameter (mm), membrane stability index (MSI) were recorded and the data were subjected to analysis of variance using Web Agri Stat Package 2.0 of ICAR Research Complex for Goa, India. The data presented in the tables are the pooled averages of two years.

Results and Discussion

The data presented in **Table 1** reveals that the effect of pulsing solutions on cut flowers was non-significant w.r.t the initial weight of spike and stem diameter, which indicates that the material used were of uniform quality. It is also evident from the Table 1 that there was a significant effect of pulsing solutions on weight change after pulsing. Maximum weight gain (1.03g) was observed in treatment P_5 i.e. Al_2 $(SO4)_3$ 400 ppm+20% Sucrose and was statistically at par with $P_{1,}$ however, minimum weight gain (0.15g) was observed under control. Solution uptake was found to be significant (1.20 ml) when flowers were pulsed with 8HQC 200 ppm+20% (P_1) Sucrose and was at par with all the treatments except P_6 and P_7. However, minimum solution was taken up by flowers pulsed in distilled water (P_7).It is evident from Table 1 that on the third day the maximum weight gain (11.20g) was observed in flowers pulsed with 8HQC 200 ppm+20% Sucrose (P_1) and was on par with P_2, P_3, P_4 and P_5 while minimum weight gain (9.10g) was observed under control. Positive results were due to increased concentration of sugars in spikes with enhanced water uptake.

Table 1 Effect of pulsing solutions on spike weight (cm) stem diameter (mm) and volume of solution uptake (ml/stem) and weight gain in gladiolus cv. Melody cut flowers

Treatments		Initial spike weight (g)	Gain in weight after pulsing (g)	Stem diameter (mm)	Volume of solution uptake (ml)	weight gain on the 3rd day (g)
P1	8HQC 200 ppm+20% Sucrose	42.83	0.95	134.96	10.25	11.20
P2	8HQC 200 ppm+10% Sucrose	44.03	0.53	135.80	11.11	11.00
P3	8HQC 300 ppm+20% Sucrose	43.74	0.54	135.01	10.46	10.80
P4	8HQC 300 ppm+10% Sucrose	45.87	0.30	135.21	10.23	10.87
P5	$Al_2(So_4)_3$ 400 ppm+20% Sucrose	42.70	1.03	135.43	10.05	10.90
P6	20 % Sucrose	44.77	0.50	135.37	10.61	10.10
P7	Distilled water (control)	44.40	0.15	135.47	9.92	9.10
CD @5%		NS	0.43	NS	1.02	0.72

The combination of sucrose and 8-HQC was effective because sucrose gets accumulated in spikes tissues, increased their osmotic concentration and improves their ability to absorb water and maintain spikes turgidity [6]. An optimum level of petal-sugars is able to avoid hydrolysis of cellular constituents [7] and the remobilization of nutrients [8].

Data pertaining to floret traits is presented in Table 2 indicates that the there was a significant effect of pulsing solutions on a number of florets opened, the number of florets remained closed, wilted florets and floret size. The maximum average number of florets open (9.22) was observed in flowers pulsed with 8HQC 200 ppm+20% Sucrose (P_1) and it was on par with P_2 and P_3. However, a minimum number of florets opened (7.77) was recorded in treatment P_7. It is clear from the Table 2 that the minimum florets (4.17) remained closed in flowers pulsed with 8HQC 200 ppm+20% Sucrose (P_1) and was at par with P_2, P_3 and P_4, however, a maximum number of florets did not open (7.66) in distilled water and was at par with P_6. Higher petal sugar level and balanced water uptake enhanced flower bud opening [9]. It was reported that the opening of gladiolus florets was complemented with an increase in fresh weight, dry weight and carbohydrate status in the perianth [10]. As far as wilting of florets is concerned, it was observed that after nine days minimum floret wilting (4.67) was observed in flowers pulsed with 8HQC 200 ppm+10% sucrose (P_2) and $Al_2(SO4)_3$ 400 ppm+20% sucrose (P_5) was at par with P_1 and P_3, while maximum florets were wilted (6.80) under control. Comparison of data presented in Table 2 shows that the maximum floret size (9.09 cm) was observed in flowers pulsed with 8HQC 200 ppm+10% Sucrose (P_2) and was at par with P_1 and P_5 while minimum floret size (7.03 cm) was observed under control (P_7). Since quinoline esters are acidic in vase solution, therefore, 8- HQC inhibits stem plugging by reducing pH of the solution [11], thereby increasing the conductivity of stems and hence flower diameter. The combination of sugar with 8-HQ and citric acid markedly inhibit senescence [4].

Table2 Effect of pulsing solutions on floret traits of gladiolus cv. Melody cut flowers

Treatments		Total number of florets	Number of florets opened	Number of florets remained closed	Number of Florets wilted	Floret size (cm)
P1	8HQC 200 ppm+20% Sucrose	13.50	9.33	4.17	5.17	8.70
P2	8HQC 200 ppm+10% Sucrose	14.22	9.35	4.87	4.67	9.09
P3	8HQC 300 ppm+20% Sucrose	14.78	8.89	4.99	5.33	8.38
P4	8HQC 300 ppm+10% Sucrose	12.35	8.00	4.35	5.67	8.25
P5	$Al_2(So_4)_3$ 400 ppm+20% Sucrose	14.03	8.37	5.44	4.67	9.00
P6	20 % Sucrose	13.67	8.23	6.90	5.67	8.86
P7	Distilled water (control)	14.67	7.77	7.66	6.80	7.03
CD @5%		NS	0.83	0.82	0.87	0.44

An inquisition of data presented in **Table 3** shows that the maximum vase life (12.77 days) was observed in flowers pulsed with 8HQC 200 ppm+10% Sucrose (P_2) and $Al_2(So_4)_3$ 400ppm+20% Sucrose (P_5) was at par with P_1, P_3 and P_4, while minimum vase life (9.33days) was observed under distilled water (P_7). Increased vase life of cut roses when pulsed with 3 per cent sucrose for 24 hours was observed [12, 13]. 8-HQC is known to inhibit ethylene production by cut surface [14] and thereby increases vase life [15]. Similarly, the longest vase life in rose flowers pulsed with 8-HQC + sucrose [16]. Minimum physiological weight loss (11.59%) was observed in flowers pulsed with 8HQC 200 ppm+10% Sucrose (P_2) and was statistically at par with P_1, P_3 and P_5, however, maximum physiological weight loss (27.18%) was observed under control. The reduction in fresh weight could be due to decreased water uptake/or increase in water loss, and a decrease in MSI. Similarly, a significant reduction in fresh weight of White Prosperity was observed [17]. It is also clear from the Table 3 that the maximum water uptake (46.41 ml) was observed in flowers pulsed with 8HQC 200 ppm+10% Sucrose (P_2) whereas, minimum water uptake (36.57ml) was recorded in flowers kept in distilled water. Use of 8-HQC, an antimicrobial agent and sucrose in enhancing water uptake in cut flowers is well known. An inquisition of data presented in Table 3 shows that the maximum membrane stability index (MSI) (79.38 %) was recorded with 8HQC 200 ppm+20% Sucrose (P_1) and was at par with P_2, however, minimum MSI value (47.00%) was observed under control conditions. There is a positive correlation between the MSI and vaselife. The higher membrane stability ensures better protection of cell organelles, thereby, the cell structure and functions. Higher membrane stability protects the sensitivity of petals against the postharvest stresses which cause damage to the cell structure.

Table 3 Effect of pulsing solutions on vase life, weight gain on 3rd day, physiological weight loss (%), water uptake and membrane stability index of gladiolus cv. Melody cut flowers

Treatments		Vase life (days)	Final spike weight (g)	Physiological weight loss (%)	Water uptake (ml)	MSI (%) After 5 days
P1	8HQC 200 ppm+20% Sucrose	12.23	37.67	12.30	46.12	79.38(8.91)
P2	8HQC 200 ppm+10% Sucrose	12.77	39.98	11.59	46.41	78.40(8.85)
P3	8HQC 300 ppm+20% Sucrose	12.13	38.37	13.96	45.18	72.83(8.53)
P4	8HQC 300 ppm+10% Sucrose	12.55	38.42	14.52	46.37	70.47(8.39)
P5	$Al_2(So_4)_3$ 400 ppm+20% Sucrose	12.77	39.67	12.07	45.07	73.50(8.57)
P6	20 % Sucrose	10.43	37.30	16.68	41.90	64.40(8.02)
P7	Distilled water (control)	9.33	32.33	27.18	36.57	47.00(6.88)
CD @5%		0.90	0.79	2.11	2.75	5.97(0.03)

Conclusion

From the present investigations, it is concluded that the pulsing of gladiolus spikes with 8HQC 200 ppm+10% sucrose would be helpful in increasing the vaselife and improving other postharvest attributes.

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