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Full Length Research Article

Influence of Certain Chemicals on Cut Scape of *Polianthes tuberosa* L.

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Abstract

There is a huge demand and hence a very lucrative market of cut flowers. They are used in various occasions in varied forms as garlands, wreaths, vase displays and many more. Most of those are grown in field or in greenhouses or in gardens; some are even collected from wild. Those with a longer vase life are preferred more than those which wilts easily. There are different ways by which the shelf life or vase life of cut flowers can be increased. To fulfil this objective, an experiment was conducted to understand the influence of certain chemicals on increasing the vase life of cut tuberose (*Polianthes tuberosa* L.) and to understand the physiological and biochemical events leading to senescence. The cut flowers of tuberose were placed in vase solution comprising of sucrose with Aluminum Sulphate (AS) or Citric Acid (CA) with various concentrations. Distilled water without any chemicals was used as control. The analysis of the data indicated significant effect of sucrose and aluminum sulphate on different physiological and biochemical attributes and hence in enhancing the vase life. Holding solutions comprising of sucrose 4% + AS 200 ppm concentration resulted in maximum increase in vase life of cut tuberose.

***Key words*:** *Polianthes tuberosa* L., Sucrose, Aluminum sulphate, Citric acid, Cut flower

A flowering plant finds its main use in cut flower industry, besides other uses. Cut flower industry is a rapidly evolving industry as the technology and farming practices evolve in the 21st century. Increase in income and interest in giving flowers as gifts has boosted up the cultivation of cut flower crops in recent years. According to Division of Floriculture, Indian Agricultural Institute, New Delhi, the value of cut flower export from India has increased manifold during the recent times. Karnataka, Tamil Nadu and Andhra Pradesh in the South, West Bengal in the East, Maharashtra in the West and Rajasthan, Haryana and Delhi in the North are the major flower growing states. Some of the flowers are marketed loose like marigold, jasmine, chrysanthemum, aster, crossandra, tuberose etc., while rose, gladiolus, tuberose, carnation, orchids, and in recent times liliums, gerbera, gypsophila etc., are sold as cut flowers. The cultivation of cut flowers in green houses is increasing so that the production will be throughout the year and the produce will also be of good quality [14]. Not only in India, but throughout the world, the scope of floriculture is next only to the Information Technology Industry [6].

We can define cut flower as the whole flower or flower buds and can be procured after removing the flowers from the whole plant. Obviously with the flowers comes some stem and leaves as well. It is used mainly for decorative purposes in vases, can be made garlands and wreaths too. Depending upon different factors like the climate, culture and the standard of living of the people residing, the demand for the cut flowers is decided. Domestic garden may supply only a limited amount collected by the local gardeners. But in most places, there is a significant market available at a commercial level for the demand and supply of cut flowers. On a wider scale of production, the plants are grown in field and greenhouses. Some of the cut flowers can even be procured from the wild.

Different physiological processes occur within the flowers after being harvested, either from the wild or from cultivated conditions which affects their quality and vase life. The supply of water and the balance therein is controlled by uptake of water, their conductance and also their maintenance. These in turn affects the post-harvest phenomena of cut flowers. The cultivation and practices of raising cut flowers are often included under floriculture. Most of the cut flowers have to be marketed quickly after harvest because of their perishable nature. Different cut flowers have different shelf life depending upon their variety. Keeping in shade and in water and by different types of treatments, the shelf life of many cut flowers can be increased. The quality of cut flowers depend on how long the flowers can remain fresh after harvest, i.e., their longevity. For the continuous supply of cut flowers to meet the demand of the market it is important to see how the flowers can be kept fresh after harvest [16].

The main objective of this work was to investigate different keeping solution and determining the best ones which extend vase life and improve the keeping quality of the cut flower of *Polianthes tuberosa*.

MATERIALS AND METHODS

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The cut flower stick of *Polianthes tuberosa* was procured from the flower shop in the market in Darjeeling. The common name of *Polianthes tuberosa* is tuberose, which in Latin means swollen or tuberous describing its root system. It is a perennial plant somewhat similar to agaves. In Greek, *Polianthes* means many flowers. In India, the plant is commonly known as *"rajanigandha*", the literal meaning of which is "fragrant at night". The tuberose is a night-blooming plant native to Mexico. The inflorescence is spike, which blooms starting from bottom towards the top and can grow up to 45 cm long. Clusters of fragrant waxy white flowers are produced. It has long, bright green leaves clustered at the base of the plant and smaller, clasping leaves along the stem. Another distinguishing morphological feature is the presence of epiphyllous stamens.

Polianthes tuberosa can be commercially cultivated for its various uses. It is a popular cut flower as whole inflorescence. Even individual florets can be used to provide fragrance to bouquets and can also be used in the preparation of garlands along with many other types of floral displays. Essential oils and aroma compounds can also be extracted for use in making high value perfumes and some cosmetic products.

The scapes of *Polianthes* were procured at bud stage from the shop, taken in a bucketful of water and were brought to the laboratory. The first step was cutting the flower scapes in a slanting manner maintaining a uniform size of 52 cm. The initial weight was measured. Different conical flasks were taken containing different floral preservatives like sucrose 2% and 4% along with AS 200 ppm and 300 ppm, and CA 1000 ppm and 2000 ppm. The scapes were kept in the solutions. For the control set, distilled water was used. To prevent water loss because of evaporation, aluminium foils were used to cover the flasks, and the setup was kept in laboratory at room temperature of 18±4 °C. The experiment was carried out for 12 days when more than 90% of the scapes began to show wilting. This was considered as the termination of vase life.

Different physiological and biochemical parameters were then calculated. Change in fresh weight, scape length, tepal diameter and vase life were noted. The readings for fresh weight change were taken on days 0, 4, 8 and 12 respectively. Scape length was first measured on day 0 using cm scale and then on the final day i.e., on day 12. Similarly, the biochemical parameters were calculated on days 0, 4, 8, 12. Total chlorophyll content was estimated following Arnon's principle [2]. Carbohydrate levels (soluble and insoluble fractions) were estimated following McCready *et al*. [8]. The protein content was measured using Lowry *et. al.* [7]. Extraction and estimation of free amino acids were analyzed following the method of Moore and Stein [9].

Each experiment was carried out three times and mean values are given in the tables. Statistical evaluation of the results has been done at treatment and replication levels. LSD (Least Significant Difference) values at 5% level are included in the tables [3].

RESULTS AND DISCUSSION

The floral preservatives used viz., sucrose 2% and 4% along with AS 200 ppm and 300 ppm, and CA 1000 ppm and 2000 ppm were found to be effective in changing the percent fresh weight of cut flowers showing an increase in fresh weight change upto day 8 and then slight decrease in cut scapes of the experimental plant. At the last day of experiment, the maximum increase in fresh weight was recorded with 4% sucrose along with 200 ppm AS (40.87) followed by sucrose 4% + AS 300 ppm (39.38). It has been reported by many workers that sucrose and biocides help in increasing and hence maintaining higher fresh weight of cut flowers [10-11], [13] (Table 1).

Table 1 Effect of certain chemicals on fresh weight [FW] (g) and leaf chlorophyll content [Chl.] (mg/g fresh weight) of cut *Polianthes tuberosa*

Treatments	Days after keeping scapes in holding solution							
	0		4		8		12	
	FW	Chl.	FW	Chl.	FW	Chl.	FW	Chl.
Control (distilled water)	35.73	1.07	39.06	0.73	40.03	0.47	38.12	0.24
Suc 2% + AS 200 ppm	36.84	1.03	43.33	0.92	43.32	0.75	38.88	0.52
Suc 2% + AS 300 ppm	39.21	1.03	42.46	0.98	44.09	0.79	37.27	0.57
Suc 2% + CA 1000 ppm	37.19	1.04	41.20	0.83	45.04	0.51	37.67	0.31
Suc 2% + CA 2000 ppm	35.90	1.08	43.27	0.84	44.00	0.53	38.63	0.46
Suc 4% + AS 200 ppm	41.78	1.05	42.92	0.90	46.51	0.61	40.87	0.40
Suc 4% + AS 300 ppm	39.74	1.03	42.70	0.85	44.53	0.58	39.38	0.50
Suc 4% + CA 1000 ppm	34.31	1.03	37.67	0.82	39.85	0.63	32.68	0.22
Suc 4% + CA 2000 ppm	37.88	1.05	43.15	0.80	43.554	0.56	36.71	0.30
LSD (P = 0.05)	1.72	0.05	1.88	0.04	1.99	0.02	1.63	NS

AS: Aluminium Sulphate, CA: Citric Acid, NS: Non-Significant, LSD: Least Significant Difference

As the senescence advances with the progress of time, there is a decrease in the chlorophyll content. But with preservatives, the rate of its depletion in the leaves of cut tuberose was found to slow down. At the last day of treatment (day 12), the highest chlorophyll content was recorded with Sucrose 2% + AS 300 ppm (0.57). AS treatments was found to be superior than CA combinations throughout the experimental period. The combinations of sucrose with citric acid (CA) differed considerably with that of sucrose and aluminium sulphate (AS) combinations (Table 1).

Soluble carbohydrate content was maximum with sucrose 4% + aluminium sulphate (AS) 200 ppm on the last day of holding period as compared to control. On the other hand, the changes of insoluble carbohydrate content in leaves were found to be insignificant in all the treatment combinations at the observation period of day 4 as well as subsequent analyses. Only a slight decrease in the levels was observed (Table 3). Contrary to the results observed in leaves, the content of soluble and insoluble sugar content in petals was found to increase initially at day 4. With the further increase in the holding period, however, there was a gradual decrease in their contents. The change was more significantly observed in soluble carbohydrate content as compared to that of insoluble sugar.

According to Halevy and Mayak [4], Amariutei *et al.* [1], with the opening of the flowers, it has been observed that there is an increase in respiration rate in many flowers which can even increase to the maximum. To ensure efficient opening of flower buds, the flower scapes require considerable quantity of food reserves. In leaves and petals, it has been found by Khan *et al*. [5], that the respirable substrates and dry matter stores can be maintained by sugars provided exogenously, which in turn help in increasing the vase life of the cut flowers as compared to control [Table 3].

Table 2 Effect of certain chemicals on scape length (cm), tepal length (cm) and vase life of cut *Polianthes tuberosa*

Treatments	Scape length (cm)	Scape length (cm)	Vase life (days)
Control (distilled water)	50.53	1.65	08.34
Sucrose 2% + AS 200 ppm	52.17	2.67	11.01
Sucrose 2% + AS 300 ppm	52.54	2.34	11.00
Sucrose 2% + CA 1000 ppm	51.54	1.93	10.66
Sucrose 2% + CA 2000 ppm	51.17	1.87	11.22
Sucrose 4% + AS 200 ppm	54.67	3.83	11.89
Sucrose 4% + AS 300 ppm	53.17	3.56	11.66
Sucrose 4% + CA 1000 ppm	52.45	1.93	10.22
Sucrose 4% + CA 2000 ppm	52.33	2.73	10.33
LSD (P = 0.05)	2.53	0.08	0.42

AS: Aluminium Sulphate, CA: Citric Acid, LSD: Least Significant Difference

Table 3 Effects of certain chemicals on soluble (Sol.) and insoluble (Insol.) sugar content (mg /g dry weight) in different parts (leaf L and petal P) of cut *Polianthes tuberosa*

Treatments	Days after keeping scapes in holding solution															
	0				4				8				12			
	Sol.		Insol.		Sol.		Insol.		Sol.		Insol.		Sol.		Insol.	
	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P
Control (d water)	65.43	70.98	15.25	18.82	50.45	74.01	14.03	19.09	26.23	66.28	12.51	14.05	16.13	40.31	10.89	13.28
Suc. 2% + AS 200 ppm	66.33	71.28	15.34	18.99	52.45	75.81	14.99	19.01	32.34	70.35	13.06	18.82	27.44	55.27	12.37	15.58
Suc. 2% + AS 300 ppm	65.55	70.67	14.57	18.42	52.99	75.94	13.70	19.88	33.23	71.35	13.65	18.34	26.53	53.32	13.05	16.28
Suc. 2% +CA1000 ppm	66.57	70.33	14.02	18.05	52.11	73.95	13.21	19.62	32.45	69.38	13.09	18.03	26.65	49.31	12.47	16.23
Suc. 2% +CA2000 ppm	65.18	71.32	15.62	16.44	51.14	73.02	14.04	18.21	31.2	68.31	14.00	17.47	27.4	48.3	13.92	14.35
Suc 4% + AS 200 ppm	65.67	70.40	15.89	18.19	51.24	74.04	14.53	19.31	36.4	71.32	13.86	18.25	29.45	59.27	13.83	22.07
Suc. 4% + AS 300 ppm	65.80	71.37	15.51	19.00	50.98	74.84	15.09	19.45	34.44	71.38	14.64	18.52	25.24	59.25	12.83	14.81
Suc. 4% +CA1000 ppm	66.25	69.36	14.05	17.21	50.22	73.06	14.4	16.29	30.22	69.39	13.215	15.02	26.32	53.28	12.64	12.56
Suc. 4% +CA2000 ppm	65.88	69.53	14.69	18.42	49.22	72.12	14.3	18.82	29.55	68.41	14.01	17.43	21.65	51.26	12.86	15.14
LSD (P=0.05)	3.26	3.47	0.70	0.82	2.46	3.6	0.66	0.81	1.31	3.31	0.63	0.7	0.81	2.02	0.54	0.63

d water: distilled water, Suc.: Sucrose, AS: Aluminium Sulphate, CA: Citric Acid, LSD: Least Significant Difference

Use of different floral preservatives in varied combinations in cut flower of tuberose resulted in significant reduction of protein with the concomitant enhancement of free amino acid levels in leaves of all the samples analyzed at different days of treatment, including the control. However, it was observed that from day 8 to the ultimate day of treatment, different chemicals have significant difference when compared to control: protein and free amino acid content showed much difference on the scapes with a combination of sucrose 4% + aluminium sulphate (AS) 200 ppm. This was maintained during the subsequent analyses at day 8 till day 12 of the holding period (Table 4).

Table 4 Effects of certain chemicals on protein (P) and free amino acid (FAA) content (mg /g dry weight) in different parts (leaf L and petal P) of cut *Polianthes tuberosa*

Treatments	Days after keeping scapes in holding solution															
	0				4				8				12			
	P		FAA		P		FAA		P		FAA		P		FAA	
	L	P	L	P	L	P	L	P	L	P	L	P	L	P	L	P
Control (d water)	24.24	27.92	10.01	12.20	20.88	22.73	10.9	12.95	13.66	18.56	10.37	13.04	9.65	15.86	10.18	13.67
Suc. 2% + AS 200 ppm	28.37	28.56	11.10	11.20	25.73	30.38	11.82	12.02	20.17	31.88	11.98	12.84	15.09	26.46	11.27	12.88
Suc. 2% + AS 300 ppm	25.63	26.16	13.66	11.01	21.50	28.20	14.28	11.29	19.40	29.62	14.67	12.15	17.89	25.00	14.37	12.78
Suc. 2% +CA1000 ppm	28.63	27.04	11.01	12.01	25.96	28.11	11.65	12.48	22.81	29.37	11.99	12.98	16.09	26.79	11.82	12.99
Suc. 2% +CA2000 ppm	24.80	28.22	11.01	11.37	20.57	30.01	11.46	12.02	19.80	30.99	11.78	12.27	13.86	26.17	11.27	12.67
Suc 4% + AS 200 ppm	28.21	27.40	11.28	12.04	26.11	29.20	12.02	13.39	23.32	30.66	12.74	13.95	19.03	29.26	12.37	13.56
Suc. 4% + AS 300 ppm	25.58	28.28	15.49	12.92	21.30	30.03	15.88	13.57	19.23	31.12	15.98	13.15	16.77	28.96	15.19	13.76
Suc. 4% +CA1000 ppm	24.90	28.61	11.83	11.01	21.21	29.14	12.37	12.39	19.07	30.08	12.46	12.21	14.65	27.97	12.18	12.56
Suc. 4% +CA2000 ppm	28.33	26.87	11.10	13.66	25.35	27.13	11.65	13.84	20.99	28.22	12.28	13.98	16.39	26.98	11.28	13.99
LSD (P=0.05)	1.21	1.31	0.5	0.55	1.044	1.14	0.55	0.56	0.68	0.93	0.52	0.61	0.48	0.79	0.51	0.65

d water: distilled water, Suc.: Sucrose, AS: Aluminium Sulphate, CA: Citric Acid, LSD: Least Significant Difference

The protein content in petals of flower scapes of tuberose, however, increased up to day 8 and then with the further increase in holding period of the treatment, it gradually decreased in comparison to the petals of untreated flowers which showed a gradual and a steady decrease in all the observation periods. Further it was observed that with the increase in percentage of sucrose, the petal protein content also simultaneously increased. On the last day of observation, Sucrose 4% + AS 200 ppm showed the highest protein content followed by Sucrose 4% + AS 300 ppm, Sucrose 4% + CA 1000 ppm and Sucrose 4% + AS 2000 ppm as compared to that of control which showed the minimum value (Table 4) [12], [15]. Free amino acids content was found to follow the result as in leaves, with a slight increase in its contents with the advancement of the holding period, although the change seemed insignificant.

Biochemical changes in leaves and petals were found to be associated with the changes in physiological parameters like scape length, tepal diameter and vase life of cut *Polianthes* as a result of various treatments with different preservatives. Results from the table showed that in comparison to control, the chemicals used significantly influenced the said parameters. Sucrose 4% combined with AS 200 ppm recorded the maximum scape length, tepal diameter and vase life against the minimum in control (Table 2).

CONCLUSION

The results showed that different physiological and biochemical attributes were affected by the applications of sucrose and aluminum sulphate and that in turn could help in enhancing the vase life of cut flowers of tube rose. The best result was found with holding solutions comprising of sucrose 4% + aluminium sulphate (AS) 200 ppm concentration which resulted in maximum increase. This could help in better yield and hence in generating more income for the growers.

LITERATURE CITED

1. Amariutei A, Burzo I, Alexe C. 1986. Researches concerning some metabolism aspects of cut gerbera flowers. *Acta Hort*. 181: 331-337.
2. Arnon DI. 1949. Copper enzymes in isolated chloroplast, polyphenol oxidase in *Beta vulgaris. Plant Physio*. 24: 1-15.
3. Clarke GM. 1969. *Statistics and Experimental Design*. Edward Arnold Ltd., London, UK. 1: 91-100.
4. Halevy AH, Mayak S. 1979. Senescence and post-harvest physiology of cut flowers-Part 1. *Hort. Rev*. 1: 204-236.
5. Khan FU, Khan FA, Hayat N, Bhat SA. 2007. Influence of Certain Chemicals on Vase Life of Cut Tulip. *Indian Journal of Plant Physiology* 12(2): 127-132.
6. Kumar RS. 2017. Cultivation and marketing of flowers in India- An empirical study. *International Jr. of Res. in Social Sciences* 7(7): 244-271.
7. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. 1951. Protein measurement with the Folin phenol reagent. *Jr. Biol. Chem*. 193: 265-275.
8. McCready RM, Guggloz J, Silviera V, Ownes HS. 1950. Determination of starch and amylose in vegetables. *Analytical Chemistry* 22: 1156-1158.
9. Moore S, Stein WW. 1948. Photometric ninhydrin method for use in the chromatography of amino acids. *Jr. Biol. Chem*. 176: 367-388.
10. Pal A, Kumar S, Srivastava R. 2003. Effect of floral preservatives on postharvest management in gladiolus spikes. *Jr. Ornam. Hort*. 6: 367-371.
11. Patel A, Mankad A. 2002. Studies on postharvest shelf life of cut *Chrysanthemum indicum* and *Tagetes erecta* flowers. *Indian Jr. of Plant Physio*. 7: 292-294.
12. Paulin A. 1986. Influence of exogenous sugars on the evolution of some senescence parameters of petal. *Acta Horticultarea* 181: 183-194.
13. Qadri ZA, Jhon AQ, Rather ZA. 2001. Effect of chemicals on longevity of cut Dutch iris. *Jr. Ornam. Hort*. 4: 40-43.
14. Shelke A. 2014. Commercial floriculture industry in India: Status and prospects. *Intl. Jr. of Management and Inform. Tech.* 10(2): 1837-1843.
15. Singh VP, Jegadheesan A. 2003. Effect of α-lipoic acid on senescence in gladiolus flowers. *Indian Jr. Plant Physiology* (Special Issue). 616-621.
16. Vijayakumar S, Singh S. 2021. Post harvest handling of cut flowers. *In*: Book: Trends and Prospects in Post Harvest Management of Horticultural Crops. Publisher: Today & Tomorrow's Printers and Publishers, New Delhi. pp 419-446.