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Studies on the Effect of Locally Available Acidifiers on Extension of Vase Life of Cut Tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal

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ABSTRACT: The experiment entitled studies on the effect of locally available acidifiers on extension of vase life of cut tuberose (*Polianthes tuberosa* L.) Cv. Arka prajwal was conducted at floricultural laboratory, college of Horticulture, Rajendra nagar during 2022-2023. The experiment was laid out in completely randomized design. The treatments consist of citric acid (200 ppm, 300 ppm), lime juice (5ml, 10ml) and Ascorbic acid (200 ppm, 300 ppm) and control Distilled water. Maximum water uptake (24.66, 18.53, 12.51 g), transpirational loss of water (21.64, 16.44, 10.59), water balance (8.02, 7.09, 6.91 g), fresh weight change (103.71, 94.28, 89.18%), low optical density (0.040, 0.048, 0.054 nm), minimum days to first floret opening (1.28 days), maximum days to longevity of basal floret (2.64 days), highest vase life (9.89 days), floret opening percentage (80.83) and least microbial count in vase solution(4.32 $\times 10^{-5}$) were all recorded at 200 ppm of citric acid when compared to other treatments. The results revealed that citric acid @ 200 ppm may be used to enhance the vase life of cut tuberose Cv. Arka Prajwal.

Keywords: Tuberose, acidifiers, citric acid, vase life.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) places among the most significant tropical, perennial attractive bulbous flowering plants with chromosome number 2n=30 that are grown for their long-lasting bloom spikes. These plants belong to the Asparagaceae family. *Polianthes* is the name has been derived from two Greek words: Polios, meaning reflecting or white, and Anthos, meaning flower and is native to Mexico. It is popularly known as Rajanigandha or Nishigandha. The fragrance spikes of tuberose occur in clusters and bloom all year round. They vary between variegated cultivars as well as single, semi-double, and double varieties. In high-end perfumes, "Single" types include 0.08 to 0.14 percent concrete, making them more fragrant than "Double" versions. Tuberose concrete and absolute are in high demand in global markets and command a premium price.

The short vase life of cut flowers is one of the major challenges florists face nowadays. Most of studies have focused on implementing chemical preservatives to extend the vase life of cut flowers; however, postharvest care for cut flowers also needs to be taken into account, including preventing against microbiological contamination of vase solutions (Jowkar, 2015). Cut flowers exhibit longer vase life when acidifying agents like citric acid, ascorbic acid are used as preservative compounds which act through adjusting water Ph and preventing the microorganisms in the vase solutions (Vahdati *et al.*, 2012).

It is well documented that one of the main cause for reducing the vase life of cut flowers is due to the filamentous fungus, yeast and bacteria that are present in vase water, on flower stems, or in a container containing vase solution clog the xylem vessels, the stem's water-conducting tubes. Water cannot reach the top portions of the flower stem because of the blockage at the lower end, which results in a loss of turgor pressure and causing wilting of flower. This can be prevented through adding acidifiers into solutions used for preservation.

Commercial preservatives perform effectively but they are costly, hazardous for people's skin, eyes, and respiratory systems, and carcinogenic. In order to get around these limitations, cut flowers can have their vase life extended with readily available preservatives that are safe, reasonably priced, and environmentally friendly (Lambert *et al.*, 2001). Hence, with regard to environment concern and easy availability, natural and commonly available preservatives have to be researched. In context of limited information on there effectiveness for extending the vase life of tuberose.

MATERIAL AND METHODS

The present study was conducted at floricultural laboratory, college of horticulture, Rajendra Nagar, Hyderabad during the year 2022-2023. The research experiment had a completely randomized design with seven treatments and three replications precisely, T_1: Citric acid - 200 ppm, T_2: Citric acid - 300 ppm, T_3: Lime juice – 5ml/l, T_4: Lime juice-10 ml/l, T_5: Ascorbic acid - 200 ppm, T_6: Ascorbic acid - 300 ppm and T_7 control- Distilled water. The flower spikes of cut tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal were procured from farmers field, kandwada village, chevella mandal. The data on Water uptake(g/spike), Transpirational loss of water (g/spike), Water balance (g/spike) Fresh weight change (%) Optical density of vase solution(nm), days to first floret opening (days), longevity of basal floret (days), vase life (days), floret opening percentage (%) and microbial count in vase solution (cfu ml^{-1}) were recorded on every alternate day till the end of vase life of tuberose cut flowers.

RESULTS AND DISCUSSION

Water uptake(g/spike): The highest water uptake in (T_1) was recorded at 200 ppm of citric acid, followed by the lowest water uptake values in (T_2) at 23.42, 16.42, and 9.68 g of citric acid. On the second, fourth, and sixth days of the vase life period, the lowest water uptake values were recorded in T_7-control distilled water, at 14.21, 8.34, and 3.22 g. In the vase life studies, there is a progressive decline in water intake from the second to the sixth day. It could be because the vase solution had a low pH, which increased the water absorption. These findings are consistent with the work of Azizi and Rasoul (2015) on cut flowers and Choi and Roh (1980) in gerberas.

Transpirational loss of water(g/spikes): From the first to the last day of the vase's life, the maximum transpiration loss of water by tuberose spikes progressively reduced. T_1 Citric acid - 200 ppm (21.64, 16.44, 10.59 g) was recorded the maximum transpiration loss of water followed by T_2 Citric acid - 300 ppm (20.56, 14.48, 8.29 g) and the minimum water uptake values recorded in T_7 – control distilled water (13.21, 8.25, 4.22 g) on 2nd, 4th and 6th day of vase life period, respectively. Maximum absorption of water by citric acid 200 ppm might have resulted in maximum transpiration loss of water because vascular tissue had strong conductivity, which resulted in increased water intake. Comparable results were testified by Sravanthi (2019) in gerbera.

Water balance(g/spike): Water balance by tuberose spikes gradually decreased from first day to the last day of vase life. T_1 Citric acid – 200 ppm was noted the maximum water uptake followed by T_2 Citric acid - 300 ppm and the minimum water uptake values recorded in T_7 – control (distilled water) respectively on 2nd, 4th and 6th day of vase life period. This is in conformity with the research findings of Leiv and Hans (2005) in tuberose, where citric acid can be citric acid can prevent vascular bundle blocking, there by improve water balance.

Fresh weight change (%): Results presented in Table 3 shows that, T_1 – citric acid 200 ppm pointedly recorded highest values of fresh weight changes (103.71, 94.28, 89.18%) followed by T_2- Citric acid 300 ppm (100.62, 90.47, 86.96%), while T_7- control (distilled water) recorded the minimum values (90.35, 81.00, 69.13 %) on 2nd, 4th and 6th day of vase life period respectively. Maintaining the maximum fresh weight change values in gladiolus spikes may have been made possible by the good water balance maintained by Citric acid 200 ppm (T_1), which is influenced directly by the difference between the transpiration loss and rates of water uptake of water (Rogers, 1963).

Optical density of vase solution (480nm): The minimum optical density on 2nd ,4th, and 6th day was recorded with T_1 – Citric acid 200 ppm (0.040, 0.048, 0.054nm) followed by T_2- Citric acid 300 ppm(0.045, 0.059, 0.069 nm), while T_7- control (distilled water) recorded the highest values (0.083, 0.098, 0.117nm) on 2nd, 4th and 6th day of vase life period respectively. Reduction in PH of vase solution resulted in reduced microorganisms in vase solution that leads to reduced turbidity. Citric acid 200 ppm (T_1) might have let down the pH of the vase solution and repressed the growth of the microbial population which might have resulted in lowering vase solution's optical density (Van Doorn *et al*., 1989).

Days to first floret opening(days): T_1 – Citric acid 200 ppm recorded the least number of days first floret opening (1.28 days) followed by T_2 – Citric acid 300 ppm (1.57 days) while T_7- control (distilled water) recorded the maximum values (2.92 days) on 2nd, 4th and 6th day of vase life period respectively. Citric acid 200 ppm (T_1) allowed uninterrupted water flow, the initial tuberose spike floret opened faster due to maximal water intake and water balance, which causes turgidity in floral tissue.

Longevity of basal floret (days): Citric acid 200 (T_1) was most effective in prolonging the longevity of basal floret (2.64 days) of cut tuberose while T_7- control (distilled water) recorded the maximum days to longevity of basal floret (1.06 days) during vase life period of cut tuberose.Longevity of basal floret of tuberose might be due to Citric acid which increases vase longevity by lowering pH levels and regulates microbial actions inhibition in vase solutions. These research findings are in accordance with Nowak *et al*. (1990) in cut Rose.

Vase life (days): vase life of tuberose spikes varied from 6.32 days to 9.89 days. Placement of spikes of tuberose in citric acid 200 ppm evidently enhanced the vase life and recorded the maximum vase life *i.e.*, (9.89 days) when compared to control (6.32 days). These results are in accordance with Van Doorn (1997). Cut flowers last longer in vases due to the effects of citric acid, which prevents microbial blockage in the vase solution and improves conductivity in xylem pathways.

Floret opening percentage (%): Significantly highest (80.83%) floret opening percentage recorded in T_1- Citric acid. Whereas significantly lowest (59.26) floret opening percentage recorded in T_7 – control (distilled water). The highest floret opening percentage might be due to high water uptake and low microbial growth.

Microbial count in vase solution (cfu ml^{-1}): Significantly least (4.32×10^{-5}) microbial count in vase

solution recorded in T_1- Citric acid. Whereas significantly highest (9.12×10^{-5}) microbial count in vase solution recorded in T_7 – control (distilled water). Murthy *et al*. (2015) reported that Lowest microbial count is due to antimicrobial activity of citric acid that prevented the microbial growth in vase solution which eventually reduced blockage of xylem vessels by inhibiting formation of air cavities in gerbera.

Table 1: Effect of locally available acidifiers on water uptake (g/spike) during vase life period of tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

Treatments (T)	water uptake (g/spike)			
	2nd day	4th day	6th day	8th day
T1-citric acid 200ppm	24.66a	18.53a	12.51a	8.45
T2 - citric acid 300ppm	23.42b	16.42b	9.68b	7.35
T3 - Lime juice 5ml/l	20.68c	14.58c	7.77c	5.74
T4-Lime juice 10ml/l	20.12d	13.87d	7.15d	5.31
T5-Ascorbic acid 200ppm	19.10e	11.93e	5.67e	4.72
T6-Ascorbic acid 300ppm	17.28f	11.22f	5.34f	3.73
T7- control (DW)	14.21g	8.34g	3.22g	-
Mean	20.01	13.55	7.33	
S.E (m) ±	0.12	0.16	0.11	
C.D at 5%	0.37	0.48	0.35	

Table 2: Effect of locally available acidifiers on Transpirational loss of water (g/spike) during vase life period of tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

Treatments (T)	Transpirational loss of water (g/spike)			
	2nd day	4th day	6th day	8th day
T1-citric acid 200ppm	21.64a	16.44a	10.59a	7.37
T2- citric acid 300 ppm	20.56b	14.48b	8.29b	6.40
T3-- Lime juice 5ml/l	18.56c	13.16c	8.83c	6.24
T4- Lime juice 10ml/l	18.29cd	12.30d	7.56 d	5.62
T5- Ascorbic acid 200ppm	17.58d	11.22e	6.96 e	4.82
T6 - Ascorbic acid 300ppm	15.65e	10.46f	5.74 f	5.20
T7- control (DW)	13.21f	8.25g	4.22 g	-
Mean	17.92	12.33	7.45	
S.E (m) ±±	0.11	0.09	0.11	
C.D at 5%	0.34	0.27	0.34	

Table 3: Effect of locally available acidifiers on water balance (g/spike) during vase life period of tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

Treatments(T)	Water balance (g / spike)			
	2nd day	4th day	6th day	8th day
T1 - Citric acid 200ppm	8.02a (3.02)	7.09 a (2.09)	6.91 a (1.91)	6.07 (1.07)
T2 - Citric acid 300 ppm	7.86b (2.86)	6.94 b (1.94)	6.39 b (1.39)	5.95 (0.95)
T3 - Lime juice 5ml/l	7.12 c (2.12)	6.42 bc (1.42)	3.94 c (-1.06)	4.50 (-0.50)
T4 - Lime juice 10ml/l	6.83 cd (1.83)	6.57 bc (1.57)	4.59 d (-0.41)	4.69 (-0.31)
T5 - Ascorbic acid 200ppm	6.52 cd (1.52)	5.71 c (0.71)	3.71 e (-1.29)	4.90 (-0.10)
T6 - Ascorbic acid 300ppm	6.63 cd (1.63)	5.76 cd (0.76)	4.60 f (-0.40)	3.53 (-1.47)
T7 - Control (DW)	6.00 d (1.00)	5.09 d (0.09)	4.00 g (-1.00)	-
Mean	7.09 (2.09)	6.22 (1.22)	4.88 (-0.12)	
S.E (m) ±	0.17	0.17	0.09	
C.D at 5%	0.51	0.53	0.27	

Parenthesis represents original values. The data were analyzed statistically after uniform addition of a base value 5.0

Table 4: Effect of locally available acidifiers on fresh weight change (%) during vase life period of Tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

Treatments(T)	Fresh weight change (%)			
	2nd day	4th day	6th day	8th day
T1 - Citric acid 200ppm	103.71 a	94.28 a	89.18a	81.16
T2 - Citric acid 300 ppm	100..62 b	90.47 b	86.96b	74.20
T3 - Lime juice 5ml/l	96.56 c	90.01 c	78.53c	71.12
T4 - Lime juice 10ml/l	94.46 d	87.12 d	75.11 cd	69.98
T5- Ascorbic acid 200ppm	92.65 e	85.77 e	73.14 cd	65.26
T6 – Ascorbic acid 300ppm	91.69 f	82.50 f	71.02 cd	62.10
T7 - Control (DW)	90.35 g	81.00 g	69.13 d	-
MEAN	95.72	87.30	77.58	
S.E (m) ±	0.13	0.14	1.41	
C.D at 5%	0.40	0.43	4.23	

Table 5: Effect of locally available acidifiers on optical density of vase solution (480nm) during vase life period of tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

Treatments(T)	Optical density of vase solution(480nm)			
	2nd day	4th day	6th day	8th day
T1 - citric acid 200ppm	0.040a	0.048a	0.054a	0.062
T2- citric acid 300 ppm	0.045b	0.059b	0.069b	0.073
T3- Lime juice 5ml/l	0.058c	0.063c	0.075c	0.084
T4- Lime juice 10ml/l	0.064d	0.072d	0.081d	0.095
T5 - Ascorbic acid 200ppm	0.072e	0.085e	0.093e	0.102
T6 - Ascorbic acid 300ppm	0.079f	0.092f	0.103f	0.119
T7 - control (DW)	0.083g	0.098g	0.117g	-
MEAN	0.064	0.074	0.085	
S.E (m) ±	0.001	0.001	0.002	
C.D at 5%	0.003	0.003	0.005	

Table 6: Effect of locally available acidifiers on days to first floret opening (days), longevity of basal floret (days), vase life (days), Floret opening percentage (%) and Microbial count in vase solution (cfu ml^{-1})during vase life period of tuberose(*Polianthes tuberosa* L.) Cv. Arka Prajwal.

Treatment s(T)	Days to first floret opening (days)	Longevity of basal floret (days)	Vase life (days)	Floret opening percentage (%)	Microbial count in vase solution (cfu ml^{-1})
T1- citric acid 200ppm	1.28a	2.64a	9.89 a	80.83a	4.32×10^{-5a}
T2- citric acid 300 ppm	1.57b	2.23b	9.35b	80.55b	5.67×10^{-5b}
T3- Lime juice 5ml/l	1.93c	1.82c	8.93c	75.68c	6.30×10^{-5c}
T4 - Lime juice 10ml/l	2.12d	1.45d	8.66d	73.93d	6.76×10^{-5d}
T5 - Ascorbic acid 200ppm	2.41e	1.25e	8.22e	71.77e	7.72×10^{-5e}
T6-Ascorbic acid 300ppm	2.78f	1.15f	8.09f	68.25f	8.14×10^{-5f}
T7- control (DW)	2.92g	1.06g	6.32g	59.26g	9.12×10^{-5g}
MEAN	2.14	1.66	8.49	72.72	6.86×10^{-5}
S.E (m) ±	0.02	0.01	0.04	0.28	0.08
C.D at 5%	0.08	0.04	0.13	0.88	0.26

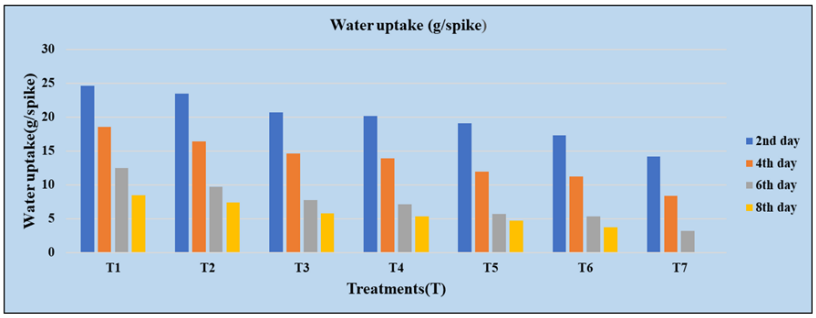


Fig. 1. Effect of locally available acidifiers on water uptake (g/spike) during vase life period of Tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

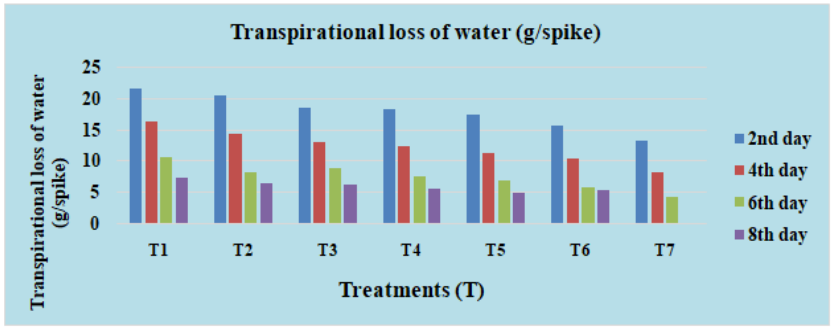


Fig. 2. Effect of locally available acidifiers on transpirational loss of water (g/spike) during vase life period of Tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

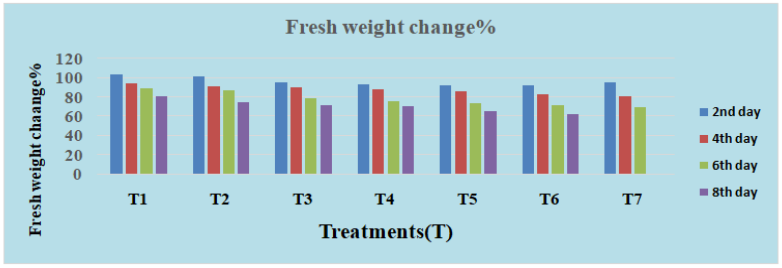


Fig. 3. Effect of locally available acidifiers on fresh weight change (%) during vase life period of Tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

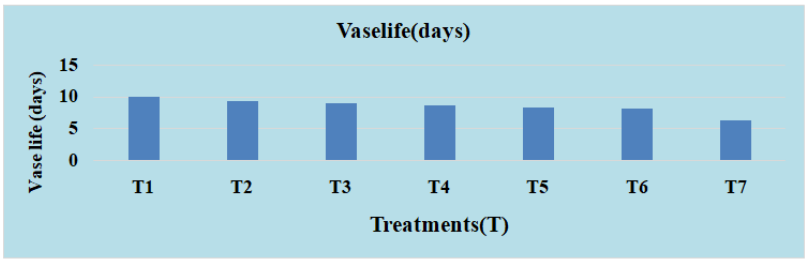
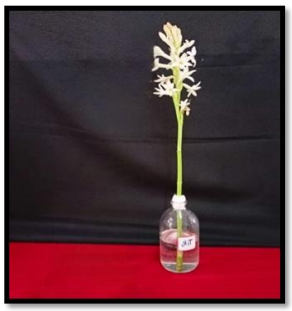


Fig. 4. Effect of locally available acidifiers on vase life (days) during vase life period of Tuberose (*Polianthes tuberosa* L.) Cv. Arka Prajwal.

At bud stage

Fully opened flowers



Best treatment T_1-citric acid 200 ppm

Microbial count in vase solution (cfu ml^{-1}): Significantly least (4.32×10^{-5}) microbial count in vase solution recorded in T_1- Citric acid. Whereas significantly highest (9.12×10^{-5}) microbial count in vase solution recorded in T_7 – control (distilled water). Murthy *et al*. (2015) reported that Lowest microbial count is due to antimicrobial activity of citric acid that prevented the microbial growth in vase solution which eventually reduced blockage of xylem vessels by inhibiting formation of air cavities in gerbera.

CONCLUSIONS

It can be concluded from the present investigation that among all the locally available acidifier treatments studied in the prolonging of vase life of cut tuberose, T_1 citric acid 200 ppm was resulted significantly maximum water uptake (24.66,18.53,12.51g), transpiration loss of water (21.64, 16.44, 10.59 g), water balance (8.02, 7.09, 6.91g), fresh weight change (103.71, 94.28, 89.18 %) low optical density of vase solution (0.040, 0.048, 0.054 nm), minimum days for first floret opening (1.28 days), highest longevity of basal floret (2.64 days), Maximum vase life (9.89 days) and floret opening percentage (80.83 %), minimum microbial count in vase solution (4.32×10^{-5}) from 2nd day to 6th day of vase life studies of cut tuberose when compared to other treatments. Henceforth this treatment can be used as acidifier in vase solution alternative to chemical preservatives.

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