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Effect of different stalk lengths and certain chemical substances on vase life of gerbera (*Gerbera jamesonii* Hook.) cv. 'Savana Red'

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Abstract

An experiment was carried out to determine the effect of different stalk lengths and certain chemical substances on vase life of gerbera (*Gerbera jamesonii* Hook.) Cv. 'Savana Red'. Twenty treatment combinations consisting of four chemicals *viz*., sucrose 4 %, sucrose 4 % + 8-HQC 250 ppm , sucrose 4 % + aluminum sulphate 100 ppm , sucrose 4 % + citric acid 250 ppm , along with control (distilled water) and four lengths of stalk *viz*., 30, 40, 50, and 60 cm. The vase solution of sucrose 4% + 8-HQC 250 ppm and stalk length of 60 cm, individually and in combination increased fresh weight of flowers by promoting solution uptake. These treatments are also beneficial for improving the vase life of flowers and useful life of flowers, opening of disc florets, with bright, shining red colour and freshness for a longer duration.

Key words: Gerbera, *Gerbera jamesonii* Hook., stalk length, chemicals, vase life, sucrose, citric acid, HQC

Introduction

Gerbera belongs to the family Asteraceae, which consists of many other important cut flowers namely aster, dahlia, chrysanthemum, gaillardia, zinnia, marigold *etc.* (Bose and Yadav, 1989). The genus Gerbera, named in the honour of German naturalist, Traugott Gerber, consists of about 40 species of hardy and perennial flowering plants, out of which only *Gerbera jamesonii* Hook. is under cultivation. It is native to Natal and Transvaal and is commonly known as Transvaal daisy, Barberton daisy or African dasiy. It is an important flower grown through out the world under wide range of climatic conditions.

Keeping quality of flowers is affected by internal and external factors. The internal factors which are responsible for the keeping quality of cut blooms, are the rate of water absorption and transpiration. Both these factors again depend on the relative area of absorption and the total water holding capacity of the tissues. After the flower is detached, the area of absorption is reduced drastically, whereas the rate of proportionate area for transpiration is much higher. Therefore, unless something is done to reduce transpiration, the cut flower will wither in less time. Respiration is another internal factor that affects the life of the cut flower. Besides, some environmental factors also affect cut flower life. These are temperature, relative humidity and wind velocity. Postharvest handling plays an important role in enhancing keeping quality of flowers wherein efforts are made to reduce stem plugging, restrict microbial activity, delay flower senescence through provision of external source of water and nutrients as required by the flower.

Materials and methods

The experiment was conducted at the P.G Research Laboratory, Department of Horticulture, N.M. College of Agriculture, Gujarat Agricultural University, Navsari Campus, Navsari. Twenty treatment combinations consisting of four chemicals *viz*., sucrose 4 % (T_1), sucrose 4 % + 8-HQC 250 ppm (T_2), sucrose 4 % + aluminum sulphate 100 ppm (T_3), sucrose 4% + citric acid 250 ppm (T_4) along with control (distilled water) (T_0) and four lengths of stalk *viz*., 30 cm (L_1), 40 cm (L_2), 50 cm (L_3), and 60 cm (L_4) were tried in Completely Randomized Design with Factorial concept. All the treatments were repeated thrice. The experimental material were kept in glass bottles of 300 mL capacity holding 250 mL treatment solution prepared in the laboratory and a bunch of three stalks of gerbera (Cv. Savana Red), harvested at the stage when the outer two row of disc florets were perpendicular to the stalk. Total sixty glass bottles and one hundred and eighty stalks, having four different uniform lengths of 30, 40, 50 and 60 cm were utilized. The stalks were slightly recut at basal end at every 3rd day during experimentation. The data on uptake of solution (mL) at 3rd, 6th and 9th days, time taken (days) to open 50, 75, and 100 % disc florets, useful life of flowers (days), vase life of flower (days), recorded during the experiment were subjected to statistical analysis. The design with factorial concept as described by Panse and Sukhatme (1967) was used. The significance of the treatment differences was tested by 'F' test on the basis of null hypothesis. The appropriate standard error of mean (S.Em.±) were calculated in each case and the critical differences (C.D.) at 5 per cent level of probability was worked out to compare the two treatment effects.

Results

The data on solution uptake by gerbera flower on third, sixth and ninth day are presented in Table 1. The effect of different chemicals and stalk length on solution uptake by gerbera flower after three, six and nine days were found to be significant. Among different chemicals, maximum uptake of solution (45.0 mL) at

Table 1. Effect of different chemicals and stalk lengths (cm) on the solution uptake by the gerbera flowers

Treatments	Solution uptake (mL)		
	3rd day	6th day	9th day
Chemicals (T)			
T_1	28.25	18.64	1.94
T_2	45.00	41.2	23.94
T_3	30.60	26.36	11.32
T_4	34.84	28.14	17.49
T_0	21.56	14.91	0.00
LSD (P=0.05)	0.99	0.70	0.49
Stalk lengths (L)			
L_1	24.14	18.13	0.00
L_2	28.40	22.74	11.26
L_3	33.79	27.36	13.5
L_4	41.86	35.16	18.99
LSD (P=0.05)	0.88	0.62	0.44

Zero value indicate that these flowers had completed their vase life before ninth day.

Table 2. Interaction effect of different chemicals and stalk lengths (cm) on the solution uptake by the gerbera flowers

Treatments	Solution uptake (mL)		
	3rd day	6th day	9th day
T_0L_1	14.76	10.13	0.00
T_0L_2	19.56	13.43	0.00
T_0L_3	21.1	15.06	0.00
T_0L_4	30.83	21.03	0.00
T_1L_1	17.96	13.00	0.00
T_1L_2	21.8	16.80	0.00
T_1L_3	33.3	19.16	0.00
T_1L_4	39.96	25.60	7.76
T_2L_1	41.46	32.43	0.00
T_2L_2	43.26	40.43	28.50
T_2L_3	45.40	41.60	29.70
T_2L_4	49.86	46.40	37.56
T_3L_1	22.50	18.43	0.00
T_3L_2	26.50	21.60	10.58
T_3L_3	32.23	26.36	16.40
T_3L_4	41.16	39.06	18.30
T_3L_1	24.03	16.67	0.00
T_3L_2	30.90	21.36	17.23
T_3L_3	36.93	30.80	21.40
T_3L_4	47.50	43.73	31.33
LSD (P=0.05)	1.98	1.40	0.99

Zero value indicate that these flowers had completed their vase life before ninth day.

third day, (41.2 mL) at sixth day and at ninth day (23.94 mL) were observed when flower stalks were kept in the solution of sucrose (4 %) + 8 –HQC (250 ppm) (T_2). Among different stalk lengths, maximum amount of solution 41.86, 35.76 and 18.99 mL was absorbed by gerbera flower having L_4 stalk length at third, sixth, and ninth day. The interaction effect of different chemicals and stalk length on solution uptake by gerbera flower on third day (Table 2) was significant. Maximum solution uptake at third (49.86 mL), sixth (46.4 mL) and ninth day (37.56 mL) was noticed when longest gerbera flower (L_4) was kept in solution of sucrose (4 %)+ 8-HQC (250 ppm) (T_2 L_4). The data pertaining to 50, 75 and 100 % opening of florets revealed that all the treatments showed significant difference (Table 3). Among the different chemicals the highest time taken for opening of 50% disc florets (7.18 days), 75 % disc florets (9.08 days), 100% disc florets (10.49 days) was recorded when gerbera stalks were kept in solution of sucrose (4 %)+ 8-HQC (250 ppm) (T_2). The interactions effect of different chemicals and stalk lengths on time taken for opening of 50, 75 and 100 % disc florets was found to be significant and have been presented in Table 4. The data indicated that the maximum time taken for opening of 50% disc florets (7.83 days), 75 % disc florets (10.37 days), 100% disc florets (12.18 days) was resulted when gerbera stalk having longest length were kept in solution of sucrose (4 %)+ 8-HQC (250 ppm) (T_2 L_4). The data presented in Table 5 on the effect of different chemical and stalk lengths on the useful life of gerbera was found to be significant. The data presented in Table 5 revealed

Table 3. Effect of different chemicals and stalk lengths (cm) on the time taken to open 50, 75 and 100 per cent disc florets of gerbera

Treatments	Time taken to open (days)		
	50 % disc florets	75% disc florets	100% disc florets
Chemical (T)			
T_1	5.21	6.90	7.75
T_2	7.18	9.08	10.49
T_3	6.17	7.93	8.77
T_4	6.33	8.70	9.20
T_0	4.25	5.75	6.29
LSD (P=0.05)	0.19	0.14	0.28
Stalk length (L)			
L_1	5.30	6.55	7.19
L_2	5.32	7.34	7.93
L_3	6.02	7.98	9.07
L_4	6.67	8.82	9.66
LSD (P=0.05)	0.19	0.12	0.25

Table 4. Interaction effect of different chemicals and stalk lengths (cm) on the time taken to open 50, 75 and 100 per cent disc florets of gerbera

Treatments	Time taken to open (days)		
	50 % disc florets	75% disc florets	100% disc florets
T_0L_1	3.62	5.47	5.96
T_0L_2	4.09	5.61	5.98
T_0L_3	4.53	5.72	6.50
T_0L_4	4.79	6.21	6.73
T_1L_1	4.15	6.23	6.52
T_1L_2	5.06	6.47	6.94
T_1L_3	5.17	6.52	8.02
T_1L_4	6.46	8.40	8.80
T_2L_1	6.83	7.19	8.73
T_2L_2	6.76	9.19	10.06
T_2L_3	7.30	9.56	11.0
T_2L_4	7.83	10.37	12.18
T_3L_1	6.40	6.30	6.66
T_3L_2	5.21	7.53	8.00
T_3L_3	6.50	8.66	10.10
T_3L_4	6.59	9.23	10.33
T_3L_1	5.51	7.56	8.10
T_3L_2	5.47	7.90	8.68
T_3L_3	6.63	9.46	9.72
T_3L_4	7.70	9.88	10.3
LSD (P=0.05)	0.69	0.28	0.57

Table 5. Effect of different chemicals and stalk lengths (cm) on useful life and vase life of gerbera flowers

Treatments	Useful life of flowers (days)	Vase life of flowers (days)
Chemicals (T)		
T_1	6.46	7.96
T_2	9.87	11.31
T_3	7.85	9.66
T_4	8.31	9.94
T_0	5.04	7.66
LSD (*P*=0.05)	0.26	0.36
Stalk lengths (L)		
L_1	5.82	6.96
L_2	7.11	9.14
L_3	8.09	10.05
L_4	9.00	11.07
LSD (*P*=0.05)	0.23	0.32

Table 6. Interaction effect of different chemicals and stalk lengths (cm) on useful life and vase life of gerbera flowers

Treatments	Useful life of flowers (days)	Vase life of flowers (days)
T_0L_1	4.14	6.48
T_0L_2	4.86	7.69
T_0L_3	5.12	7.88
T_0L_4	6.06	8.60
T_1L_1	5.63	5.79
T_1L_2	6.19	7.86
T_1L_3	6.72	8.50
T_1L_4	7.30	9.70
T_2L_1	6.91	7.98
T_2L_2	10.12	11.30
T_2L_3	10.74	12.30
T_2L_4	11.69	13.65
T_3L_1	6.51	7.76
T_3L_2	7.19	9.39
T_3L_3	7.93	10.2
T_3L_4	9.77	11.2
T_3L_1	5.94	11.3
T_3L_2	7.23	6.80
T_3L_3	9.92	9.46
T_3L_4	10.16	11.36
LSD (*P*=0.05)	0.52	0.73

that among different chemicals, longest useful life of flower (9.87 days) was obtained in sucrose (4 %)+ 8-HQC (250 ppm) (T_2). Among flower lengths, the highest useful life of flower (9.0 days) was recorded from L_4 (60 cm).The interaction effect of different chemicals on useful life of flower was also found to be significant (Table 6). Longest useful life of flower (11.69 days) was recorded when gerbera cut flower having maximum length L_4 (60 cm) were kept in solution of sucrose (4 %)+ 8-HQC (250 ppm) (T_2 L_4). The data furnished in the Table 5 revealed that among the different chemicals, the maximum vase life (11.31 days) was obtained by the use of sucrose (4 %)+ 8-HQC (250 ppm) (T_2). In case of stalk length, the vase life of gerbera increased with increase in length. The maximum vase life of stalk (11.07 days) was obtained when stalk of gerbera was of 60 cm length (L_4). The interaction effect of different chemicals and stalk length on vase life of flower presented in Table 6 was found to be significant. Longer vase life (13.65 days) was obtained when gerbera stalk of 60 cm length were kept in sucrose (4 %)+ 8-HQC (250 ppm) solution (T_2 L_4).

Discussion

From the Table 1 and 2, it is obvious that the solution uptake through stalk was influenced by chemicals, stalk lengths and their combinations. The absorption of water through stalk was maximum at 3rd, 6th and 9th day when stalks were kept in vase solution of sucrose (4 %)+ 8-HQC (250 ppm). Similar results were obtained in gladiolus (De *et al.,* 1996) and in tuberose (Reddy *et al.,* 1997). A beneficial effect of sucrose in absorption was reported by De and Barman (1998b) in tuberose and of 8-HQC by Bhattacharjee (1993) in rose. Other chemicals like aluminum sulphate was beneficial as it acidified the holding solution, which results in greater solution uptake by gerbera. Similar results were obtained in gladiolus (Gowda and Gowda, 1990) and in tuberose (Saini *et al.,* 1997 and De and Barman, 1998a). Aluminum sulphate with sucrose in vase solution significantly influenced the water uptake of the tuberose cut spike (Reddy and Singh, 1996). The maximum solution uptake by cut flower stalks was observed in longest stalk of gerbera at 3rd , 6th and 9th day. Similar result was obtained by Bhattacharjee (1993, 94) in rose. Maximum solution uptake was observed under interaction of 60 cm long stalk length and sucrose (4 %)+ 8-HQC (250 ppm) thus longer stalk length having more carbohydrate and HQC reduced stem blockage which results in increase in the solution uptake.

Results revealed that time taken for opening of the disc florets was significantly influenced by chemicals and stalk lengths individually as well as by their combination (Table 3 and 4). The maximum time taken to open the disc florets was recorded in sucrose (4 %)+ 8-HQC (250 ppm) (T_2) solution. According to Larsen and Cromorty (1967) and Burdett (1970) the microbial growth are checked by the germicidal and bactericidal properties of these chemical substances and thereby were found effective for gladiolus (Lal *et al.*, 1990 and Murali and Reddy, 1991). Other chemical treatments like sucrose (4 %) + aluminum sulphate (100 ppm) and sucrose (4 %) + citric acid (250 ppm) significantly delayed opening of disc florets over control. In case of stalk lengths, maximum time taken for opening of disc florets was recorded for flowers having longest stalk length of 60 cm (L_4). Interaction effect of chemical and stalk length indicated that maximum time taken for opening of disc florets was observed with the stalk having maximum length and kept in sucrose (4 %) + 8-HQC (250 ppm) solution.

Maximum useful life was recorded in longest stalk length alone and in combination with chemicals like sucrose and 8-HQC. This may be due to higher carbohydrate, thus promoting respiration and extending the longevity. Similar results were obtained in tuberose (De and Barman, 1998b). Sucrose is a main source of energy and good respiratory substrate for the maintenance of osmotic potential while 8-HQC helped in controlling harmful bacteria and prevented bacterial plugging of water conducting tissues and there by increased useful life of gerbera stalk.

Maximum vase life was obtained with sucrose (4 %) +8-HQC

(250 ppm) holding soluation. Similar results were recorded in tuberose (Singh and Arora, 1995), rose (Masousky,1969 and Bhattacharjee,1993) and in chrysanthemum (Bhat *et al.*,1999). The increased longevity of flower due to sucrose could be explained from the role of applied sugars in delaying senescence and promoting respiration. It delays the onset of excessive protein degradation as in gladiolus (Gowda and Gowda,1990 and Merwe *et al.,* 1986), tuberose (Pathak *et al.,1979*); Mukhopadhyaya,1982; De and Barman 1998 a) and rose (Borochov *et al.*,1976; Masousky,1969 and Bhattacharjee, 1999)

Sucrose is the main source of energy and good respiratory substrate for the maintenance of osmotic potential in flower. Kaltaler and Steponkus (1976) concluded that the main effect of applied sugar in extending the longevity of flowers was to maintain mitochondrial structure and function. Sucrose could also have antagonist effect on abscisic acid in delaying the senescence as observed in rose (Borochov *et al.,* 1976) and carnation (Mayak and Dilley, 1976). Marousky (1971) explained that sugar improves the water balance in cut flowers, uptake of water is increased due to stomatal closure which reduces the transpiration rate.

The effect of 8-HQ components (8-HQC and 8-HQS) in enhancing vase life of cut flowers had been attributed to its antibacterial property as noted by Serini and Banfi (1974). According to Lal *et al.* (1990) the chelating properties of the Quinoline compounds/esters probably chelated the metal ions of enzymes active in creating the stem blockage. HQC also acidifies the water and affect the flower longevity. Sucrose with HQS has germicidal effect and was beneficial for prolonging the vase life of tuberose (Reddy *et al.*,1997).

The interaction effect of chemicals and stalk lengths was also found significant. The maximum vase life of the gerbera was recorded when gerbera stalk having longest length (L_4) kept in vase solution of sucrose (4 %)+ 8-HQC (250 ppm) solution (T_2 L_4). These favourable effect on vase life of spike might be due to sufficient availability of restorable substrate and 8-HQC which reduced microbial activity and increased and absorption of solution.

The results revealed that the vase solution of sucrose 4% + 8-HQC 250 ppm and stalk length of 60 cm, individually and in combination increased fresh weight of flowers by promoting solution uptake. These treatments are also beneficial for improving the vase life of flowers and useful life of flowers, opening of disc florets, with bright, shining red colour and freshness for a longer duration.

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