Indian Journal of Agricultural Sciences **79** (8): 604–7, August 2009

Effect of different holding solutions on post-harvest life of gladiolus (*Gladiolus hybridus*)

RAJIV KUMAR[1], L C DE[2], A R ROY[3] and MED RAM VERMA[4]

ICAR Research Complex for NEH Region, Umiam, Meghalaya 793 103

Received: 30 June 2008

ABSTRACT

A study was conducted during 2006-07 to prolong the post-harvest life of gladiolus using different holding solutions. Six holding solutions, viz tap water (control), 4% sucrose, 4% sucrose + 8-HQC (250 ppm), 4% sucrose + acetyl salicylic acid (Aspirin) (200 ppm), 4% sucrose + $Al_2(SO_4)_3$ (200 ppm) and 4% sucrose + 0.1% $ZnSO_4$ were used to prolong the post-harvest life of 'Pusa Jyotsana' gladiolus using completely randomized design with 7 replications. Holding solutions significantly affected the change in fresh weight over initial fresh weight. On 3rd day in vase, maximum increase in fresh weight (16.87 g and 15.07 g) respectively was recorded in tap water and 4% sucrose + 8-HQC (250 ppm). On 5th day in vase, maximum increase in fresh weight (18.66 g and 18.07 g) respectively of spike was recorded in holding solution of 4% sucrose + acetyl salicylic acid (200 ppm) and 4% sucrose + 8-HQC (250 ppm). Minimum loss in fresh weight (–5.73 g) of spike at senescence was observed in holding solution of 4% sucrose + acetyl salicylic acid (200 ppm). Significantly, maximum solution uptake by the spike was observed in tap water (52.85 ml and 72.28 ml, respectively) on 3rd day and 5th day in vase while, maximum solution uptake (129.42 ml) was recorded in holding solution containing 4% sucrose + acetyl salicylic acid (200 ppm) followed by 4% sucrose + 8-HQC (250 ppm) at senescence stage. Holding solution of 4% sucrose + 8-HQC (250 ppm), significantly improved the diameter of 1st (10.14 cm) and 3rd (9.50 cm) floret, whereas, the longevity of first florets (4.43 days), effective useful life (10.14 days) and vase life (13.14 days) were recorded in 4% sucrose + 8-HQC (250 ppm). Number of fully opened florets was found maximum (4.57 and 5.00, respectively) with 4% sucrose + 8-HQC (250 ppm) on 5th and 7th day in vase.

Key words: Cut flowers, Fresh weight, Gladiolus, Holding solutions, Spikes, Vase life

Gladiolus belongs to the family Iridaceae. It is an important bulbous ornamental prized for its attractive spike with florets of various dazzling colours, forms, sizes and long vase-life. Cut spikes are highly perishable in nature. The extent of vase- life depend upon water relations of spike and senescence rate of florets. Hence, an effort was made to prolong the post-harvest life of the gladiolus by using different holding solutions.

MATERIALS AND METHODS

The experiment was conducted in the Division of Horticulture, ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2006–07 on 'Pusa Jyotsana' gladiolus cv. The spikes were harvested between 8 and 9 AM from the research plot when the three basal florets showing colour and the cut end of the spike were immediately dipped in freshly collected tap water and brought to laboratory. In laboratory, the stems were re-cut at 80 cm with 1 or 2 bract, like leaves below the first floret. After recording the fresh weight and length, spikes were dipped in 500 ml capacity amber coloured bottles containing 200 ml of six different holding solutions, viz tap water, 4% sucrose 4% sucrose + 8-HQC (250 ppm), 4% sucrose + acetyl salicylic acid (200 ppm), 4% sucrose + $Al_2(SO_4)_3$ (200 ppm) and 4% sucrose + $ZnSO_4$ (0.1%). Each treatment had 7 spikes with each spike as replication. The experiment was laid out in complete randomized design.

RESULTS AND DISCUSSION

Different holding solution significantly affected change in fresh weight (Table 1) over initial fresh weight. On 3rd day in vase, maximum increase in fresh weight (16.87 and 15.07 g, respectively) was recorded in tap water and 4% sucrose + 8-HQC (250 ppm), while minimum (9.10 g) changes was observed in holding solution of 4% sucrose + $Al_2(SO_4)_3$ (200 ppm). On 5th day in vase, maximum increase in fresh weight (18.66 and 18.07 g, respectively) of spike was recorded in holding solution of 4% sucrose + acetyl salicylic acid (200 ppm) and 4% sucrose + 8-HQC (250 ppm). On 7th day in vase, maximum increase in fresh weight

[1]Scientist (E-mail: flori_rajiv@yahoo.co.in) [2]Senior Scientist, [3]Technical Officer, Division of Horticulture, [4]Scientist, Division of Agricultural Economics and Statistics

Table 1 Effect of holding solutions on changes in fresh weight (g) over initial fresh weight of 'Pusa Jyotsana' gladiolus

Treatment	3rd day	5th day	7th day	9th day	At senescence
Tap water (control)	16.87	14.16	4.25	4.00	–32.64
Sucrose (4%)	11.33	8.73	2.65	5.20	–31.56
S (4%) + 8-HQC (250 ppm)	15.07	18.07	13.86	7.70	–18.21
S (4%) + acetyl salicylic acid (200 ppm)	14.71	18.66	17.56	14.32	–5.73
S (4%) + $Al_2(SO_4)_3$ (200 ppm)	9.10	4.49	1.37	–7.01	–29.96
S (4%) + $ZnSO_4$ (0.1%)	14.19	15.34	14.46	11.38	–16.22
SEm±	0.76	1.16	1.34	1.27	1.21
CD (*P*=0.01)	2.02	3.17	3.66	3.45	3.29

Table 2 Effect of holding solutions on cumulative changes in solution (ml) uptake of 'Pusa Jyotsana' gladiolus

Treatment	3rd day	5th day	7th day	9th day	At senescence
Tap water (control)	52.85	72.28	79.14	85.42	117.42
Sucrose (4%)	45.57	57.00	61.00	65.00	77.42
S (4%) + 8-HQC (250 ppm)	43.14	65.14	80.28	92.00	121.57
S (4%) + acetyl salicylic acid (200 ppm)	41.14	64.00	77.71	94.00	129.42
S (4%) + $Al_2(SO_4)_3$ (200 ppm)	37.71	50.57	58.57	64.28	74.57
S (4%) + $ZnSO_4$ (0.1%)	43.71	53.71	68.00	79.42	120.57
SEm±	1.80	2.46	2.83	3.30	5.00
CD (*P*=0.01)	4.91	6.71	7.71	8.98	13.61

(17.56 g) was recorded in vase solution containing 4% sucrose + 8-HQC (250 ppm), while maximum decrease or loss was observed in tap water. On 9th day in vase, maximum increase in fresh weight (14.32 g) was recorded in 4% sucrose + acetyl salicylic acid (200 ppm), while maximum loss in fresh weight (–7.01g) was observed in 4%sucrose + $Al_2(SO_4)_3$. There was reduction in fresh weight of spike irrespective of treatment at senescence stage. Minimum loss in fresh weight (–5.73 g) of spike at senescence was observed in holding solution containing 4% sucrose + acetyl salicylic acid (200 ppm), followed by 4% sucrose + $ZnSO_4$ (0.1%), while it was maximum in tap water (–32.64 g). The beneficial effect of acetyl salicylic acid is due to its antitranspirant activities (De 1995, Leslie and Romani 1986). Improvement in fresh weight of cut spike of 'Peter Pears' due to 8-HQ pretreated and sucrose pulsing has also been reported (Singh *et al.* 2007).

Solution uptake by the spike in different holding solutions was progressively increased from 3rd day to senescence stage (Table 2). Significantly maximum solution uptake by the spike was observed in tap water (52.85 ml and 72.28 ml, respectively) on 3rd day and 5th day in vase. On 7th day and 9th day in vase, maximum solution uptake (80.28 and 94.00 ml, respectively) was noted in 4% sucrose + 8-HQC (250 ppm) and 4% sucrose + acetyl salicylic acid (200 ppm), while it was minimum in 4% sucrose + $Al_2(SO_4)_3$ (58.57 ml and 64.28 ml, respectively). Significantly maximum solution uptake (129.42 ml) was recorded in holding solution containing 4% sucrose + acetyl salicylic acid (200 ppm), followed by 4% sucrose + 8-HQC (250 ppm) and 4% sucrose + $ZnSO_4$ (0.1%) and similar results have also been reported by Murali, (1990) and De *et al.* (1996).

Table 3 indicated the changes in dry weight of florets and stalk as affected by different holding solutions. Significant changes in dry weight of florets and stalk at 3rd day and at senescence was observed except in dry weight of florets on 3rd day in vase. Minimum loss (–0.06 g) in dry weight of stalk on 3rd day was observed in 4% sucrose + 8-HQC (250 ppm), while it was maximum in tap water (–0.84 g). Increase in dry weight (1.43 g) in floret was recorded in holding

Table 3 Changes in dry weight (g) of florets and stalk of 'Pusa Jyotsana' gladiolus as influenced by holding solutions

Treatment	3rd day		At senescence	
	Florets	Stalk	Florets	Stalk
Tap water (control)	–0.62	–0.84	–0.68	–1.76
Sucrose (4%)	0.56	0.50	0.55	–0.91
S (4%) + 8-HQC (250ppm)	0.47	–0.06	1.12	–0.45
S (4%) + acetyl salicylic acid (200ppm)	0.57	0.12	1.43	–0.21
S (4%) + $Al_2(SO_4)_3$ (200ppm)	0.43	–0.80	0.31	–1.34
S (4%) + $ZnSO_4$ (0.1%)	–0.95	–0.32	1.08	0.13
SEm±	0.150	0.098	0.161	0.138
CD (*P*=0.01)	NS	0.422	0.656	0.564

NS, Non-significant

Table 4 Post-harvest quality and vase life of 'Pusa Jyotsana' gladiolus as influenced by holding solutions

Treatment	Diameter of 1st floret	Diameter of 3rd floret	No. of unopened florets at senescence	Increase in spike length (cm) at senescence	Longevity of first floret (days)	Effective useful life (days)	Vase life (days)
Tap water (control)	9.14	8.60	4.29	7.56	2.29	6.00	9.00
Sucrose (4%)	9.18	8.89	1.43	9.64	3.14	7.71	9.43
S (4%) + 8-HQC (250ppm)	10.14	9.50	2.43	11.40	4.43	10.14	13.14
S (4%) + acetyl salicylic acid (200ppm)	9.64	9.07	3.71	16.50	3.29	7.29	8.86
S (4%) + $Al_2(SO_4)_3$ (200ppm)	10.00	9.32	2.43	9.00	3.71	9.57	9.86
S (4%) + $ZnSO_4$ (0.1%)	9.64	9.04	1.29	9.33	3.43	9.29	9.14
SEm±	0.188	0.205	0.342	1.393	0.184	0.274	0.328
CD (*P*=0.01)	0.72	0.79	1.32	5.36	0.71	1.05	1.26

solution containing 4% sucrose + acetyl salicylic acid (200 ppm) and minimum loss in dry weight of stalk (0.13 g) was recorded in 4% sucrose + $ZnSO_4$ (0.1%).

In present study, holding solution containing 4% sucrose + 8-HQC (250 ppm) significantly improved the diameter of 1st (10.14 cm) and 3rd (9.50 cm) floret, followed by 4% sucrose + $Al_2(SO_4)_3$ (200 ppm) (Table 4). The minimum (1.29) and maximum (4.29) number of unopened florets were recorded in 4% sucrose + 0.1% $ZnSO_4$ and control, respectively. The maximum increase in spike length (16.50 cm) at senescence was observed in 4% sucrose + acetyl salicylic acid (200 ppm), followed by 4% sucrose + 8-HQC (250 ppm) (11.40 cm). Longevity of first florets (4.43 days), effective useful life (10.14 days) and vase life (13.14 days) were recorded maximum with 4% sucrose + 8-HQC (250 ppm), followed by 4% sucrose + $Al_2(SO4)_3$ (200 ppm). Improvement in flower diameter and longevity of florets with 8-HQC is attributed to its influence by acting as germicide, acidifying water, improving water balance and inhibiting alternative cyanide respiration (Halevy and Mayak 1981, De *et al.* 1996). $Al_2(SO_4)_3$ has been found to acidify the holding solution to reduce bacterial and fungal growth (Halevy and Mayak 1981, Bhattacharjee 1999). Beneficial effects of 8–HQ and sugar on delaying petal senescence in cut flower has also been reported (Singh *et al.* 2007, Gupta and Banerjee 2008).

Data presented in Table 5 indicated that different holding solutions did not affect fully open, half open and wilted florets on 3rd day in vase; partial open florets on 7th day and fully opened florets on 9th day in vase. Number of fully opened florets was found maximum (4.57 and 5.00, respectively) in 4% sucrose + 8-HQC (250 ppm) on 5th and 7th day in vase. Maximum number of partially opened on 5th day (2.14) and 9th day (1.71) was recorded in 4% sucrose + $Al_2(SO_4)_3$ (200 ppm) and control, respectively. Minimum number of wilted florets on 5th day (nil), 7th day (0.57) and 9th day (2.57)

Table 5 Effect of holding solutions on number of fully opened, half opened and wilted florets of 'Pusa Jyotsana' gladiolus at different intervals

Treatment	3rd day			5th day			7th day			9th day		
	Fully Open	Half open	Wilted	Fully open	Half open	Wilted	Fully open	Half open	Wilted	Fully open	Half open	Wilted
Tap water (control)	3.00 (1.85)	0.42 (0.91)	0.00 (0.71)	3.42 (1.98)	1.42 (1.38)	1.42 (1.38)	3.28 (1.94)	2.00 (1.56)	2.57 (1.72)	2.85 (1.82)	1.71 (1.48)	5.00 (2.33)
Sucrose (4%)	3.14 (1.91)	0.57 (0.98)	0.00 (0.71)	3.42 (1.97)	1.28 (1.28)	0.85 (1.11)	3.14 (1.88)	1.14 (1.25)	3.57 (1.99)	2.57 (1.68)	0.85 (1.13)	5.28 (2.39)
S (4%) + 8–HQC (250ppm)	2.85 (1.83)	1.14 (1.23)	0.00 (0.71)	4.57 (2.25)	1.00 (1.18)	0.71 (1.08)	5.00 (2.34)	1.14 (1.25)	1.42 (1.35)	3.28 (1.94)	0.85 (1.15)	4.57 (2.24)
S (4%) + Acetyl salicylic acid (200ppm)	2.71 (1.78)	1.00 (1.20)	0.00 (0.71)	3.85 (2.08)	1.14 (1.25)	0.42 (0.93)	4.00 (2.11)	1.14 (1.25)	1.85 (1.49)	3.57 (1.98)	0.42 (0.93)	4.00 (2.10)
S (4%) + $Al_2(SO_4)_3$ (200ppm)	2.71 (1.78)	1.14 (1.25)	0.00 (0.71)	3.28 (1.94)	2.14 (1.62)	0.42 (0.93)	2.71 (1.72)	1.00 (1.12)	2.85 (1.81)	2.42 (1.65)	1.14 (1.23)	4.71 (2.28)
S (4%) + $ZnSO_4$ (0.1%)	3.00 (1.87)	0.85 (1.13)	0.00 (0.71)	3.85 (2.09)	1.14 (1.28)	0.00 (0.71)	4.00 (2.12)	1.42 (1.38)	0.57 (1.00)	3.57 (2.01)	1.14 (1.25)	2.57 (1.75)
SEm±	0.073	0.123	0.00	0.067	0.104	0.099	0.115	0.126	0.133	0.141	0.107	0.086
CD (*P*=0.01)	NS	NS	NS	0.260	0.398	0.382	0.441	NS	0.510	NS	0.414	0.331

was recorded in 4% sucrose + 0.1% $ZnSO_4$. Increase in flower opening of gladiolus spikes with 0.1% $ZnSO_4$ was caused by its effect on continuous water transport (Murali 1990). Improvement in flower opening due to sucrose and $Al_2(SO_4)_3$ has also been reported (Sheikh and John 2005, Kumar *et al.* 2007 in tuberose 'Double Pearl').

REFERENCES

Bhattacharjee S K.1999. Prolonging keeping qualities of vase cut flowers with chemicals. *Annals of Agricultural Research* **20** (3): 389–391.

De L C. 1995. 'Studies on post harvest life of cut roses and gladioli.' Ph D thesis, IARI, New Delhi

De L C, Bhattacharjee S K and Misra R L. 1996. Postharvest life of pulsed gladiolus spikes as affected by different chemicals. *Journal of Ornamental Horticulture* **4** (1/2): 18–22.

Gupta V N and Banerjee B K. 2008. Effect of chemicals preservatives on the post harvest life of gladiolus cut spikes. *(in) Book of Abstracts,* pp 116. Alka Singh and B K Dhaduk (Eds). National Symposium on Recent Advances in Floriculture, held during 4–6 March 2008 at Navsari, Gujarat.

Halevy A H and Mayak S. 1981. Senescence and postharvest physiology of cut flowers, Part-II. *Horticultural Review* **3**: 59–143.

Kumar Banti, Malik Sunil, Kumar Mukesh, Singh M K and Kumar Vipin. 2007. Post harvest quality and vase life of tuberose (*Polianthes tuberosa* Linn.) cut spikes as affected by vase chemicals. *Journal of Ornamental Horticulture* **10** (4): 274–5.

Leslie C A and Romani R J. 1986. Salicylic acid-a new inhibitor of ethylene biosynthesis. *Plant Cell Report* **5**: 144–6.

Murali T P. 1990. Mode of action of metal salts and sucrose extending the vase life of cut gladiolus. *Acta Hortculturae* **266**: 307–15.

Sheikh M Q and John A Q. 2005. Effect of pulsing chemical combinations on vase life and spike characteristics in gladiolus. *Journal of Ornamental Horticulture* **8** (4): 309–11.

Singh Alka, Kumar Jitendra and Kumar Pushpendra. 2007. Influence of 8–Hydroxy Quinoline (8–HQ) and sucrose pulsing on petal pigments, flower longevity and vase life. *The Horticultural Journal* **20** (2): 94–8.