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Effect of Sucrose on Water Relations During the Vase Life of Cut Gerbera (*Gerbera jamesonii* Bolus ex. Hook.)

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ABSTRACT

Sucrose in vase solution significantly influenced the water relations associated with water uptake, transpirational loss of water and water balance in cut gerbera (*Gerbera jamisonii* Bolus Ex. Hook.) and extended the vase life. The flowers held in sucrose 5% vase solution recorded highest value in water uptake (9.52 g/f), transpirational loss of water (9.31 g/f) and water balance (4.21 g/f) where as the flowers held in distilled water (control) were observed with lowest values in water uptake (5.33 g/f), transpirational loss of water (5.83 g/f) and water balance (3.50 g/f). The treatment sucrose 5% in vase solution recorded maximum fresh weight of cut gerbera (92.67) which was on par with sucrose 6% (91.27) and sucrose 3% (89.57). With better water relations and maximum fresh weight, the treatment sucrose 5% recorded longest vase life of cut gerbera (9.45 days) which was on par with sucrose 6 % (8.90 days). The flowers held in distilled water (control) recorded the lowest vase life (4.63 days).

Key words : Fresh weight change, Transpirational loss of water, Vase life, Water balance, Water uptake.

Gerbera (*Gerbera jamesonii* Bolus ex. Hook.) is the most commonly used cut flower world wide in floral arrangements and as a common flower in bouquets. The vase life of cut flowers denotes the total duration from the cut to the wilting of flowers and depends on its water relations (Halevy and Mayak, 1981; Van Doorn, 1997). The major limiting factor in the vase life of many cut flowers is water stress which creates disturbances in the water relations of cut flowers thereby changes occur in the anatomy, physiology and biochemistry of the flower leading to senescence (Wakada *et al*.,1984). The rate of absorption and transpiration of water decides the life span and freshness of cut flowers. After flowers are cut and placed in water they exhibit changes in fresh weight. A water deficit will develop only when the rate of water uptake is lower then the rate of transpiration and hence the onset of water stress can be delayed by reducing the rate of transpiration. The post harvest life of cut gerbera could be enhanced by the use of an effective flower food, *i.e*., sugar to provide energy to the flower thereby increases and maintains the uptake of water and nutrients by the flower. Hence, the present work was conducted with a view to study the effect of sucrose on water relations and vase life of cut gerbera.

MATERIAL AND METHODS

The cut gerbera flowers used in the study were grown in naturally ventilated polyhouse with all recommended fertigation and pest management practices. The flowers were harvested from one year old mother plant at the commercial stage (ray florets 3/4th opened) in the morning hours between 6.30 and 7.30 am by pulling the scape of 50-60 cm from the crowns. Immediately after harvest 5 cm of basal woody portion was cut under deionized water and brought to the laboratory. The flowers were precooled at 4$\pm$2^{0}C for about 4 hrs and then immediately sorted to uniform length and quality of capitulum, in order to maintain uniformity with in the replications. Flower scapes were trimmed under water to 40 cm. Lemper (1981) suggested that cleaning the stems, and recutting the base before placing them in the solutions are essential.

The experiment was designed in completely randomized design with factorial concept and each treatment was replaced thrice with five flowers per replication. The treatments studied in the experiment were eight. Details of the eight treatments are: T_1- Sucrose 3 %, T_2- Sucrose 4 %, T_3- Sucrose 5 %, T_4 - Sucrose 6 %, T_5- Sucrose 7 %, T_6- Sucrose 8 %, T_7- Sucrose 9 %, T_8- Control (Distilled water). The experiment was carried out at ambient room temperature 22 $\pm$2 ^{o}C, 60 to 75 per cent relative humidity, using a 12 hours photoperiod. The flowers were continuously held in the test solution till the end of the vase life. In each glass bottle five flowers were placed and considered as one replication. After recording fresh weight, the individual flower scapes were placed randomly in the 500 ml glass bottles

Table 1. Effect of post harvest application of sucrose on water uptake (g/f) during vase life period of cut gerbera cv. Lamborgini

	Days					
Treatments	2	4	6	8	10	Mean
Sucrose 3 %	7.80	9.04	6.91	5.50	3.60	6.57 [d]
Sucrose 4 %	9.44	9.23	8.12	5.81	4.79	7.48 [c]
Sucrose 5 %	13.83	11.65	9.83	6.63	5.66	9.52 [a]
Sucrose 6 %	10.61	9.73	8.49	6.07	5.11	8.00 [b]
Sucrose 7 %	7.88	8.61	7.43	5.60	3.26	6.56 [d]
Sucrose 8 %	9.90	8.30	7.17	4.97	2.94	6.65 [d]
Sucrose 9 %	10.15	9.02	6.88	3.67	2.48	6.44 [d]
Control(DW)	8.61	7.21	5.72	2.87	2.23	5.33 [e]
Mean	9.78 [a]	9.10 [b]	7.57 [c]	5.14 [d]	3.76 [e]	

	F- test	SEm±	CD 5%
Days (D)	**	0.06	0.18
Treatment(T)	**	0.08	0.23
D x T	**	0.18	0.51

** Significant at ($P \leq 0.01$) * Significant at ($P \leq 0.05$) NS : Not significant
Figures bearing same letters did not differ significantly.

containing 250 ml of aqueous test solution of different treatments. The mouth of the bottles was sealed with aluminium foil, which effectively prevented the evaporational loss of aqueous test solutions. The weight of each container and the test solution / distilled water with and without flower scapes were recorded once in two days, while recording weights recutting of the floral stems (about 0.5 cm) was done under distilled water. Vase life and other visual observations of the flowers were recorded daily. The physiological parameters such as water uptake (g/f), Transpirational loss of water (g/f), Water balance (g/f), Fresh weight (% of initial weight) were caliculated by the procedure given by Venkatarayappa *et al*. (1980). Vase life was defined as the number of days from the start of the experiment until the flower exhibited stem bending or ligulae wilting or abscission. The data were subjected to statistical analysis as per the procedure outlined by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Cut gerbera held in different concentrations of sucrose differed significantly on water uptake, transperational loss of water and water balance during vase life period as seen from the data presented in table 1, 2 and 3. Highest water uptake was recorded with sucrose 5% (9.52 g/f) followed by sucrose 6% (8.00 g/f) and sucrose 4% (7.48 g/f) with significant difference (Table-1). The lowest water uptake was, however, observed with control (5.33 g/f). During different days of vase life period, the water uptake decreased significantly from 9.78 g/f (Day 2) to 3.76 g/f (Day 10). The treatment, sucrose 5% recorded significantly highest water uptake during entire vase life period *i.e*., on day 2,4,6,8 and 10 (13.83,11.65,9.83,6.63 and 5.66 g/f respectively) followed by sucrose 6% from day 2 to day 10 with significant difference. The increased water uptake in these treatments could be due to translocated sugars accumulation in the flower tissue which might have increased their osmotic concentration and inproved their ability to absorb more water (Halevy and Mayak, 1974; Paulin *et al*., 1986).

A perusal of the data on transpirational loss of water (TLW) revealed that highest TLW was recorded with sucrose 5% (9.31 g/f) followed by sucrose 6% (8.32 g/f) and sucrose 4 % (7.90 g/f) with significant difference (Table 2). The treatment control, however was observed with lowest TLW (5.83 g/f). During the vase life period of cut gerbera, on different days of observation, the TLW decreased from day 2 (9.20 g/f) to day 10 (4.12 g/f) with significant difference from day 4 to day 10 and without significant difference from day 2 to day 4.These results were in line with the findings of

Prashanth and Chandrasekhar (2007) who observed, maximum water uptake and transpirational loss of water in cut gerbera held in optimum concentration of sucrose *i.e*., 5%.

It is vivid from the data presented in Table 3 that cut flowers of gerbera treated with sucrose 5% recorded highest water balance (4.21 g/f) followed by sucrose 3% (3.73 g/f) which was on par with sucrose 7% (3.72 g/f), sucrose 8% (3.70 g/f) and sucrose 9% (3.70 g/f). During different days of vase life period of cut gerbera, the water balance significantly decreased from day 2 (4.58 g/f) to day 8 (3.09 g/f) and at day 10 significantly increased (3.64 g/f), with higher water uptake (9.52 g/f) over transpirational loss of water (9.31 g/f), the treatment , sucrose 5% recorded maximum water balance (Table 3) Haley and Mayak (1979) also reported similar results in cut flowers. According to their opinion, sugars at optimum concentration are responsible for maintenance of water balance in cut flowers by inducing stomatal closer and thereby reducing water loss.

The fresh weight of cut gerbera was also significantly influenced by different concentrations of sucrose in vase solution (Table 4). Highest fresh weight was observed with sucrose 5% (92.67) which was on par with sucrose 6% (91.27) and sucrose 3% (89.57) whereas the control recorded lowest fresh weight (82.39) which was on par with sucrose 8% (82.94), on different days of observation *i.e*., day 2,4,6,8 and 10 during vase life period of cut gerbera. The fresh weight was significantly influenced by different concentrations of sucrose. The fresh weight significantly decreased from day 2 (104.12) to day 10 (70.15) with optimum concentration of sucrose in vase solution, improved fresh weight of flower scapes as a result of better water relations was reported by Bhattacharjee (1998) similar findings were also recorded by Luo *et al.* (2003) in cut cornation and Prashant and Chandrasekhar (2007) in cut gerbera.

The data on vase life presented in Table 5 revealed that vase life of cut gerbera differed significantly with different sucrose treatments. Among the treatments, the longest vase life was observed with sucrose 5% (9.45 days) which was on par with sucrose 6% (8.90 days), where as the control recorded the lowest (4.63 days) vase life. This could be attributed to the optimum concentration of sucrose which might have enhanced the effect of

Table 2. Effect of post harvest application of sucrose on transpirational loss of water (g/f) during vase life period of cut gerbera cv. Lamborgini

	Days					
Treatments	2	4	6	8	10	Mean
Sucrose 3 %	7.56	8.97	6.98	6.02	4.66	6.84 [d]
Sucrose 4 %	9.08	10.17	8.50	6.88	4.89	7.90 [c]
Sucrose 5 %	12.83	10.54	10.39	7.00	5.79	9.31 [a]
Sucrose 6 %	9.92	9.59	9.50	7.14	5.44	8.32 [b]
Sucrose 7 %	7.04	8.80	8.19	6.54	3.63	6.84 [d]
Sucrose 8 %	8.76	8.94	7.87	5.96	3.25	6.96 [d]
Sucrose 9 %	9.52	8.97	7.98	4.60	2.70	6.75 [d]
Control(DW)	8.90	6.46	6.90	4.29	2.61	5.83 [e]
Mean	9.20 [a]	9.06 [a]	8.29 [b]	6.05 [c]	4.12 [d]	

	F- test	SEm±	CD 5%
Days (D)	**	0.07	0.19
Treatment(T)	**	0.08	0.24
D x T	**	0.19	0.54

** Significant at ($P \leq 0.01$) * Significant at ($P \leq 0.05$) NS : Not significant
Figures bearing same letters did not differ significantly.

Table 3. Effect of post harvest application of sucrose on water balance (g/f) during vase life period of cut gerbera cv. Lamborgini

Treatment	Days					
	2	4	6	8	10	Mean
Sucrose 3 %	4.24 (0.24)	4.07 (0.07)	3.93 (-0.07)	3.48 (-0.52)	2.94 (-1.06)	3.73 [b] (-0.27)
Sucrose 4 %	4.36 (0.36)	3.06 (-0.94)	3.62 (-0.38)	2.93 (-1.07)	3.90 (-0.10)	3.58 [c](0.42)
Sucrose 5 %	5.00 (1.00)	5.11 (1.11)	3.45 (-0.55)	3.63 (-0.37)	3.87 (-0.13)	4.21 [a](0.21)
Sucrose 6 %	4.69 (0.69)	4.14 (0.14)	2.99 (-1.01)	2.93 (-1.07)	3.67 (-0.33)	3.68 [b] (-0.32)
Sucrose 7 %	4.84 (0.84)	3.81 (-0.19)	3.24 (-0.76)	3.06 (-0.94)	3.63 (-0.37)	3.72 [b] (-0.28)
Sucrose 8 %	5.13 (1.13)	3.36 (-0.64)	3.30 (-0.70)	3.01 (-0.99)	3.69 (-0.31)	3.70 [b] (-0.301)
Sucrose 9 %	4.63 (0.63)	4.05 (0.05)	2.90 (-1.10)	3.07 (-0.93)	3.78 (-0.22)	3.70 [b] (-0.28)
Control(DW)	3.71 (-0.29)	4.75 (0.75)	2.82 (-1.18)	2.58 (-1.42)	3.62 (-0.38)	3.50 [d] (-0.60)
Mean	4.58 [a](0.58)	4.04 [b](0.04)	3.28 [d] (-0.72)	3.09 e (-0.91)	3.64 [c] (-0.36)	

	F- test	SEm±	CD 5%
Days (D)	**	0.02	0.05
Treatment(T)	**	0.02	0.06
D x T	**	0.05	0.14

** Significant at (P ≤ 0.01) * Significant at (P ≤ 0.05) NS : Not significant
Figures bearing same letters did not differ significantly.
Parenthesis represents original values. The data was analysed statistically after uniform addition of a base value 4.0

cytokinin in delaying senescence of flowers and reduced the effect of ethylene thereby increasing the vase life of flowers (Mayak and Dilley, 1976). The extended vase life of cut gerbera with optimal concentration of sucrose was due to better water relations and also probable use of sucrose as a respirable substrate (Bhattacharijee, 1972; Paulin, 1977). Based on the results of the study, it can be concluded that vase life of cut gerbera could be extended with sucrose 5% in vase solution.

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Table 4. Effect of post harvest application of sucrose on fresh weight change (% of initial weight) during vase life period of cut gerbera cv. Lamborgini

	Days					
Treatments	2	4	6	8	10	Mean
Sucrose 3 %	104.43	97.89	93.78	80.63	71.13	89.57 [a]
Sucrose 4 %	105.23	96.77	94.73	63.37	71.55	86.33 [b]
Sucrose 5 %	107.04	100.91	95.77	83.90	75.73	92.67 [a]
Sucrose 6 %	106.20	99.55	94.59	84.40	71.59	91.27 [a]
Sucrose 7 %	103.47	96.03	85.76	77.22	70.13	86.52 [b]
Sucrose 8 %	101.57	85.68	85.07	73.94	68.44	82.94 [c]
Sucrose 9 %	102.96	100.36	81.28	78.65	69.47	86.54 [b]
Control(DW)	102.03	98.14	77.40	71.27	63.12	82.39 [c]
Mean	104.12 [a]	96.92 [b]	88.55 [c]	76.67 [d]	70.15 [e]	

	F- test	SEm±	CD 5%
Days (D)	**	0.87	2.45
Treatment(T)	**	1.10	3.10
D x T	**	2.46	6.92

** Significant at (P ≤ 0.01) * Significant at (P ≤ 0.05) NS : Not significant
Figures bearing same letters did not differ significantly.

Table 5. Effect of post harvest application of sucrose on vase life (days) in cut gerbera cv. Lamborgini

Treatment	Vase life (days)
Sucrose 3 %	7.55 [b]
Sucrose 4 %	8.14 [b]
Sucrose 5 %	9.45 [a]
Sucrose 6 %	8.90 [a]
Sucrose 7 %	7.55 [b]
Sucrose 8 %	7.14 [b]
Sucrose 9 %	6.00 [c]
Control(DW)	4.63 [d]
Mean	7.42
SEm ±	0.39
CD 5%	1.18
F.test	**

** Significant at (P ≤ 0.01) * Significant at (P ≤ 0.05) NS : Not significant
Figures bearing same letters did not differ significantly.

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