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Effect of different preservatives on shelf life of cut tuberose (*Polianthes tuberosa* L.)

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ABSTRACT

Tuberose is an important cut flower crop in Indian as well as world. But, postharvest senescencse is unduced by several factors *viz.*, water stress, carbohydrate deplelion, micro organism. Improvement of keeping quality and extension of vase life of cut flowers are important areas in floricultural research. Postharvest senescence is induced by several factors like water stress, carbohydrate depletion, microorganism etc. It has been reported that pulsing treatments prevents vascular infections and inhibit ethylene production and thereby result in prolong storage period and higher quality flowers with increased vase life. The study was conducted during the period July to August 2024 to find out suitable preservative(s) of vase solution that increases vase life of tuberose (CV. Single). Eleven treatments *viz.*, T1 = Control, T2 = Sucrose 2.5%, T3 = Sucrose 5%, T4 = Citric acid 2.5%, T5 = Citric acid 5%, T6 = $AgNO_3$ 15 ppm, T7 = $AgNO_3$ 30 ppm, T8 = Sucrose 2.5% + Citric acid 2.5%, T9 = Sucrose 2.5% + Citric acid 5%, T10 = Sucrose 2.5% + $AgNO_3$ 15 ppm and T11 = Sucrose 5% + $AgNO_3$ 25 ppm. Experimental results revealed that different preservatives solutions significantly affected the vase-life of tuberose flowers. The combination and concentration of Sucrose 2.5% and $AgNO_3$ 15 ppm (T10) were found to most suitable preservative solution for extending the vase life of tuberose cut flowers.

Key words: Tuberose, vase life, preservative, sucrose, citric acid, $AgNO_3$.

INTRODUCTION

Tuberose is a perennial, bulbous flowering plant, belongs to the family Amaryllidaceae and is one of the most popular cut flowers grown in India and as well as worldwide (Singh and Shanker, 15). Tuberose is spreaded from Mexico to the different parts of the world during the 16th century. The white, sweet scented flowers are valued as cut flower, used in bouquets, for making garlands, veins and as a source of essential oils for perfumery industries. Postharvest losses in many cut flowers are estimated to be as high as 40% in the absence of floral preservatives. The flowers remain fresh for quite a long time and withstand distance transportation and fill a useful place in the flower market. Their white colored floret has very potential demand in the market. The loose flowers of tuberose contain 0.080-0.135% concrete and used for extraction of essential oils which are used in high grade perfume industry (Jadhav *et al.,* 5). Tuberose flowers are highly perishable in nature along with acropetalous movement of the florets along the spike, when flower spikes are harvested from the plant, there will be deterioration in the internal carbohydrates and loss in turgidity is accelerated, therefore need to be treated with suitable chemicals, to enhance their vase life and improve quality. The vase life of tuberose flowers in tap water is limited for only for few days (Baidya *et al.,* 2).

It has been reported that pulsing treatments prevents vascular infections and inhibit ethylene production and thereby result in prolong storage period and higher quality flowers with increased vase life (Vidhya and Bhattacharjee 18). Whenever transpiration exceeds water uptake, resistance to water flow develops in the stems leading to water deficit. This resistance can be attributed to microbial occlusions, physiological vascular blockage or air embolism. Water uptake and water loss by harvested cut flowers in vases may fluctuate cylindrically with an overall declining trend. In India, commercial floriculture is a still upcoming trade and it offers a wide scope for experimentation, standardization and improvement of various techniques for enhancing vase life of cut flower.

Tuberose is one of the highly valuable flowers used in perfume and scent industry. People prefer tuberose, because of its use as cut flowers, bouquet arrangements and indoor decorations. For enhancing

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the quality and improving the vase life of Cut flowers, many chemicals like as Silver nano, sucrose, $Al_2(SO_4)_3$, $CoCl_2$, etc are used as preservatives. After dipping in chemical preservatives, two different storage has been followed such as dry and wet storage by keeping in room and cold chamber (8°C). Wet storage is placing the flowers with their base solution. Dry storage is after dipping the flowers in solution it is wrapped and stored the proton motive force and also decreases membrane permeability and finally cell death.

Improvement of keeping quality and extend of vase life of cut flowers are important areas in floricultural research. Senescence of cut flowers is induced by several factors e.g. water stress, carbohydrate depletion, microorganism etc. Chemical preservatives are known to be antibacterial agents, water uptake enhancers along with other properties, are used for extending vase life of cut flowers. Therefore, the present study was carried out with an objective to evaluate the effect of different concentration of sucrose, citric acid and $AgNO_3$ on vase life of tuberose cut flower.

MATERIALS AND METHODS

The study was conducted at Imayam Institute of Agriculture and Technology, Thuraiyur, Trichy, Tamil Nadu during the period July to August 2024. Tuberose flower spikes harvested in early morning 4AM and collected from farmer's field of Sengattupatti village, Thuraiyur when one or two basal florets opened in flower spikes. Harvested flower spikes transported from Field to Lab within 6 hours of harvesting time and flower spikes covered with plastic film during transportation to minimize the moisture loss. Flower spikes kept in laboratory and re-cut by 1.5- 2.5 cm. The 50 cm length of each flower spike was maintained uniformly. The experiment was laid out in Completely Randomized Design (CRD).

The vase solution was prepared at the beginning of experiment. Treatment details of holding solutions used in experiment consists of T1 (Control), T2 (Sucrose 2.5%), T3 (Sucrose 5%), T4 (Citric acid 2.5%), T5 (Citric acid 5%), T6 ($AgNO_3$ 15 ppm), T7 ($AgNO_3$ 30 ppm), T8 (Sucrose 2.5% + Citric acid 2.5%), T9 (Sucrose 2.5% + Citric acid 5%), T10 (Sucrose 2.5% + $AgNO_3$ 15 ppm), and T11 (Sucrose 5% + $AgNO_3$ 25 ppm) (Fig. 1). The observations recorded on different postharvest parameters such as, gain or loss in fresh weight, total vase solution uptake, vase life in days, flower diameter, flower length, No. of florets opens and No. of flower drops. Flowering spikes were kept in 200 ml solution of 250 ml conical flask. Conical flask mouths were covered with a sheet of polyethylene film, to minimize evaporation and to reduce further contamination.

Fig. 1. Various treatments (T1 to T11) carried out in the laboratory.

RESULTS AND DISCUSSION

The amount of vase solution absorbed and loss or gain of flower weight in different vase preservatives. From the Table 1 it is clear that weight of all treatments were increased from 1st to 5th day and decreased from 7th day. Among the treatments maximum weight gain and water uptake was observed by T10 (Sucrose 2.5% + $AgNO_3$ 15 ppm) followed by T11 (Sucrose 5% + $AgNO_3$ 25 ppm). The minimum weight

Table 1. Effect of different vase preservatives on gain or loss in fresh weight and total vase solution uptake.

Treatment	Gain or loss in fresh weight (g)					Total vase solution uptake (g)
	1st day	3rd day	5th day	7thday	9th day	
T_1	58	63.83	64.63	61	53.33	47
T_2	58	64.33	66	63	57	51.67
T_3	57.33	68	71	63.67	62	53
T_4	56	66.8	68.8	65	61	54.33
T_5	56.33	67	68.77	66	63	53.66
T_6	57.67	67.07	69.5	65	62	54.67
T_7	57.67	71.78	74.97	66	65	56.66
T_8	58.33	70.67	74.17	69.17	66	57
T_9	56.67	71.55	75.25	71	67	55.67
T_{10}	56.56	73.2	77.2	72.47	70.47	58
T_{11}	59.67	72.03	75	71.33	68	57.33
CD	0.26	2.35	2.312	0.58	0.72	2.01
SED	0.78	0.8	0.79	1.07	2.11	0.68

(T1= Control, T2= Sucrose 2.5%, T3= Sucrose 5%, T4= Citric acid 2.5%, T5= Citric acid 5%, T6= $AgNO_3$ 15ppm, T7= $AgNO_3$ 30ppm, T8= Sucrose 2.5% + Citric acid 2.5%, T9= Sucrose 2.5% + Citric acid 5%, T10= Sucrose 2.5% + $AgNO_3$ 15ppm and T11= Sucrose 5% + $AgNO_3$ 25ppm).

gain and water uptake was observed in T1 (Control) followed by T2 (Sucrose 2.5%). Similar results were reported by Hutchinson *et al.* (4) on effect of accel, sucrose, and silver thiosulphate on water relations, post-harvest physiology of cut tuberose flowers and Talukdar *et al*. (16) on effect of pulsing and different holding solutions on flower quality and vase life of tuberose cv. Calcutta Double.

The floret diameter of tuberose spikes showed the significant difference for different vase solution from fourth day onwards (Table 2). After harvesting initially flower diameter increases for first 2 days after that it decreases from 3rd day onwards in all the treatments. Among the treatments, on 2nd day the maximum flower diameter increase was observed in T10 (Sucrose 2.5% + $AgNO_3$ 15ppm) (4.46 cm) followed by T7 ($AgNO_3$ 30ppm) (4.44), whereas the minimum flower diameter was observed on T1 (Control) (4.04) followed by T2 (Sucrose 2.5%) (4.09), on 4th day also same treatments recorded maximum and minimum flower diameter. The similar results were observed by Kumar *et al.* (7) and Motaghayer and Esna-Ashari, (10) on postharvest quality of tuberose spikes as affected by colouring agents and storage and Talukdar *et al.* (16) and Sigma *et al.* (14) on effect of pulsing and different holding solutions on flower quality and vase life of tuberose cv. Calcutta Double.

Table 2. Effect of different vase preservatives on flower diameter of tuberose.

Treatment	0 day	1st day	2nd day	3rd day	4th day
T_1	3.52	4.51	4.72	3.62	3.2
T_2	3.57	4.62	4.81	3.68	3.28
T_3	3.73	4.71	4.95	3.83	3.49
T_4	3.62	4.61	4.81	3.73	3.36
T_5	3.57	4.42	4.62	3.72	3.28
T_6	3.67	4.46	4.64	3.78	3.32
T_7	3.92	5.01	5.13	3.9	3.72
T_8	3.81	4.92	5.04	3.81	3.6
T_9	3.83	4.94	5.17	3.86	3.66
T_{10}	4.05	5.17	5.27	4.04	3.82
T_{11}	3.87	4.94	5.18	3.92	3.84
C.D.	0.04	0.03	0.04	0.03	0.05
SED	0.02	0.01	0.01	0.01	0.02

(T1= Control, T2= Sucrose 2.5%, T3= Sucrose 5%, T4= Citric acid 2.5%, T5= Citric acid 5%, T6= $AgNO_3$ 15ppm, T7= $AgNO_3$ 30ppm, T8= Sucrose 2.5% + Citric acid 2.5%, T9= Sucrose 2.5% + Citric acid 5%, T10= Sucrose 2.5% + $AgNO_3$ 15ppm and T11= Sucrose 5% + $AgNO_3$ 25ppm)

The flower length of tuberose spikes showed the significant difference for different vase solution from fourth day onwards. Flower length increases first 2 days after that it decreases (Table 3). On 4th day maximum floret length increase was observed in T11 (Sucrose 5% + $AgNO_3$ 25ppm) (3.84) fallowed by T10 (Sucrose 2.5% + $AgNO_3$ 15ppm) (3.82), whereas minimum floret length was observed in T1 (Control) (3.20) followed by T2 (Sucrose 2.5%) (3.28) and T5 (Citric acid 5%) (3.28) are found similar. Findings were in similar with Talukdar *et al.* (16) and Mahroo and Ashari, (9) on effect of pulsing and different holding solutions on flower quality and vase life of tuberose cv. Calcutta Double.

The number of flowers opened per day per spike showed significant difference for different vase solution from 1st to 4th day (Table 4). On 4th day of observation, maximum number of florets was opened in T10 (Sucrose 2.5% + $AgNO_3$ 15ppm) (4.33) and minimum number of florets opening occurred in T1 (Control) (2.33) followed by T2 (2.66). The average number of florets (3.33) opening occurred in T4 (Citric acid), T6 ($AgNO_3$ 15ppm), T7 ($AgNO_3$ 30ppm), T8 (Sucrose 2.5% + Citric acid 2.5%), T11 (Sucrose 5% + AgNO3 25ppm). Similar results were reported by Adarsh *et al.* (1) and Sao and Verma, (13) on Vase life studies in tuberose cv. Shringar as affected by post-harvest handling treatments.

Table 3. Effect of different vase preservatives on flower length of tuberose.

Treatment	0 day	1st day	2nd day	3rd day	4th day
T_1	3.52	4.51	4.72	3.62	3.2
T_2	3.57	4.62	4.81	3.68	3.28
T_3	3.73	4.71	4.95	3.83	3.49
T_4	3.62	4.61	4.81	3.73	3.36
T_5	3.57	4.42	4.62	3.72	3.28
T_6	3.67	4.46	4.64	3.78	3.32
T_7	3.92	5.01	5.13	3.9	3.72
T_8	3.81	4.92	5.04	3.81	3.6
T_9	3.83	4.94	5.17	3.86	3.66
T_{10}	4.05	5.17	5.27	4.04	3.82
T_{11}	3.87	4.94	5.18	3.92	3.84
C.D.	0.04	0.03	0.04	0.03	0.05
SED	0.02	0.01	0.01	0.01	0.02

(T1= Control, T2= Sucrose 2.5%, T3= Sucrose 5%, T4= Citric acid 2.5%, T5= Citric acid 5%, T6= $AgNO_3$ 15ppm, T7= $AgNO_3$ 30ppm, T8= Sucrose 2.5% + Citric acid 2.5%, T9= Sucrose 2.5% + Citric acid 5%, T10= Sucrose 2.5% + $AgNO_3$ 15ppm and T11= Sucrose 5% + $AgNO_3$ 25ppm)

Table 4. Effect of different vase preservatives on number of flower open in tuberose.

Treatment	0 day	1st day	2nd day	3rd day	4th day
T_1	1.67	4	5.67	4.33	2.33
T_2	2.33	4.33	6	4.67	2.66
T_3	2.67	4.67	6.67	5.33	3
T_4	2.33	5	6.33	5.33	3.33
T_5	2.67	5.33	5.67	5.67	3.67
T_6	2.67	5.67	6	6	3.33
T_7	2.33	6	6.67	5.67	3.33
T_8	2.67	5.67	6.33	5.33	3
T_9	2.67	5.33	7	5.67	3
T_{10}	2.67	6.33	7.33	6.67	4.33
T_{11}	1.67	5.67	6.33	5.67	3.33
C.D.	N/A	0.98	0.98	1.07	N/A
SED	0.45	0.33	0.33	0.36	0.43

(T1= Control, T2= Sucrose 2.5%, T3= Sucrose 5%, T4= Citric acid 2.5%, T5= Citric acid 5%, T6= $AgNO_3$ 15ppm, T7= $AgNO_3$ 30ppm, T8= Sucrose 2.5% + Citric acid 2.5%, T9= Sucrose 2.5% + Citric acid 5%, T10= Sucrose 2.5% + $AgNO_3$ 15ppm and T11= Sucrose 5% + $AgNO_3$ 25ppm)

Table 5. Effect of different vase preservatives on number of flowers drop of tuberose.

Treatment	5th day	6th day	7th day	8th day	9th day
T_1	3.33	4	5	5.67.	6.67
T_2	3	3.67	4.33	5.33	5.67
T_3	2	3	4	5	5.33
T_4	1.67	2.33	2.67	5	5.33
T_5	2	3	4	5	5
T_6	2	2.67	4.67	5.33	5.33
T_7	1	2	3.67	4	4.33
T_8	0.67	1.33	2.67	3.67	4.33
T_9	1.33	2	2.33	3.33	4
T_{10}	0.67	1.33	1.67	2.67	2.67
T_{11}	1	2	3	3.33	3.67
C.D.	1.68	1.51	1.65	1.19	1.15
SED	0.57	0.51	0.56	0.4	0.39

(T1= Control, T2= Sucrose 2.5%, T3= Sucrose 5%, T4= Citric acid 2.5%, T5= Citric acid 5%, T6= $AgNO_3$ 15ppm, T7= $AgNO_3$ 30ppm, T8= Sucrose 2.5% + Citric acid 2.5%, T9= Sucrose 2.5% + Citric acid 5%, T10= Sucrose 2.5% + $AgNO_3$ 15ppm and T11= Sucrose 5% + $AgNO_3$ 25ppm)

Table 5 shows the effect of different vase preservatives on the number flower drop in tuberose. Significant no. of flower drop observed from 5th day onwards. On the ninth day of observation, maximum no. of flower drop occurred in T1 (Control) (6.67), followed by T2 (Sucrose 2.5%) (5.57) and minimum no. flower drop occurred in T10 (Sucrose 2.5% + $AgNO_3$ 15ppm) (2.67) followed by T11 (Sucrose 5% + $AgNO_3$ 25ppm) (3.67). Jowkar *et al*. (6) and Kumari *et al*. (8) reported similar results on effect of different vase preservative solutions on vase life of cut flowers.

Whereas, the treatments comprised T1 = Control, T2 = Sucrose 2.5%, T3 = Sucrose 5%, T4 = Citric acid 2.5%, T5 = Citric acid 5%, T6 = $AgNO_3$ 15 ppm, T7 = $AgNO_3$ 30 ppm, T8 = Sucrose 2.5% + Citric acid 2.5%, T9 = Sucrose 2.5% + Citric acid 5%, T10 = Sucrose 2.5% + $AgNO_3$ 15 ppm, and T11 = Sucrose 5% + $AgNO_3$ 25 ppm.

Vase life of tuberose cut spikes showed significant difference for different vase preservatives treatments. From all the above tables it can be observed maximum vase life was recorded in T10 (Sucrose 2.5% + $AgNO_3$ 15ppm) (2.67) followed by T11 (Sucrose 5% + $AgNO_3$ 25ppm) (3.67), whereas minimum vase life was found in T1 (Control), followed by T2 (Sucrose 2.5%). Findings were in accordance with Mahraoo *et al.* (9) on effect of different concentrations of four preservatives solutions on tuberose and Talukdar *et al.* (16) on effect of pulsing and different holding solutions on flower quality and vase life of tuberose *(Polianthes tuberosa* L.) cv. Calcutta Double. The maximum uptake of water by the flowers in the treatments might be due to influence of pulsing with silver nitrate which helped in increased uptake of water and germicidal properties of $AgNO_3$ in addition to inhibition of ethylene biosynthesis which resulted in gain in fresh weight. This might be due to the presence of sucrose in the solution that had acted as a food source or respiratory substrate and delayed the degradation of proteins and improved water balance of cut flowers. Sucrose antagonized the effect of ABA, which promote senescence. The reason being that water uptake may be the important factor in improving the length of vase life of cut flower (Halevy and Mayank, 3). As the leaves on flower transpire, water is drawn up through the xylem. If the process is impeded by a vascular blockage and accelerated by increased stomatal opening, then transpiration will exceed, uptake and water deficiency will occur. So solutes like Sucrose 2.5% + $AgNO_3$ 15ppm (T10) added to vase solutions, can decrease transpiration or increase water uptake. So flower remains fresh for more days. From the above results, it can be concluded that different vase preservatives solutions significantly affected the vase-life of tuberose flowers. The combination of Sucrose 2.5% and $AgNO_3$ 15ppm (T10) concentration found to be the most suitable

preservative for extending vase life of tuberose cut flowers (Paul *et al.,* 11; Reethu *et al.,* 12; Uddina *et al.,* 17).

The application of different vase preservative solutions significantly influenced the vase life of cut tuberose flowers. Among all treatments, the combination of 2.5% sucrose and 15 ppm $AgNo_3$ (T10) proved to be the most effective in prolonging vase life. This treatment enhanced flower longevity by providing an optimal balance of energy source and antimicrobial action, thereby maintaining floral freshness and delaying senescence.

AUTHORS' CONTRIBUTION

Writing original draft, Formal analysis (MM, RD, SKK & BVS); Investigation, Supervision, Validation (YR, HG, HM, SB & PS); Software editiing (LNR, SBG, VS & PS).

DECLARATION

The authors do not have any conflicts of interest to declare.

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