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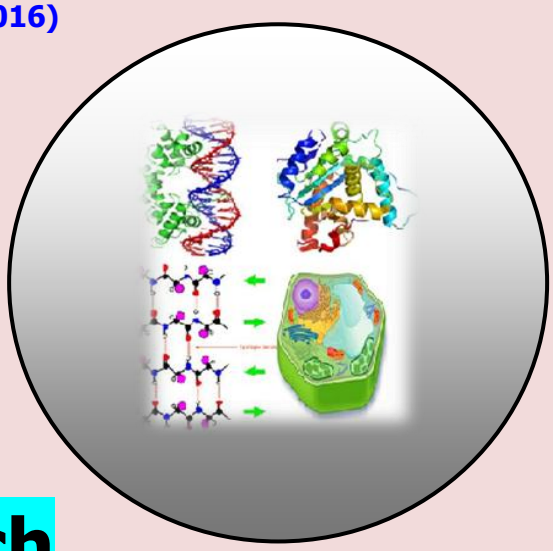

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Extending Post Harvest Life and Keeping Quality of Gerbera (*Gerbera jamesonii)* using Silver Nitrate, Salicylic Acid and Sucrose

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ABSTRACT

Gerbera Jamesonii popularly called Transvaal daisy regarded as best cut flower in the World and occupies the fourth position in global floriculture trade of ten popular cut flowers in the world. Stem bending and petal discolouration are the main cause of post harvest loss and shows inverse co-relation among them. Besides these two factors, flower diameter plays an important role in the market prospect of the global cut flower industry. Presently, Salicylic acid (15mg/l) alone and/or in combination with Silver nitrate (20mg/l) significantly prolonged the shelf life of cut flower due to its acidic pH and biocide property .Silver nitrate have positive impact at lower concentration but when used with sucrose showed commulative effect on water uptake, angle deviation, discolouration of florets &shelf life. Sucrose (4%) showed better results when used in combination with biocides (Silver nitrate and Salicylic acid).Maximum water uptake ((29.4g/flower; 9th day), least angle deviation and prolonged shelf life (16 ± 1 days) observed in DW+ $AgNO_3$ (20mg/l) + Salicylic Acid (15mg).
Key words: Gerbera Cut Flowers, Silver Nitrate, Salicylic Acid, Stem Curvature and Vase Life.

INTRODUCTION

Till very recently, the trade primarily revolved around the roses, lilies, carnations, chrysanthemums, tulips etc., but the trend is now fast shifting in favour of Gerberas for their colourful flowers of equisite shape, size and bewitched colours. Gerbera (*Gerbera jamesonii*) popularly known as Transvaal daisy, is a perennial Mediterranean plant native of South Africa. Gerbera is one of the natures beautiful creations and occupies fourth place among elite group of top ten cut flowers of the International market (Chaudhary and Prasad, 2000). Their latter utility accounts for highly lucrative trade worth 53% of the cut flower turnover at the Dutch auctions. Despite of their splendid beauty and prolong freshness ,the Gerbera flowers have a limited longevity, prone to quick senescence and this accounts for 50 percent loss of the farm value (Bhattacherjee, 1999). Cut flowers lose their water soon after harvesting and water balance is a major factor determining quality and vase life of cut flowers (Da Silva 2003).Bacterial contamination vascular blockage and stem occlusions result in negative effect on water uptake, hence shortening their vase life. Application of antibacterial compounds as the vase solution inhibits vascular

blockage and increase water uptake (Shanan 2012). India due to diverse agro-climatic and congenial locations is in an enviable position to become a leader in the world floriculture trade but still account 0.35% of the international trade due probably to absence of post-harvest protocols required to to increase market acceptability and to post-harvest prevent losses. Conforming to these measures, the present studies focused on the effect of silver nitrate ($AgNO_3$), Salicylic acid (SA) plus sucrose (4%) on the post harvest parameters i.e. water uptake, stem bending, petal discolouration and vase life of *Gerbera jamesonii* varieties 'Red Sky', 'Blizzard' and 'Alppraz'.

MATERIAL AND METHODS

The present studies are conducted at Department of Botany, Post Graduate Govt. College for Girls, Sector-11, Chandigarh. The experiment was carried out on *Gerbera jamesonii* varieties 'Red Sky', 'Blizzard' and 'Alppraz' variety with nine flowers per treatment and the experiment is repeated thrice. The flowers are placed in s containing 250 ml flasks of preservative solutions with distilled water as control and the experiments are maintained at 25 $\pm$ 2°C. The flowers harvested in early morning are transferred to laboratory under dry condition (30-35 Relative Humidity), the lower 2cm stem is cut under tap water to prevent air embolism. The flowers are pre-treated with cool water for 3 hour. The effects of different combination of Silver nitrate and Salicylic acid alone and /or in combination with 4% sucrose. T_1-Control, T_2-DW + $AgNO_3$ (20mg/l), T_3-DW + Salicylic Acid (20mg/l), T_4-DW+ 4 % Sucrose + $AgNO_3$ (20mg/l), T_5 –DW + $AgNO_3$(20mg/l) + Salicylic Acid (15mg), T_6 –DW + $AgNO_3$(20mg/l) + 4%Sucrose + Salicylic Acid (15mg/l), in Gerbera varieties 'Red Sky', 'Blizzard' and 'Alppraz'.

(i) **Uptake of water**

In order to study the water uptake, the vase solution volume is kept 100ml in all the treatments. The volume of vase solution is measured on every the 3rd day (3^{rd}, 6^{th}, 9^{th} 12^{th}) using the measuring cylinder**.** The water uptake from the spike is calculated by the difference between the consecutive weights of the flasks with the preservative solution (without flowers), and it is expressed in gram/cut flower.

Water uptake = [F+S] Day 1 – [F+S] Day 2

F– Weight of the flask, S – Weight of the preservative solution.

(ii) Stem bending (degree*day-1)

Presently, the stem bending in the Gerberas is measured using a Celco protractor and classified based on bending degrees of curvature (Fig.1). The gerberas stem bending is rated as prominent sign for the vase –life of the cut flower. The gerberas stem bending were rated as follows: 0 for bending up to 2^0, 1 bending between 3^0 and 4^0, 2 for bending between 5^0 and 6^0, 3 for bending between 6^0 and 7^0, 4 for bending 180^0.

(iii) Petal Discolouration

The petal discolouration is studied according to procedure adopted in earlier studies(Macnish *et. al.,* 2000) with assigning different rating scale for the cut flowers:Rating1 =slight fading, Rating 2 = moderate fading and Rating 3 = advanced fading.

(vi) Vase life (days after harvesting time)

The cut flowers are kept in preservative solution till their one-third petals are wilted and fowers show stem bending of 180^0 .The time taken by the cut flowers in particular preservative solution should be regarded as the vase –life of the flower and the number of days taken to achieve this stage is recorded as its longevity.

Data recorded

The data of parameters (uptake of water, stem bending, petal discoloration & vase life) is computed, calculated during every 3, 6, 9 and 12 days of cut flower vase life.

RESULTS

(i) Effect of Salicylic acid (SA)

Salicylic acid is a natural growth regulator showed significant results alone or in combination with Silver nitrate (T_3,T_5) in all the parameters studied and showed persistent increase in water uptake from 3^{rd} day onwards and recorded maximum(20.5;29.4g/flower respectively) on 9^{th} day. The water uptake after 9^{th} day showed decline on the 12^{th} day but 3 times in T_5 compared to control (Table1). This combined synergistic effect is reflected in shelf life (16±1 days) in T_5 combination treatment in comparison to control (T_1) where the shelf life is hampered (6±1 days).

(ii) Effect of Silver Nitrate ($AgNO_3$)

Silver nitrate (20mg/l; T_2) treatment as vase solution showed constant increase in water uptake i.e. 8g, 15g per flower respectively for 3 and 6 days with decline recorded on 9th day (13g/flower) however, addition of sucrose (4 %; T_4) showed significant beneficial effect in water uptake on the 9th day (17g/flower) with extending the vase life (10±1 days; Table 1).

(iii) Effect of Sucrose

In the present studies, the sucrose treated vase solutions(T_4,T_6) showed less stem bending(5^0) and better shelf life(T_6;14±1 days). Both the combinations (T_4, T_6) showed increase in water uptake up to 6th day showing respectively 17.0&24.9g/flower which is observed 2.5 times (15.8g/flower; T_6) than control (T_1) on 12th day (Table1).

(iv) Petal Discolouration

Petal discolouration, a main criteria that depict the freshness and water conductivity in flower is observed maximum (6±1 days) in control (T_1) while minimum (16±1) in T_5 **(**DW + $AgNO_3$ (20mg/l) + Salicylic Acid (20mg/l) in yellow cultivars in comparison to others i.e. 15 ± 1 days in red and 14 ±1 days in white cultivars).

(v) Fresh weight

Fresh weight, a key indicator of the healthy status of flower showed least variation in the control (T_1) whereas, the maximum change is observed in Gerbera cut flower up to 6th day as compared to control, however, T_5-DW + $AgNO_3$ (20mg/l) + Salicylic Acid (20mg/l) showed a shade better results than T_6-DW + $AgNO_3$ (20mg/l) + 4% Sucrose + Salicylic Acid (15mg/l).

(vi) Angle Deviation

Stem deviation is significant post harvest problem affecting acceptance and market value of the cut gerbera.post harvest handling, angle deviation is most significant parameter which depicts quality of cut flower and its longevity which results in market acceptance of cut flower. Maximum bending (180^0) is observed in flowers in control (T_1) whereas, those subjected to treatment of Silver nitrate acid with/or without Salicylic showed least angle deviation (4^o) in T_3 (DW + Salicylic Acid(20mg/l),) and T_5 (DW+$AgNO_3$(20mg/l)+Salicylic Acid(20mg/l) after 12 days. Hence, the maximum variation from the start (3rd day) to 12th day is observed in control (T_1) vase solution and minimum angle bending in T_5 (DW+$AgNO_3$ (20mg/l) + Salicylic Acid (20mg/l) with shelf life of 16 ± 1 days.

(vii) Vase life

The shelf life of these three gerbera cultivars ranged from 6 ± 1 to 16 ± 1 days. The Maximum shelf life is in T_5 (16 ± 1) followed by T_6 (14 ± 1 days) in yellow cultivar while minimum by T_1 (6 ± 1 days), however, the red and white cultivars showed maximum 15 ± 1 days and 14 ± 1 days respectively in T_5 **(**DW+ $AgNO_3$ (20mg/l) + Salicylic Acid (20mg/l).

DISCUSSION

Stem bending and petal discolouration are the key factors and cause of post-harvest loss and posing great challenge to the cut flower industry (Amarjit 2000). In the present studies, inverse co-relation between the stem bending & the fresh weight of flower in comparison to control is primarily due increased uptake of water which maintained high turgidity in the stem and reduces stem deviation (Hashemabadi and Bagheri 2013; Aghera *et. al*., 2016; Hassani and Alimirzaii, 2017). Besides these two factors, flower diameter plays an important role in the market prospect of the cut flower. Presently, Salicylic acid significantly prolonged the shelf life of cut flower due to its acidic pH and bactericide property to inhibit bacterial growth & avoid vascular blockage and increases water uptake in accord with earlier studies. Besides this, Salicylic acid inhibited the ethylene biosynthesis and increases shelf life with delayed senescence (Canacki, 2008; Vahadati *et al*., 2012; Amin, 2017, Bayat and Aminifard, 2017, Heidarnezhadian *et al*., 2017).

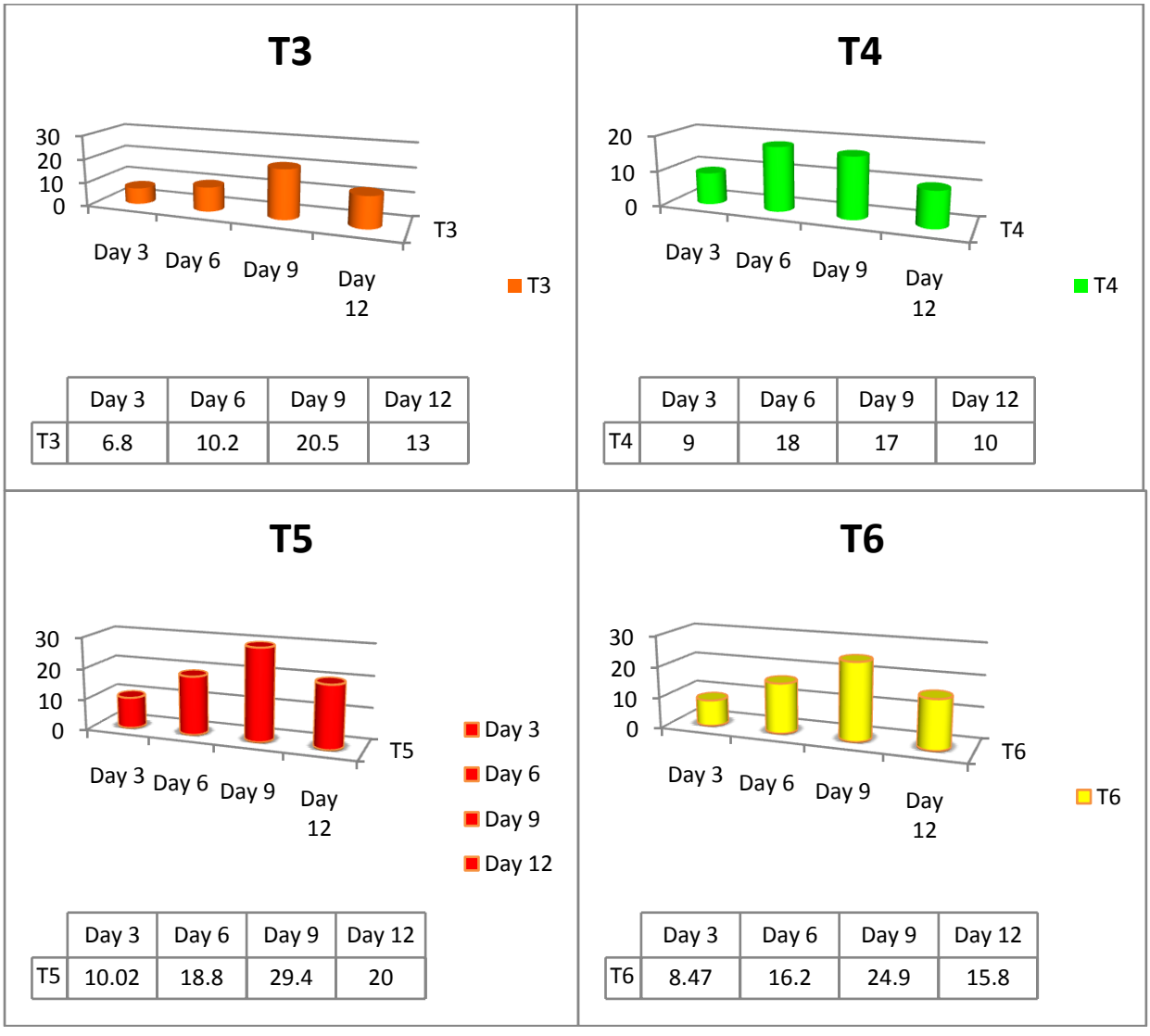
Silver nitrate have showed positive impact and promoted water uptake, flower diameter and shelf life when used in lower concentration (present study; Aghera *et. al.,* 2016; Hassani and Alimirzaii, 2017), however, high concentration of Silver Nitrate caused negative impact on water uptake and promoted senescence in confirmation to earlier studies (Lopez *et. al*., 2016; Hassan, 20O5). Silver Nitrate treatment with Sucrose (4%), showed commulative higher uptake, decreases angle deviation and discolouration of florets in comparison to control ,hence significantly extended the shelf life in cut flowers (present study; Hatami *et. al*. 2013; Anand and Sankari, 2015; Aghera *et. al.,* 2016;Lopez et. al., 2016). Sucrose, a floral preservative, plays an important role in post harvest handling of cut Gerbera flowers. Sucrose provides carbohydrate source for respiration which delays the protein degradation and increase water uptake in flowers and maintain rigidity & turgidity due to cell wall thickening and lignification of vascular tissues (Mayak and Halevy 1980; Steinitz, 1983), which plays important role in flower freshness and increases shelf life (Nair *et al*., 2003). Sucrose promote microbial proliferations in the present studies ,hence the combination of sucrose(4%) with biocides(Silver nitrate and Salicylic acid) showed better results in all parameters with extended shelf life of cut Gerbera flowers.

Figures 1-4. Flowers in Vase Solution T_5 –DW + $AgNO_3$ (20mg/l) + Salicylic Acid (15mg/l.

Table 1. Effect of chemical preservatives on the different parameters in post harvest handling of *Gerbera.*

Vase Solution	Fresh Weight (gms)	Water Uptake (g/flower)				Angle Deviation				Vase Life
		3rd day	6th day	9th day	12th day	3rd day	6th day	9th day	12th day	
T_1	16.64	5.26	4.1	5.4	6.8	1^0	5^0	7^0	180^0	6±1
T_2	23.5	8	15	13	9	1^0	2^0	3^0	6^0	8±1
T_3	27.5	6.8	10.2	20.5	13	1^0	2^0	3^0	4^0	12±1
T_4	25.71	9	18	17	10	1^0	2^0	4^0	5^0	10±1
T_5	25.0	10.2	18.8	29.4	20	1^0	2^0	2^0	4^0	16±1
T_6	28.83	8.47	16.2	24.9	15.8	1^0	2^0	2^0	5^0	14±1

T1-Control, T_2-DW + $AgNO_3$ (20mg/l), T_3-DW + Salicylic Acid (20mg/l), T_4-DW + 4%Sucrose+$AgNO_3$ (20mg/l), T_5-DW + $AgNO_3$ (20mg/l) + Salicylic Acid (15mg/l), T_6-DW + $AgNO_3$ (20mg/l) + 4%Sucrose + Salicylic Acid (15mg/l).



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CONCLUSION

It is concluded from the present study that the role of preservative solutions is vital for the shelf life. Salicylic acid with or without Silver nitrate show significant effect on quality & biochemical parameters of flowers. The most effective concentrations of DW+$AgNO_3$(20mg/l)+Salicylic Acid(15mg/l) alone and pulsing with 4% sucrose proves best. To conclude, $AgNO_3$(20mg/l)+Salicylic Acid(15mg/l) with or without pulse treatment has the potential to be used as a commercial preservative solution to improve the keeping quality and vase-life of this important cut flower.

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