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Vase Life Characteristics of Gerbera as Influenced by BA and GA_3

P. Panja[1*], D. Bhattacharjee[1], D. Mallick[1], R. Reddy[1] and R. S. Dhua[1]

[1]*Department of Post Harvest Technology of Horticultural Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal, India.*

Authors' contributions

This work was carried out in collaboration between all authors. Author PP designed the study, performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Authors DB and DM managed the analyses of the study. Author RR managed the literature searches. Author RSD guided and corrected the draft. All authors read and approved the final manuscript.

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ABSTRACT

Gerbera (*Gerbera jamesonii*) widely used as a decorative garden plant, is a member of the Compositae family. Due to high temperatures and humidity, the post-harvest vase-life of gerbera is very less. Keeping quality is an important parameter for evaluation of cut flower quality so the addition of chemical preservatives to the holding solution is recommended to prolong the vase-life. Gerbera variety Palmbeach was grown in the poly house of AICRP and experiment was conducted under laboratory condition at the Department of Post Harvest Technology, BCKV, West Bengal. Uniform stalk length was maintained about 30 cm. and after cut, they were weighed and subjected to pulsing treatment with a freshly prepared chlorine solution (100 ppm) from sodium hypochlorite (4%) and $AgNO_3$ solution (100 ppm) separately. After 24 hours of pulsing treatment all the cut stems were then kept in vase preservative solutions Benzyladenine (BA) comprising T_1(20 ppm), T_2(10 ppm), T_3(5 ppm), T_4(tap water) and Gibberellic acid (GA_3) comprising T_1(20 ppm), T_2(10 ppm), T_3(5 ppm), T_4(tap water) treatments separately. The experimental design was laid out in Completely Randomized Design with five replications. The increased vase life of 9 days, with delayed flower drooping, petal discolouration and petal fall was observed with flowers which were pulsed with chlorine (100 ppm) followed by keeping in BA (10 ppm) as well as the maximum vase life of 10.8 days was noted with flowers which were pulsed with silver nitrate with delayed petal discolouration, petal fall and flower drooping was observed with GA_3 (10 ppm) among the different vase preservatives containing GA_3. The result showed that pulsing with silver nitrate (100 ppm) is more effective than chlorine (100 ppm) and among the growth regulators, the performance of GA_3

**Corresponding author: E-mail: payel.panja06@gmail.com;*
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was much better than BA which was pulsed with silver nitrate in the maintenance of the postharvest quality and shelf life. The performance of BA treatment was comparatively better which were pulsed with chlorine (100 ppm).

Keywords: Gerbera; pulsing; vase life; Benzyladenine; Gibberellic acid.

1. INTRODUCTION

Gerbera (*Gerbera jamesonii*) popularly known as Transvaal Daisy or Barberton Daisy which is a member of the Compositae family, widely used as a decorative garden plant. Gerbera is native to South Africa (Transvaal and Natal Provinces) and Asian region. It is in considerable demand in both domestic and export markets. The blooms are attractive, suitable for any floral arrangements and are available in different shades and hues. Flowers are available in a wide range of colours, including yellow, orange, pink, crimson, red, purple and white. Gerbera is most commonly used worldwide as a cut flower, however, dwarf hybrids lines exist which are suited for potted or bedding plants [1]. The cut gerbera flowers have a long vase-life provided treated adequately immediately after harvest and fetches premium market prices. The flowers are hardy and stand the rigours of transportation admirably.

Several commercial floral preservatives have been formulated for gerberas. Some farmers dip the flower heads in 0.1 mM benzyl adenine (BA) for a few minutes to maintain the flower weight and senescence [2]. Gibberellic acid did not delay leaf senescence in most of the plant species and its content in tissues was not interrelated with senescence [3]. Howrah, Mallick Ghat and other flower markets in Kolkata receive most of its cur gerbera from Baruipur area of South 24Pgs; Ranaghat and Haringhata area of Nadia; Panskura and Kolaghat area of East Midnapore and Bagnan area of district Howrah. Although gerbera cut flowers are grown by only a few farmers, the demands of flowers usually remain higher particularly during festivals. Due to the high temperatures and high humidity, the post-harvest vase-life of gerbera is very less. The short post-harvest vase-life [4], inadequate knowledge about the flower gerbera and in general, handling, transportation and marketing of these cut flowers are somewhat difficult.

Research on the post-harvest handling of cut flowers needs to be undertaken, because floriculture and post-harvest handling and preservation of cut flowers in general and gerbera in particular are at an infant stage. Therefore any treatment that will maintain the flower quality after harvest and increase the vase life of cut flowers will enhance its production.

2. MATERIALS AND METHODS

The experiment was conducted under laboratory conditions at the Department of Post Harvest Technology of Horticultural Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal. Palmbeach variety of gerbera was used for the experiment. Gerbera flowers grown in the poly house of AICRP on Floriculture were harvested at a stage when all the florets opened fully and are perpendicular to the stalk were used for the experiment. The flowers were harvested early in the morning and are properly packed. The individual flower heads were sleeved by polythene packets and grouped in bunches of 10 which were tied by rubber bands. Collectively all bunches were wrapped with wet newspaper to avoid damages during transportation of the flowers from growers field to the Laboratory. No treatment was given to the flowers from the period after harvest till the materials were brought to the laboratory. As soon as the cut flowers were bought to the laboratory, bunches were unpacked and the polythene sleeves were removed from the flower heads. The flowers were then sorted and graded by discarding the abnormal and diseased/pest infected ones. Uniform stalk length of all the flowers were maintained about 30 cm. As soon as the stems were cut they were weighed and were subjected to pulsing treatment with a freshly prepared chlorine solution (100 ppm) from sodium hypochlorite (4%) and $AgNO_3$ solution (100 ppm) separately.

After 24 hours of pulsing treatment all the cut stems of gerbera flowers were then kept in vase preservative solutions which are influenced by Benzyladenine (BA) comprising; T_1- Benzyladenine (20 ppm), T_2 - Benzyladenine (10 ppm), T_3 - Benzyladenine (5 ppm) and T_4 – Control (Tap water). During the period of the experiment, the changes of minimum and maximum temperature recorded were 17-36^{0}C and the relative humidity was within the range of 37-100%.

Again in the same process after 24 hours of treatment in silver nitrate and chlorine solution each 100 ppm, the treated flowers were then subjected to vase preservative solutions which is influenced by Gibberellic acid (GA_3) comprising; T_1- Gibberellic acid (20 ppm), T_2- Gibberellic acid (10 ppm), T_3- Gibberellic acid (5 ppm) and T_4 - Control (tap water). During the period of the experiment, the changes of minimum and maximum temperature recorded were 30-34^{0}C and the relative humidity was within the range of 50-65%. All treatments were replicated five times in Completely Randomized Design (CRD). The experiment was started early in the morning and after every 24 hours.

3. RESULTS AND DISCUSSION

The experiment was conducted to know the best treatment among the various ones used to increase the longevity of cut gerbera cv. Palmbeach. The results of the experiment from Tables 1-4 shows that the pulsing of the flowers with 100 ppm each of chlorine or silver nitrate solution for 24 hours and then transferring to a different vase solution either containing 5, 10 and 20 ppm BA or 5, 10 and 20 ppm GA_3 were significantly influenced the many aspects of post-harvest quality like vase life, drooping, petal discolouration and fall of cut gerbera flowers.

Results of the tables significantly show that silver nitrate pulsing was more effective than chlorine in improving the vase life of gerbera cut flowers preserved in vase preservatives containing 0,5, 10 and 20 ppm BA or 0,5, 10 and 20 ppm GA_3. However, the inhibition of bacterial blockage, increasing the vase life and delayed both silver nitrate and chlorine.

It is observed that the vase life for the cut flowers pulsed in 100 ppm chlorine solution for 24 hours and then transferred to the vase solution of BA 10 ppm to complete its vase life to the maximum of 9.0 days (Table 1). While pulsing in silver nitrate (100 ppm) followed by keeping the flower in vase solution of BA 10 ppm to complete its vase life was increased to the maximum of 7.6 days (Table 2). All the other treatments were comparatively less effective than this. The minimum was recorded in the flowers pulsed either with chlorine or silver nitrate solution (100 ppm) for 24 hours and then transferred to tap water (control).

The earliest drooping of 6.00 and 5.20 days was observed on the flowers pulsed with chlorine and silver nitrate solution respectively and then transferred to a vase solution comprising only tap water. The maximum days (9.0 and 7.80 days) taken for the drooping of flower heads was observed in the flowers pulsed with chlorine and silver nitrate solution and then transferred to the BA (10 ppm) solution. The maximum days (11.0) taken for the drooping of flower heads was observed in the flowers pulsed with chlorine and then transferred to the vase solution of 10 ppm GA_3 (Table 3) and while silver nitrate pulsing for 24 hours followed by keeping the flowers in vase solution containing GA_3 5-10 ppm took 11 days to droop (Table 4).

Pulsing with chlorine and silver nitrate for 24 hours followed by transferring flower in BA 10 ppm showed delayed discolouration of petals, e.g. 10.40 and 9.20 days respectively as compared with GA_3. Similarly pulsing with chlorine and silver nitrate for 24 hours followed by transferring flower in GA_3 10 ppm showed delayed discolouration of petals, *e.g.* 11.2 and 12.33 days respectively as compared with BA.

The earliest petal fall of 7.5 and 8.0 days was observed in the flowers pulsed with 100 ppm each of chlorine and silver nitrate solution and then transferred to a vase solution containing tap water alone. Among the vase preservatives containing BA 10, 5 and 20 ppm comparatively delayed petal fall of 11, 9, 8.33 days and 10.8, 9.9, 10.0 days respectively. Compared with BA, flowers pulsed either with chlorine or silver nitrate solution followed by preserving GA_3 also showed delayed petal fall. The maximum delayed petal fall (12.3 days) was recorded with silver nitrate pulsing followed by treatment with GA_3 10 ppm whereas pulsing with chlorine followed by GA_3 10 ppm treatment as vase preservative delayed petal fall of 11.20 days.

Chlorine is used in postharvest horticulture to control bacteria and fungi in cut flower holding and vase solutions [5, 6]. The mode of action of chlorine is non-specific, involving oxidation of cellular components of microbes, including proteins in cell membranes and protoplasm. Chlorine demand by contaminants and surface reduces chlorine levels in solution, sometimes rapidly. High initial concentrations can be used to satisfy chlorine demand. However, high levels may be phytotoxic [7].

A differences in free available chlorine (FAC) concentrations for a range of vase solution showed that FAC levels were stable in deionised water. FAC decreased more rapidly when cut flowers with rough stems (bark or trichomes) were placed in the solution when compared to flowers with smooth (waxy cuticle) stems. FAC also decreased more rapidly with increasing number of stems in vases. Inclusion of sucrose (2%, w/v) in the vase solution reduced FAC levels [8].

The application of the cytokinins benzyl aminopurine (BA) or thidiazuron (TDZ) as pulsing or dipping treatments delayed flower senescence cut flowers [9]. Supplying cut flowers with exogenous sugar maintain the pool of dry matter and respirable substrates, especially in petals, thus promoting respiration and extending longevity. The application of cytokinin and calcium decreased the senescence percentage and electrolyte leakage and increased activity of anti-oxidant enzymes, catalase and peroxidase. The highest level of cytokinin and calcium increased the permanence and quality of cut flowers more effectively [10].

The more is the bacterial plugging, the lesser is the water uptake, and hence, more drooping. Gerbera stems are susceptible to water blocking and may cause the flower head to droop over. Bent neck is the result of clogged stem due to dirty vase water. The noxious effect of used water could not be corrected even if the flowers were transferred 24 hours later into fresh water.

Insufficient water uptake due to xylem occlusion is one of the main reasons for inferior cut flower performance during vase life. Causes of xylem occlusion are various: microbial growth, deposition of materials such as gums and mucilage in the lumen of xylem vessels, the formation of tyloses and the presence of air emboli in the vascular system [11]. The stem-end blockage is a major factor in the imbalance between water uptake by and water loss from cut flowers [11,12]. Stem end blockage in cut flowers is of three types: microbial due to living bacteria and decay products, physiological wound-induced [13] and physical air emboli [14]. The addition of the floral preservative to the vase water is recommendable to control bacterial growth and to diminish the vascular blockage [15,16]. The vascular blockage is related to the fast reduction of vase life. The bacterial growth in the xylem of untreated gerbera stems indicates that the addition of the floral preservative to the vase water is recommendable to control bacterial growth and to diminish the vascular blockage [15].

Table 1. Effect of chlorine pulsing and BA treatment on postharvest quality of gerbera cut flowers

Treatment	Vase life in days	Days taken for drooping of flower heads	Days taken for discolouration of petals	Days taken for petal fall
T_1	7.400^{b}	7.200^{b}	7.600^{c}	8.330^{bc}
T_2	9.000^{a}	9.000^{a}	10.400^{a}	11.000^{a}
T_3	7.600^{b}	8.000^{ab}	8.800^{b}	9.000^{b}
T_4	5.800^{c}	6.000^{c}	7.600^{c}	7.500^{c}
SEm (±)	0.339	0.400	0.283	0.406
CD (5%)	1.025	1.210	0.855	1.227

N.B. Similar alphabets are not significant. They are statistically at per

Table 2. Effect of silver nitrate pulsing and BA treatment on postharvest quality of gerbera cut flowers

Treatment	Vase life in days	Days taken for drooping of flower heads	Days taken for discolouration of petals	Days taken for petal fall
T_1	5.800^{b}	6.200^{ab}	7.400^{bc}	10.000^{a}
T_2	7.600^{a}	7.800^{a}	9.200^{a}	10.800^{a}
T_3	6.200^{ab}	6.800^{ab}	8.200^{ab}	9.900^{a}
T_4	4.800^{b}	5.200^{b}	6.400^{c}	8.000^{b}
SEm (±)	0.469	0.557	0.500	0.426
CD (5%)	1.418	1.515	1.512	1.287

N.B. Similar alphabets are not significant. They are statistically at per

Table 3. Effect of chlorine pulsing and GA_3 treatment on postharvest quality of gerbera cut flowers

Treatment	Vase life in days	Days taken for drooping of flower heads	Days taken for discolouration of petals	Days taken for petal fall
T_1	8.000^b	8.200^b	8.400^c	8.300^b
T_2	10.000^a	11.000^a	11.200^a	11.200^a
T_3	8.200^b	8.900^b	10.000^b	10.600^a
T_4	7.400^b	8.000^b	8.400^c	8.800^b
SEm (±)	0.605	0.481	0.339	0.372
CD (5%)	1.800	1.454	1.025	1.126

N.B. Similar alphabets are not significant. They are statistically at per

Table 4. Effect of silver nitrate pulsing and GA_3 treatment on postharvest quality of gerbera cut flowers

Treatment	Vase life in days	Days taken for drooping of flower heads	Days taken for discolouration of petals	Days taken for petal fall
T_1	9.000^{ab}	10.000^a	10.500^b	11.200^a
T_2	10.800^a	11.000^a	12.330^a	12.300^a
T_3	9.000^{ab}	11.000^a	11.250^{ab}	11.500^a
T_4	7.500^b	8.000^b	8.500^c	8.900^b
SEm (±)	0.576	0.387	0.402	0.400
CD (5%)	NS	1.171	1.215	1.210

N.B. Similar alphabets are not significant. They are statistically at per

4. CONCLUSION

The result of the experiment showed that pulsing with silver nitrate (100 ppm) is more effective than pulsing with chlorine (100 ppm) and among the two growth regulators, the performance of GA_3 was much better than BA in the maintenance of the postharvest quality and shelf life of cut gerbera flowers which were pulsed with silver nitrate (100 ppm). The performance of BA treatment as vase preservative was comparatively better which were pulsed with chlorine (100 ppm). The increased vase life of 9 days, with delayed flower drooping, petal discolouration and petal fall was observed with flowers which were pulsed with chlorine (100 ppm) followed by keeping in BA (10 ppm) as well as the maximum vase life of 10.8 days was noted with flowers which were pulsed with silver nitrate with delayed petal discolouration, petal fall and flower drooping was observed with GA_3 (10 ppm) among the different vase preservatives containing GA_3.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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