



## Reduction of foliage discoloration and extending vase life of chrysanthemum (*Dendranthema × Grandiflora*) with different floral preservatives

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### ABSTRACT

Different floral preservative treatments consisting of citric acid, aluminium sulphate, sucrose and their combination were used to reduce the foliage discoloration and enhance the vase life of chrysanthemum (*Dendranthema × grandiflora* Ramat.) cv Thai Chen Queen. The experiment was conducted at the Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi during 2012-13. Experiment was laid out in completely randomized block design with five treatment combinations and each treatment was replicated thrice. It was observed that all the preservative treatments significantly reduced foliage discoloration and increased the vase life over control (distilled water). The preservative solution containing 150ppm citric acid+500ppm aluminium sulphate+2% sucrose resulted in maximum vase life (25.41 days), maximum carotenoid content with zero wilting and leaf yellowing and reduced leaf browning.

**Key words:** Chrysanthemum, Cut flowers, Floral preservatives, Foliage discoloration, Thai Chen Queen, Vase life

Chrysanthemum (*Dendranthema × grandiflora* Ramat.) ranks second in world cut flower trade. In India chrysanthemum is gaining popularity as cut flower in the urban floriculture trade. Among various cut flower varieties used Thai Chen Queen is more popular. Fresh flower loses their freshness and quality both during handling and transportation. Due to high perishability, flower and foliage parts are vulnerable to huge postharvest losses. The main postharvest problems in chrysanthemum is premature foliage yellowing, wilting and the failure of the flowers to fully open. The flowers of chrysanthemum have long vase life but its foliage often becomes yellow, brown and wilted during storage and transportation which reduces the postharvest quality of cut flowers. Foliage yellowing is cultivar specific and is caused by poor production, excessive or improper storage and use of preservative solutions at higher than recommended concentrations. Leaves of cut chrysanthemum frequently become yellow, spontaneously, sometimes prior to the onset of flower senescence making the flowers unattractive, reduces their quality and shortens vase life (Doi *et al.* 2003, 2004). To preserve the best quality of flowers after harvest and to make them tolerant to fluctuations in environmental conditions, treatment with floral preservatives is recommended. Although influence of different holding solutions on chrysanthemum has been

reported (Kofranek and Halevy 1972, Marousky 1969, 1971, Talukdar *et al.* 2004) but the information on controlling leaf discoloration is not reported much. Since the problem is varietal specific, an investigation was carried out to study the effect of various floral preservatives on improving the postharvest quality of chrysanthemum cut flower cv Thai Chen Queen.

### MATERIAL AND METHODS

The present study was carried out in the Division of Floriculture and Landscaping IARI, New Delhi during 2012-13. Flowers of cv Thai Chen Queen were harvested from research farms of Division of Floriculture and Landscaping, during morning hours. After harvesting, flowers were immediately placed in the bucket containing water and brought to the laboratory. The stems were cut to a uniform length of 30 cm and were dressed by removing lower 1/3<sup>rd</sup> leaves. The cut stems were then placed in various preservative solutions of 150 ppm citric acid+500 ppm aluminium sulphate (T<sub>1</sub>), 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>), 300ppm citric acid+500ppm aluminium sulphate (T<sub>3</sub>), 300ppm citric acid+500ppm aluminium sulphate+2% sucrose (T<sub>4</sub>) and distilled water/ control (T<sub>5</sub>). The experiment was laid out in completely randomized design, replicated thrice with three stems per replication. Observations on vase life, per cent weight loss, percent increase in flower size, solution uptake, leaf yellowing (%), leaf wilting (%) and leaf browning (%) were recorded and the data were subjected to analysis of

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variance. Pigments (chlorophyll a, chlorophyll b, total chlorophyll and carotenoids) were extracted from the leaves of chrysanthemum by dimethyl sulfoxide (DMSO) method (Hiscox and Isrealstam 1979) and the concentrations of the extracted pigments were calculated based on the absorbance values at 664 nm, 648 nm, and 470 nm respectively, (Lichtenthaler 1987).

## RESULTS AND DISCUSSION

It is evident from the Table 1 that no leaf wilting was observed when cut flowers were kept in preservative solution containing aluminium sulphate, citric acid and sucrose, however maximum leaf wilting (17.59%) was observed under control (distilled water). The presence of citric acid in the preservative solution helps in reducing the transpirational losses and preventing foliage wilting. Zero leaf yellowing was observed when the flowers were held in a preservative solution containing 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>) and 300 ppm citric acid+500ppm aluminium sulphate+2% sucrose (T<sub>4</sub>), while maximum leaf yellowing (46.66%) was observed in distilled water (control). This might be due to the fact that exogenous application of sucrose during postharvest handling may preserve chlorophyll loss and hence, prevented yellowing. It was also reported that carbohydrate deprivation commonly occurs in higher plants during senescence (Peoples and Dalling 1988), in darkness (Elmarani *et al.* 1994) and under postharvest conditions (King *et al.* 1990). Similarly, floating the leaves of chrysanthemum cv Tara in one per cent sucrose solution preserved the chlorophyll and delayed the yellowing from 3- 9 days (Reyes-Arribas *et al.* 2000). Keeping the flowers in a preservative solution containing 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>) showed minimum leaf browning (25.00%) and it was significantly different from all the

treatments (Table 1) while maximum leaf browning (94.64%) was observed in preservative solution containing 300 ppm citric acid+500 ppm aluminium sulphate (T<sub>3</sub>).

The data presented in Table 1 reveals that maximum chlorophyll B (8.59 µg/ml) and total chlorophyll (13.14 µg/ml) content was observed in preservative solution containing 300 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>4</sub>) and it was statistically at par with all treatments except control. However, minimum chlorophyll B (2.10µg/ml) and total chlorophyll content (8.20 µg/ml) was observed in distilled water. Retention of maximum chlorophyll content in the leaves of flowers held in a solution containing aluminium sulphate, citric acid and sucrose is the possible reason of the reduction of foliage yellowing as exogenous supply of aluminium sulphate and sucrose helps in the maintenance of the membrane permeability, increasing chlorophyll content and known to maintain freshness of flowers and leaves. Maximum carotenoid content (3.17 µg/ml) was also observed in 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>) and it was at par with 300 ppm citric acid+500 ppm aluminium sulphate+2 % sucrose (T<sub>4</sub>) and distilled Water (T<sub>5</sub>), however, minimum carotenoid content (0.07 µg/ml) was observed in 150 ppm citric acid+500 ppm aluminium sulphate (T<sub>1</sub>) which was at par with 300 ppm citric acid+500 ppm aluminium sulphate (T<sub>3</sub>), which indicates that the presence of sucrose is the preservative solution maintains the carotenoid levels. Maximum chlorophyll A content (8.87µg/ml) was observed in flowers held in a preservative solution containing 300 ppm citric acid+500 ppm aluminium sulphate (T<sub>3</sub>) and was statistically at par with 150 ppm citric acid+500 ppm aluminium sulphate (T<sub>1</sub>). However, minimum chlorophyll A content (2.33 µg/ml) was observed when flowers were kept in preservative solution containing 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>).

Table 1 Effect of different floral preservatives on leaf discolouration and biochemical constituents of chrysanthemum cv Thai Chen Queen

Treatment	Leaf wilting (%)	Leaf yellowing (%)	Leaf browning (%)	Chlorophyll A (µg/ml)	Chlorophyll B (µg/ml)	Total Chlorophyll (µg/ml)	Carotenoids (µg/ml)
150 ppm citric acid + 500 ppm Aluminium Sulphate (T <sub>1</sub> )	0.00 (1.00)	5.00 (2.00)	93.33 (81.14)	7.56	5.33	12.89	0.07
150 ppm citric acid + 500 ppm Aluminium Sulphate + 2% Sucrose (T <sub>2</sub> )	0.00 (1.00)	0.00 (1.00)	25.00 (24.99)	2.33	8.52	10.85	3.17
300 ppm citric acid + 500 ppm Aluminium Sulphate(T <sub>3</sub> )	0.00 (1.00)	5.33 (2.04)	94.64 (82.11)	8.87	3.15	11.92	0.45
300 ppm citric acid + 500 ppm Aluminium Sulphate + 2% Sucrose (T <sub>4</sub> )	0.00 (1.00)	0.00 (1.00)	73.21 (63.77)	4.55	8.59	13.14	2.33
Distilled water (T <sub>5</sub> )	17.59 (4.14)	46.66 (6.89)	21.84 (26.77)	6.10	2.10	8.20	1.80
CD (P = 0.05)	1.19	2.09	32.87	2.06	3.34	2.21	2.04

Figures in parentheses are transformed values

Table 2 Effect of floral preservatives on post harvest parameters of chrysanthemum cv Thai Chen Queen

Treatment	Vase life (Days)	Weight loss (%)	Increase in flower size (%)	Solution uptake (ml)
150 ppm citric acid + 500 ppm aluminium sulphate (T <sub>1</sub> )	22.41	24.33 (29.46)	22.65 (28.37)	41.20
150 ppm citric acid + 500 ppm aluminium sulphate + 2% Sucrose (T <sub>2</sub> )	25.41	1.30 (6.91)	24.96 (29.92)	73.83
300 ppm citric acid + 500 ppm aluminium sulphate(T <sub>3</sub> )	21.50	15.65 (23.10)	23.55 (28.96)	35.00
300 ppm citric acid + 500 ppm aluminium sulphate + 2 % sucrose (T <sub>4</sub> )	24.66	1.61 (7.76)	26.50 (30.89)	54.33
Distilled water (T <sub>5</sub> )	18.87	2.25 (11.15)	14.58 (22.28)	51.21
CD (P = 0.05)	4.02	6.24	5.48	14.68

Figures in parentheses are transformed values

Data presented in Table 2 shows that among various preservative used maximum vase life (25.41 days) was observed with 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>) which was statistically at par with all the treatments except control where minimum vase life (18.87 days) was observed. The increase in vase life might be due to better water relations, delay in protein degradation, maintenance of membrane integrity and thereby delaying senescence. Holding the flowers in citric acid+sucrose enhance cut flower longevity by increasing water uptake, improved water balance, maintaining normal levels of transpirational loss of water (Vijayalaxmi *et al.* 2011). The presence of aluminium sulphate in floral preservative helps in retarding the bacterial growth, which helps in enhancing the vase life of chrysanthemum cut flowers (Rajagopalan and Abdul Khader 1993). Similar were the findings of Yuniarti *et al.* (2007) who reported that use of holding solution containing citric acid increased the vase life of chrysanthemum cv Cat Eye's by 9.00 days compared to control. Our results further corroborates with the studies of Jain *et al.* (2009) who reported the maximum vase life of chrysanthemum cv Shyama with 150 ppm citric acid+1000 ppm Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+2% sucrose. Similarly, Wiraatmaja *et al.* (2007) also reported that longer vase life (6.02 days over control) of chrysanthemum cut flower with 2.70% of sucrose+400 ppm of citric acid.

The minimum weight loss (1.30%) was observed when flowers were held in a preservative solution containing 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>) and was statistically at par with T<sub>4</sub> and T<sub>5</sub>, however maximum weight loss (24.33%) was observed in treatment T<sub>1</sub> (Table 2). The possible reason for minimum weight loss might be low transpirational losses. The presence of aluminium sulphate in vase solution resulted in partial closure of stomata and hence, reduced transpiration loss of water (Kumar *et al.* 2010). Similarly, Jain *et al.* (2009) observed that holding the cut flowers of chrysanthemum cv Shyamal in 300 ppm citric acid+500 ppm Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+2% sucrose solution resulted in minimum weight loss.

Data presented in Table 2 shows that cut flowers of cv Thai Chen Queen when held in solution containing 300 ppm citric acid+500 ppm aluminium sulphate+2% sucrose

(T<sub>4</sub>) resulted in maximum flower size (26.50%) and it was at par with all the treatments except control (14.58%). Holding the flowers in a preservative solution containing 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>) resulted in maximum solution uptake (73.83 ml) and the minimum solution uptake (35.00 ml) was observed in treatment T<sub>3</sub> and was statistically at par with T<sub>1</sub>. Similarly, Jain *et al.* (2009) found that keeping the cut flowers of cv Kanchil in 150 ppm citric acid+1000 ppm aluminium sulphate+2% sucrose solution showed maximum flower diameter and solution uptake. The flowers fed with sucrose solution have increased opening as the addition of sucrose allows the flower to develop fully which is not possible with water. Considering different aspects of biocide application i.e. microbial control, solution uptake, relative fresh weight, flower longevity, and appearance, etc. aluminium sulfate was an efficient treatment (Jowkar *et al.* 2012).

Comparison of the treatments revealed the fact that the cut flowers of cv Thai Chen Queen when held in preservatives containing 150 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>2</sub>) showed minimum leaf wilting, minimum leaf yellowing and minimum leaf browning, maximum carotenoids, maximum vase life, volume of solution uptake and minimum weight loss. However, retention of maximum chlorophyll B and total chlorophyll content was observed in preservative solution containing 300 ppm citric acid+500 ppm aluminium sulphate+2% sucrose (T<sub>4</sub>).

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