Enhancing the Vase Life of Cut Rose cv. Top Secret using Sucrose and Other Chemical Preservatives

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A B S T R A C T

An experiment was conducted to find out the best preservative solution for enhancing the vase life of cut rose cv. Top Secret. Nine different combinations of sucrose, Al₂SO₄, AgNO₃ and 8-HQC including control(distilled water) were taken to study the vase life and those were T1: Control,T2: 2%Sucrose +200ppm Al₂SO₄,T3: 4%Sucrose + 200ppm Al₂SO₄,T4: 2%Sucrose + 50ppm AgNO₃, T5: 4%Sucrose + 50ppm AgNO₃,T6: 2%Sucrose + 200ppm Al₂SO₄ + 300ppm 8-HQC,T7: 4% Sucrose + 200ppm Al₂SO₄ + 300ppm 8-HQC,T8: 2% Sucrose + 50ppm AgNO₃ + 300ppm 8 HQC,T9: 4%Sucrose + 50ppm AgNO₃ + 300ppm 8-HQC. The study revealed that the treatment T6 increased the water uptake, fresh weight in percentage basis and diameter of the flower and also taken maximum number of days (9days) for fully opening of flower. Treatment T2 is found to be the best combination for unfolding of 1st petal and to attain marketable stage. Similarly, treatment T3 is found to be the best treatment combination on basis of visual scoring and treatment T7 showed the maximum vase life (12days) of rose cv. Top Secret.

Keywords
Rose, Vase life, Sucrose, Chemical Preservative

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Introduction

Top secret is amongst one of the very popular varieties of rose grown worldwide due to its magnificent beauty and very attractive deep red colour which is in highest demand in Odisha flower market. Cut flowers are highly perishable commodities and vulnerable to large post-harvest losses. There is a prodigious post-harvest losses in value of cut flowers which is seen all along the marketing channels and it can be up to 40-50 % (Bhattacharjee, 1999). The most significant elements of quality are shape, size, colour and freshness of the flower from the market point of view.

So the conclusive aim of the consumer is to maintain these components as much as possible and to maintain the flowers in fresh
condition. Hence prolonging the vase life of cut flowers began as an amateur interest in the recent years and it is being practiced on a commercial scale based on scientific principles.

Keeping quality of flowers is affected by pre harvest and post-harvest factors. Pre-harvest factors are genetic or inherent makeup and growing conditions of flowers. In post-harvest factors water relations, respiration, relative humidity, growth regulators, preservative solutions, pre-cooling and storage, packaging and transporting is there. These factors can be taken into consideration to improve the keeping quality of the flowers. The flowers should be cooled as soon as possible after harvest to minimize deterioration. Cooling does this by reducing respiration rate, water loss, ethylene production, microbial development etc. But farmers of Odisha are lacking of these modernized technologies which leads to poor shelf life of flowers resulting in heavy loss to them. Hence this experiment was undertaken to find out the possible ways to enhance the vase life of roses without pre-cooling.

**Materials and Methods**

The experiment was conducted at PG research laboratory, Department of Horticulture, Institute of Agricultural sciences (IAS), Siksha ‘O’ Anushandhan Deemed to Be University, Bhubaneswar during February to March 2019 to find out the best combination of sucrose and chemical preservatives for enhancing the vase life of cut rose cv. Top Secret.

During the experiment the following treatments were tested for enhancing the vase life of cut rose cv. 'Top Secret'.

T1 = Control (Distilled Water)
T2 = Sucrose 2 per cent+ Al₂SO₄ (200ppm)
T3 = Sucrose 4 per cent+ Al₂SO₄ (200ppm)
T4 = Sucrose 2 per cent+ AgNO₃ (50ppm)
T5 = Sucrose 4 per cent+ AgNO₃ (50ppm)
T6 = Sucrose 2 per cent+ AgNO₃ (50ppm)+8HQC (300ppm)
T7 = Sucrose 4 per cent+ Al₂SO₄ (200ppm)+8HQC (300ppm)
T8 = Sucrose 2 per cent+ AgNO₃ (50ppm)+8HQC (300ppm)
T9 = Sucrose 4 per cent+ AgNO₃ (50ppm)+8HQC (300ppm)

The above treatments were analysed using Completely Randomized Design with three replications and 54 roses were taken for the above treatments with two numbers of stem per treatment.

Before execution of this experiment, 54 number of 500ml capacity glass containers were properly sterilized to hold the solution. The flowers were harvested at its tight bud stage and immediately after harvesting these cut roses were kept in water. The flowers were taken for the experiment without pre-cooling in a cooling chamber, packed in corrugated fibre board. Then the stalks were kept about 45cm length by giving a slanting cut with a properly sterilized blade for the better absorption and the leaf numbers were maintained with 3 stands of leaves.

Observations on percent uptake by cut flower, increase in fresh weight of flower, diameter of the flower, date of unfolding of first petal, days taken to attain marketable stage, days taken for fully opened flower, quality of flowers by scoring and Vase life were taken in 24 hrs interval every day. After 4days the stems were cut upto 2cm to remove blockage and better absorption of the solution. The data for that day was taken before and after the stem cutting. Visual scoring was done on 4th day of the experiment where the cut roses were scored on the basis of their colour and freshness. For this purpose 10
persons were asked to observe and score the flowers out of 10 for their visual characters and the data was taken.

Statistical analysis

The data concerning vase life recorded for various characters were subjected to statistical analysis based on their sample means, (Gomez and Gomez, 1984). The analysis of variance table was prepared. The effects were tested by ‘F’ test at 5 per cent level of significance. The critical different at 5 per cent level was calculate for comparing the treatment means.

Results and Discussion

Percentage increase in water uptake

Best water uptake on the basis of both weight and volume was observed under T6 may be attributed to the combined action of aluminium sulphate and 8-HQC in the preservative solution. Aluminium sulphate reduces pH of the solution, effectively inhibits bacterial growth (Liao et al., 2001) and prevents microbial clogging at the microbial cut end of the stem thus improving water uptake. Results of present study are also in conformity with the findings of (Hassanpour et al., 2004) who reported that Al₂SO₄ acidifies vase solution, diminishes bacterial proliferation and enhances water uptake. Addition of 8-HQC improves the water uptake further which also acidifies water and checks microbial growth (Singh et al., 2001). The minimum water uptake was observed under T1 (control) as it didn’t contain any sugar or preservatives so it was least effective among all the treatments (Table 1).

Percentage increase in fresh weight

The maximum increase in fresh weight of flower was seen under T6 due to the combined effect of sucrose, aluminium sulphate and 8-HQC in the preservative solution. Aluminium sulphate increases the fresh weight of flower confirmed by Maryam et al., 2012. It acts as an antimicrobial agent in vase solution (Hassanpour et al., 2004) by inhibiting the bacterial blockage in vessels of cut flowers. 8-HQC and Al₂SO₄ causes partial closure of stomata reducing water loss through transpiration and 8-HQC further effective in enhancing the fresh weight of cut roses confirmed by Patel et al., 2007. As T1 (control) has only distilled water without sucrose and any preservatives, it showed least fresh weight in cut roses (Table 2).

Increase in diameter

Maximum increase in flower diameter (6.95cm) was observed under T6 due to the combined effect of sugar in opening of petals and 8-HQC acts as a biocide. Sucrose inhibits senescence process and maintain water balance reported by Bhattacharjee (1995). These results are also confirmed with the results obtained by Goszczynska et al., (1989) in cut rose ‘Sonia”; Bhattacharjee (1993) in cut rose ‘Priyadarshini”; Bhattacharjee (1994) in cut rose ‘Super Star”; Singh and Tiwari (2002) in rose (Table 3).

Sucrose along with 8-HQC increase the diameter of cut flower which may be due to the chelating property of the 8-HQC which helps in chelating metal ions of enzyme creating vascular blockage and reduce physiological stem blockage in sterilized tissue (Halevy and Mayak,1981).

Similar results are also obtained by Dumbre et al., (2002), Satish et al., (2012). As T1 (control) has only distilled water without sucrose and any preservatives, it showed least diameter (4.21cm) in cut roses.
### Table 1: Effect of sucrose and chemical preservatives on percentage water uptake by cut rose stem cv. Top Secret on volume basis

| Treatments | Percentage of water uptake (on volume basis) |
|------------|---------------------------------------------|
|            | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
| T<sub>1</sub> Distilled Water (Control) | 1.72  | 2.06  | 2.31  | 2.98  | 3.88  | -     |
| T<sub>2</sub> Sucrose (2%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) | 5.21  | 7.58  | 8.98  | 10.2  | 12.64 | 12.66 |
| T<sub>3</sub> Sucrose (4%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) | 3.98  | 5.54  | 6.76  | 7.95  | 9.21  | 9.23  |
| T<sub>4</sub> Sucrose (2%) + AgNO<sub>3</sub> (50ppm) | 2.32  | 3.5   | 4.58  | 5.68  | 6.91  | -     |
| T<sub>5</sub> Sucrose (4%) + AgNO<sub>3</sub> (50ppm) | 2.30  | 3.46  | 4.5   | 5.17  | 6.39  | 6.40  |
| T<sub>6</sub> Sucrose (2%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) + 8-HQC (300ppm) | 5.78  | 8.22  | 10.57 | 11.79 | 14.9  | 14.10 |
| T<sub>7</sub> Sucrose (4%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) + 8-HQC (300ppm) | 4.48  | 6.84  | 8.1   | 9.31  | 10.68 | -     |
| T<sub>8</sub> Sucrose (2%) + AgNO<sub>3</sub> (50ppm) + 8-HQC (300ppm) | 3.96  | 5.14  | 6.33  | 7.49  | 8.74  | -     |
| T<sub>9</sub> Sucrose (4%) + AgNO<sub>3</sub> (50ppm) + 8-HQC (300ppm) | 3.45  | 4.64  | 5.77  | 6.91  | 8.14  | 8.15  |
| SEM (±) | 0.004 | 0.012 | 0.003 | 0.004 | 0.004 | 0.004 |
| CD (5%) | 0.012 | 0.014 | 0.058 | 0.058 | 0.013 | -     |

### Table 2: Effect of sucrose and chemical preservatives on percentage increase in fresh weight of cut rose stem cv. Top Secret

| Treatments | Percentage increase in fresh weight |
|------------|-------------------------------------|
|            | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 |
| T<sub>1</sub> Distilled Water (Control) | 12.16 | 15.55 | 17.19 | 18.35 | -     |
| T<sub>2</sub> Sucrose (2%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) | 19.50 | 24.38 | 29.04 | 32.67 | 35.05 |
| T<sub>3</sub> Sucrose (4%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) | 17.01 | 21.67 | 25.37 | 28.67 | 30.46 |
| T<sub>4</sub> Sucrose (2%) + AgNO<sub>3</sub> (50ppm) | 14.03 | 17.8  | 20.87 | 22.61 | -     |
| T<sub>5</sub> Sucrose (4%) + AgNO<sub>3</sub> (50ppm) | 12.89 | 16.67 | 18.63 | 20.12 | -     |
| T<sub>6</sub> Sucrose (2%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) + 8-HQC (300ppm) | 20.45 | 26.32 | 31.88 | 35.64 | 38.05 |
| T<sub>7</sub> Sucrose (4%) + Al<sub>2</sub>SO<sub>4</sub> (200ppm) + 8-HQC (300ppm) | 18.80 | 23.67 | 28.1  | 31.53 | 33.61 |
| T<sub>8</sub> Sucrose (2%) + AgNO<sub>3</sub> (50ppm) + 8-HQC (300ppm) | 15.26 | 19.33 | 22.98 | 25.21 | 26.86 |
| T<sub>9</sub> Sucrose (4%) + AgNO<sub>3</sub> (50ppm) + 8-HQC (300ppm) | 14.51 | 18.35 | 21.99 | 24.12 | -     |
| SEM (±) | 0.004 | 0.012 | 0.003 | 0.004 | 0.003 |
| CD (5%) | 0.014 | 0.037 | 0.011 | 0.012 | 0.009 |
Table 3 Effect of sucrose and chemical preservatives on increase in diameter of cut rose stem cv. Top Secret

| Treatments | Increase in diameter (cm) |
|------------|---------------------------|
|            | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 |
| T_1 Distilled Water (Control) | 2.20  | 2.68  | 2.95  | 3.30  | 3.88  | 4.21  | 4.21  | -    |
| T_2 Sucrose (2%) + Al_2SO_4 (200ppm) | 2.64  | 3.02  | 3.98  | 4.62  | 5.31  | 6.02  | 6.65  | -    |
| T_3 Sucrose (4%) + Al_2SO_4 (200ppm) | 2.89  | 3.18  | 4.10  | 4.96  | 5.77  | 6.10  | 6.68  | -    |
| T_4 Sucrose (2%) + AgNO_3 (50ppm) | 3.23  | 3.85  | 4.62  | 5.45  | 6.18  | 6.71  | 6.71  | -    |
| T_5 Sucrose (4%) + AgNO_3 (50ppm) | 3.40  | 3.89  | 4.68  | 5.81  | 6.32  | 6.77  | 6.77  | -    |
| T_6 Sucrose (2%) + Al_2SO_4 (200ppm) + 8-HQC (300ppm) | 2.60  | 3.24  | 3.96  | 4.40  | 5.81  | 6.02  | 6.40  | -    |
| T_7 Sucrose (4%) + Al_2SO_4 (200ppm) + 8-HQC (300ppm) | 2.81  | 3.30  | 3.88  | 4.62  | 5.89  | 6.60  | 6.89  | -    |
| T_8 Sucrose (2%) + AgNO_3 (50ppm) + 8-HQC (300ppm) | 3.02  | 3.85  | 4.40  | 5.31  | 5.96  | 6.75  | 6.75  | -    |
| T_9 Sucrose (4%) + AgNO_3 (50ppm) + 8-HQC (300ppm) | 3.19  | 3.88  | 4.56  | 5.23  | 5.53  | 5.81  | 6.68  | -    |
| SEM (±) | 0.027 | 0.005 | 0.005 | 0.005 | 0.005 | 0.027 | 0.005 | -    |
| CD (5%) | 0.082 | 0.017 | 0.017 | 0.017 | 0.017 | 0.082 | 0.017 | 0.016 |

**Days taken to attain marketable stage**

The maximum days (3.34 days) was taken under T2 while the minimum days were taken (1.67 days) under T8. However, the days taken to attain marketable stage of flowers under various treatments didn’t show any significant variation.

**Days for fully opened flower**

The best treatment was observed under T6 having maximum days (9 days) for fully opened flower followed by T7 having 8.84 days which had same components except sucrose. As sucrose promotes unfolding of petals (Nirikoshi et al., 2016), T7 took less days for fully opened flower. The minimum days (7.17 days) under T4 due to the absence of aluminium sulphate which prolong the unfolding of the petals reported by Maryam et al., 2012 and Yayeh et al., (2017) (Table 4).

**Vase life**

Maximum vase life (12 days) was observed under T7 followed by T6 (11 days) having all the components same except sucrose. Sugar supply increases the longevity, since it acts as a source for nutrition of tissue approaching carbohydrate starvation. Therefore, Sucrose enhances the vase life of cut rose reported by Ichimura et al., 2003, Chaudhary et al., (2018). During the senescence process sucrose helps in improving the vase life of flowers indicated by Lama et al., (2013).
Table.4 Effect of sucrose and chemical preservatives on unfolding of 1st petal, marketable stage, opening of flower, vase life and visual scoring of cut rose stem cv. Top Secret

| Treatments                          | Day of unfolding of 1st petal | Days taken to attain marketable stage | Days taken for fully opened flower | Vase life | Colour | Freshness |
|-------------------------------------|-------------------------------|--------------------------------------|-----------------------------------|-----------|--------|-----------|
| T1 Distilled Water (Control)        | 1                             | 2.16                                 | 7.34                              | 8         | 6      | 6.33      |
| T2 Sucrose (2%) + Al₂SO₄ (200ppm)   | 2                             | 3.34                                 | 8.67                              | 10        | 7      | 7.66      |
| T3 Sucrose (4%) + Al₂SO₄ (200ppm)   | 2                             | 3                                    | 8.50                              | 10        | 8      | 8         |
| T4 Sucrose (2%) + AgNO₃ (50ppm)     | 1                             | 2                                    | 7.17                              | 9         | 7      | 7         |
| T5 Sucrose (4%) + AgNO₃ (50ppm)     | 1                             | 2                                    | 7.34                              | 9         | 6      | 5.66      |
| T6 Sucrose (2%) + Al₂SO₄ (200ppm) + 8-HQC (300ppm) | 2                             | 2.67                                 | 9                                  | 11        | 6      | 6         |
| T7 Sucrose (4%) + Al₂SO₄ (200ppm) + 8-HQC (300ppm) | 1.34                          | 2.34                                 | 8.84                              | 12        | 6      | 6         |
| T8 Sucrose (2%) + AgNO₃ (50ppm) + 8-HQC (300ppm) | 1                             | 1.67                                 | 7.84                              | 10        | 5      | 5.33      |
| T9 Sucrose (4%) + AgNO₃ (50ppm) + 8-HQC (300ppm) | 1                             | 2.67                                 | 8                                  | 10        | 5      | 5.66      |
| SEM (±)                             | 0.11                          | 0.527                                | 0.372                             | 0.430     | 0.27   | 0.31      |
| CD (5%)                             | 0.330                         | 1.565                                | 1.107                             | 1.278     | 0.80   | 0.93      |
Hajizadeh et al., (2012) reported that aluminium sulphate is a common biocide for increasing the vase life of cut roses further confirmed by Maryam et al., (2012). Aluminium sulphate and sucrose prolonged the vase life of rose which is confirmed in various experiments by Kim et al., (2001), Bala et al., (2008), Farahat et al., (2014), Bajwa et al., (2016). 8-HQC also enhances the vase life of rose reported by Chand et al., (2012). The minimum vase life (8 days) was seen under T1 (control) because it didn’t contain sucrose or any preservatives.

**Visual scoring**

**Colour**

The maximum score (8) was seen under T3 due to the combined effect of sucrose and aluminium sulphate. Al₂SO₄ reduces pH of the solution, effectively inhibits bacterial growth (Liao et al., 2001) and prevents microbial clogging at the microbial cut end of the stem thus improving water uptake.

Results of present study is also confirmative with the findings of (Hassanpour et al., 2004) who reported that Al₂SO₄ acidifies vase solution, diminishes bacterial proliferation and enhances water uptake. Sucrose at whereas presence of 8-HQC causes petal discoloration and petal drop in the flower and silver nitrate caused stem rotting and poor colour and wilting in some the flowers. So the minimum score (5) was seen under T8 and T9.

**Freshness**

The maximum score (8) was seen under T3 due to the combined effect of sucrose and Al₂SO₄. Whereas the minimum score (5.33) was seen under T8 due to the combined effect of silver nitrate and 8-HQC which showed petal discoloration, petal drop, stem rotting and wilting of flowers.

**Days of unfolding of 1st petal**

Maximum days(2days) taken for unfolding of first petal under T2,T3 and T6 due to the combined effect of sucrose and aluminium sulphate. Sucrose at various concentrations and aluminium sulphate prolong the time period required for opening of flower suggested by Bajwa et al., (2016). Aluminium sulphate alone had positive effect and it is the best in prolonging the bud opening confirmed by Maryam et al., (2012) and Yayeh et al., (2017). As Al₂SO₄ and 8-HQC helps in further water uptake in cut roses that may enhance the unfolding of petal. The minimum day (1day) taken for opening of 1st petal was under T1 (distilled water), T4,T5,T8 and T9 due to the effect of sugar which promotes petal unfolding and as there was absence of aluminium sulphate the opening took place earlier.

From the above investigation, it is concluded that the preservative solution T6 comprising of Sucrose 2% + Al₂SO₄ 200ppm + 8-HQC 300ppm has maximum water uptake, fresh weight, flower diameter and takes maximum days to fully opening of flower.

Similarly, treatment T3(Sucrose 4% + Al₂SO₄ 200ppm) scores maximum in visual scoring on the basis of colour and freshness whereas preservative solution T7 comprising of Sucrose 4% + Al₂SO₄ 200ppm + 8-HQC 300ppm has maximum vase life.

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