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THE EFFECT OF CULTIVAR AND DIFFERENT COMBINATIONS OF CITRIC ACID AND SUCROSE ON THE VASE LIFE OF ROSE (ROSA HYBRIDA) FLOWERS

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Abstract. This research was conducted in the Department of Horticulture and Landscape Gardening, Tikrit University, to determine the differences in vase life between two rose cultivars, Ingrid Bergman and Golden Medallion, along with some post-harvest characteristics of rose plants, and to identify the best combination treatment of sucrose and citric acid for extending vase life. Sucrose was used at three concentrations (0, 3, 5)% and citric acid at four concentrations (0, 100, 200, 300) mg/L on both cultivars. The experiment was carried out using a Completely Randomized Design (CRD) and included 8 combination treatments with 10 flowers per treatment. The results were then analyzed separately, comparing the cultivars with each other and the combination treatments with each other. The results indicated that the red cultivar was superior to the yellow cultivar in all the traits studied. The combination treatments showed that adding sucrose and citric acid at any of the concentrations extended vase life and increased the amount of water uptake.

Keywords: Vase life, Rose, citric acid, sucrose.

Introduction

The rose is among the most famous cut flowers and ornamental plants. The genus Rosa belongs to the family Rosaceae, which is cultivated around the world except in tropical regions, and is grown in Asia, the Middle East, and North America [1]. The rose is a globally popular, fragrant cut flower that comes in many forms and colors and is used to make bouquets for decorative arrangements. Vase life is the most important indicator for selecting flowers suitable for cutting, since consumers of cut flowers demand high-quality flowers at the time of purchase that also have a long vase life. Much research has been conducted over several decades aimed at prolonging the life of cut flowers, because it is not worthwhile to produce flowers only to let them quickly lose their quality and vitality after cutting. Hence the need arose to use floral preservative solutions that contain carbohydrates, antimicrobial agents, ethylene inhibitors, growth regulators, and some mineral compounds. Studies have shown that each type of flower has its own specific preservatives [2].

Sugars play an important role in maintaining the quality of cut flowers because the amount of sugar present in the flowers is limited. Sucrose is the most widely used sugar in floral preservatives; it maintains dry matter and respiratory substrates in the petals and is one of the main substances used in cell growth and expansion [3]. The life of cut flowers can be extended by using preservative solutions, as adding sugar to the vase solution counteracts harmful effects such as leaf drop and petal discoloration (Susan, 2003). [4] examined the effect of treatment with sucrose, HQS-8, and silver thiosulfate (STS) as pulsing solutions on the vase life of Rosa hybrida flowers. Sucrose was used at concentrations of 0, 20, 40, 60, 80, 100, or 120 g/L in combination with HQS-8 at 200 mg/L for 10 hours and silver thiosulfate at 0.2 µmol for 2 hours. The results showed that sucrose at concentrations higher than 80 g/L increased vase life by about 6–7 days, while lower concentrations reduced vase life to 4 days. [5] studied the effect of some chemicals and sucrose on the vase life of three rose (Rosa hybrida L.) cultivars: Bouing, Creamly, and Sena. The following solutions were used: a control treatment (distilled water); sucrose at 10 g/L; sucrose at 10 g/L + citric acid at 100 mg/L; sucrose at 10 g/L + aluminum sulphate at 100 mg/L; and sucrose at 10 g/L + silver thiosulphate at 0.5 µmol as a two-hour pulse. The results showed that sucrose at 10 g/L significantly increased vase life in the Sena and Creamly cultivars, respectively, compared with the distilled water treatment, while the control treatment (distilled water) recorded the greatest amount of water uptake in all the cultivars studied.

Citric acid is an organic acid found in nature that is used to adjust water acidity and thereby control microorganisms, and it is commercially recommended for a number of cut flowers [6]. Darandeh and Hadavi [7] discussed the effects of organic-acid treatments on postharvest quality in cut flowers. [8] found that adding citric acid to the preservative solution at concentrations of 300, 600, and 900 mg/L increased vase life, although the increase was not significant, whereas citric acid led to a significant increase in the chlorophyll content of the treated leaves. In an experiment by [9] using combinations of citric acid at concentrations of (0, 15, 30, 45, 60, 75, 90, 105, 120) and sucrose at concentrations of (0, 2, 4, 6, 8, 10, 12, 14, 18)%, it was found that the treatment with 2% sucrose + 15 ppm citric acid recorded the longest vase life, and that this mixture has the potential to be used as a preservative solution for commercial flowers to delay flower senescence, enhance post-harvest quality, and extend the vase life of cut roses. [2] found that adding sucrose at 3% and citric acid at 100 mg/L to the preservative solution of chrysanthemum flowers extended vase life and increased the total sugar content of the flowers at the end of the experiment.

This study was conducted to investigate the effect of preservative solutions containing sucrose and citric acid on the vase life and some characteristics of cut flowers of two rose cultivars.

Methods

The experiment was conducted in the laboratory of the Department of Horticulture and Landscape Gardening, Tikrit University. The cut flowers were placed in a bucket containing water to a depth of 10 cm and transferred to the laboratory. The length of the flower stalk

was standardized to 28 cm for all treatments, the lower leaves were removed while leaving two pairs of leaves at the top of the stalk, and the diameter of the flower stalk was measured for all flowers, averaging about 5.5 mm. The cut flowers were then placed in preservative solutions: they were placed in plastic bottles containing 300 mL of distilled water or the preservative solution, and the mouths of the plastic bottles were covered with cellophane. In total, the experiment included the following treatments:

Treatments:

1. Red cultivar + distilled water
2. Red cultivar + 3% sucrose + 100 mg/L citric acid
3. Red cultivar + 5% sucrose + 200 mg/L citric acid
4. Red cultivar + 5% sucrose + 300 mg/L citric acid
5. Yellow cultivar + distilled water
6. Yellow cultivar + 3% sucrose + 100 mg/L citric acid
7. Yellow cultivar + 5% sucrose + 200 mg/L citric acid
8. Yellow cultivar + 5% sucrose + 300 mg/L citric acid



A B

Figure 1. Experimental arrangement of cut rose flowers in preservative solutions (a) and during the postharvest evaluation (b).

The experiment was carried out using a Completely Randomized Design (CRD) with 8 treatments and 10 flowers per treatment [10]. The following traits were measured: vase life (days); water uptake (measured by subtracting the solution remaining in the vase on the last day from the initial solution volume) [11]; total sugars (%); and chlorophyll and anthocyanin pigments in the flowers.

Results and Discussion

The results shown in Figures 2–7 indicate that the red cultivar was superior in all the traits studied. It recorded the longest vase life (13.67 days), the greatest amount of water uptake (94.374 mL), the highest anthocyanin content (14.83 mg/100 g), the highest total carbohydrate percentage (0.802%), the highest chlorophyll A content (0.943 mg/g), and the highest chlorophyll B content (6.077 mg/g). The yellow cultivar recorded 7.92 days, 91.17 mL, 9.00 mg/100 g, 0.790%, 0.443 mg/g, and 4.409 mg/g, respectively. This may be attributed to differences in the genetic makeup of the cultivars and to environmental effects, which lead to morphological or anatomical differences, or both [12]. These results agree with [13], who

noted that the vase life of cut roses differs among cultivars, as some cultivars may be more resistant than others to the vascular blockage caused by bacteria.

The results shown in Figure 8 also indicate that vase life increased when sucrose and citric acid were added to the vase water. The longest vase life, 12.83 days, was recorded with the treatment of 5% sucrose + 200 mg/L citric acid, compared with only 6 days for flowers placed in distilled water. This may be because sucrose solutions act directly to maintain water balance while reducing the loss of turgidity, which allows greater water uptake and increases osmotic pressure [14].

The results shown in Figure 9 indicate that adding sucrose and citric acid to the flower preservative solution increased water uptake compared with distilled water. This may be attributed to the role of sucrose in supplying energy for essential cellular activities, such as maintaining the structure and function of mitochondria and other cell organelles, and to its role in regulating the uptake of water and minerals into the xylem vessels through control of transpiration ([2])*. It may also be due to its role in improving water balance, petal expansion, and flower opening, as a result of cell expansion, which requires the flow of water into the cell driven by the high sugar concentration within it (Baker, 1983; [15]. The lower water uptake of flowers placed in distilled water may be due to the growth of microorganisms, blockage of the vessels, and high water pressure [16].

The results in Figure 10 show that the treatment of 5% sucrose + 200 mg/L citric acid recorded the highest anthocyanin content, 16.17 mg/100 g, compared with the lowest value, 9.50 mg/100 g, recorded with the treatment of 5% sucrose + 300 mg/L citric acid.

The results in Figure 11 indicate that adding sucrose and citric acid to the flower preservative solution increased total sugars. The highest values were recorded with the treatments of 5% sucrose + 200 mg/L citric acid and 5% sucrose + 300 mg/L citric acid, at 0.805% and 0.806%, respectively, compared with 0.780% for flowers placed in distilled water.

The results in Figure 12 show that the chlorophyll A content decreased when sucrose and citric acid were added to the flower preservative water. The lowest values were recorded with the treatment of 3% sucrose + 100 mg/L citric acid, while the highest value was in flowers placed in distilled water alone. In contrast, the same treatment recorded a significant increase in chlorophyll B (Figure 12).

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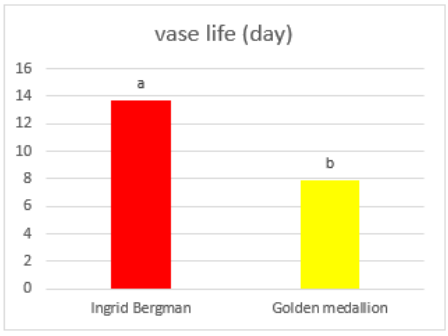


Figure 2. Vase life of Ingrid Bergman and Golden Medallion rose cultivars.

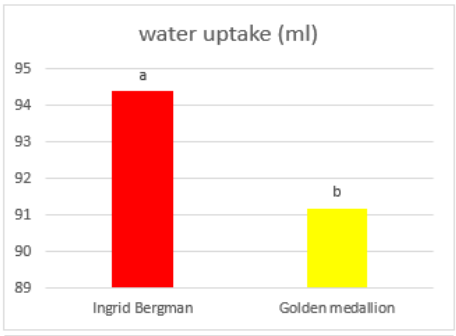


Figure 3. Water uptake of Ingrid Bergman and Golden Medallion rose cultivars.

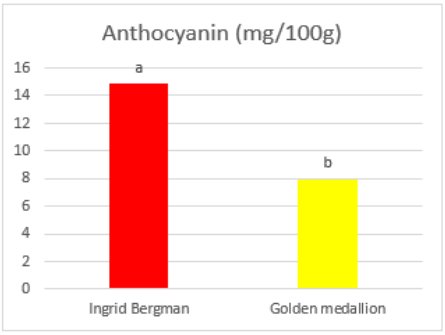


Figure 4. Anthocyanin content of Ingrid Bergman and Golden Medallion rose cultivars.

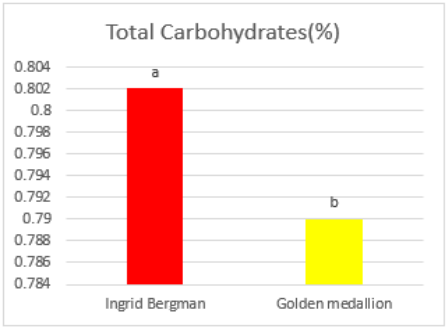


Figure 5. Total carbohydrate content of Ingrid Bergman and Golden Medallion rose cultivars.

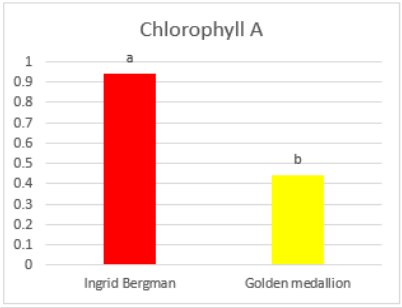


Figure 6. Chlorophyll A content of Ingrid Bergman and Golden Medallion rose cultivars.

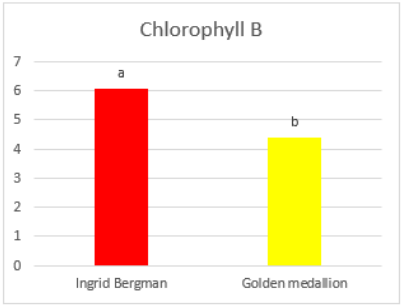


Figure 7. Chlorophyll B content of Ingrid Bergman and Golden Medallion rose cultivars.

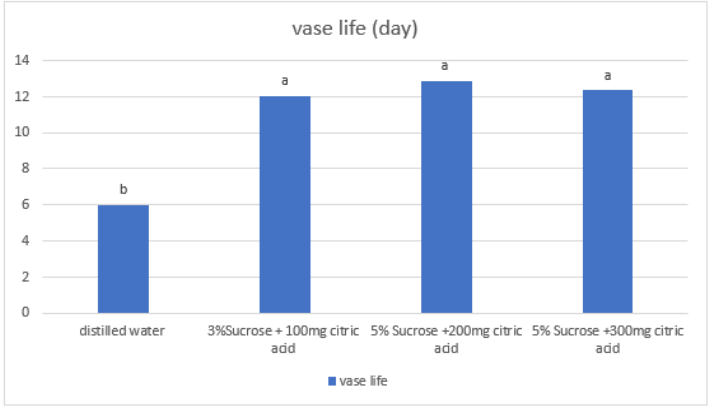


Figure 8. Effect of sucrose and citric acid combinations on rose vase life.

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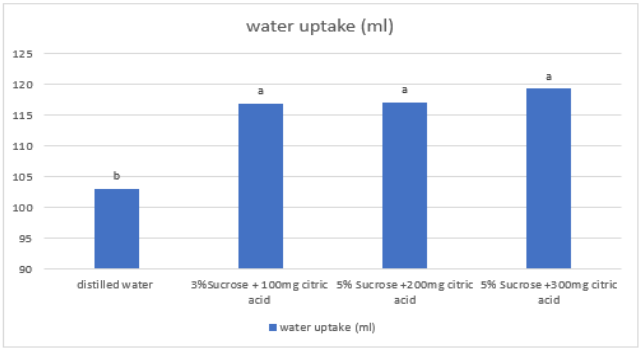


Figure 9. Effect of sucrose and citric acid combinations on water uptake.

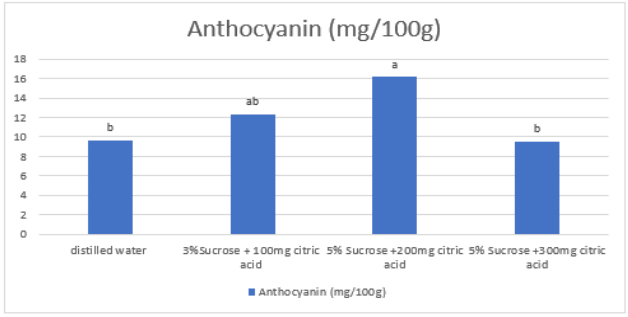


Figure 10. Effect of sucrose and citric acid combinations on anthocyanin content.

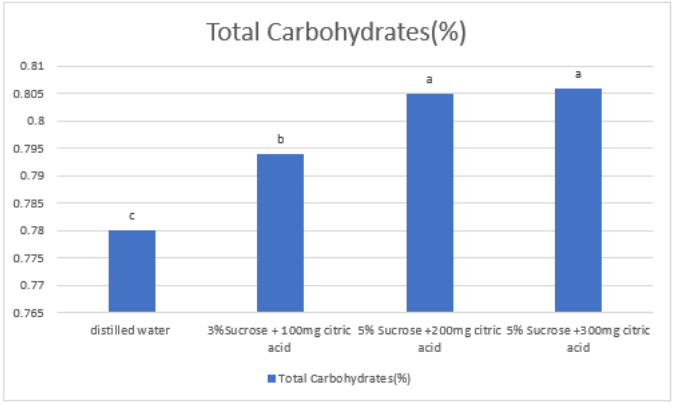


Figure 11. Effect of sucrose and citric acid combinations on total carbohydrates.

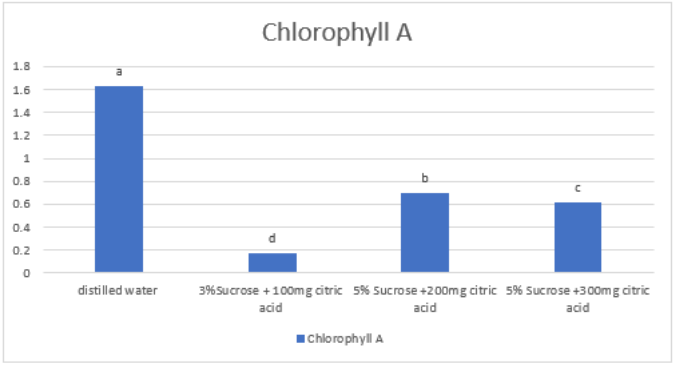


Figure 12. Effect of sucrose and citric acid combinations on chlorophyll A.

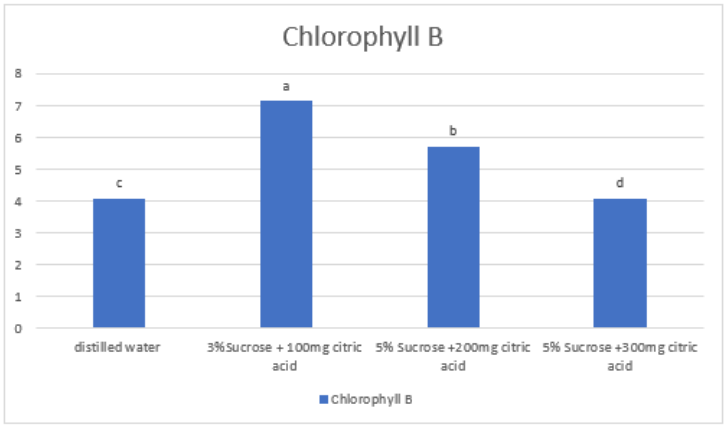


Figure 13. Effect of sucrose and citric acid combinations on chlorophyll B.

Conclusions and Recommendations

The findings demonstrate that cultivar selection and the composition of the preservative solution influence the postharvest quality and vase life of cut Rosa hybrida flowers. Ingrid Bergman (red cultivar) exhibited a longer vase life (13.67 days) than Golden Medallion (yellow cultivar; 7.92 days), together with higher water uptake, anthocyanin content, total carbohydrates, and chlorophyll contents.

Among the evaluated preservative combinations, 5% sucrose with 200 mg/L citric acid produced the longest vase life (12.83 days), compared with 6.00 days in distilled water, and the highest anthocyanin content (16.17 mg/100 g). Water uptake was greatest with 5% sucrose and 300 mg/L citric acid (119.30 mL), while both 5% sucrose combinations maintained comparatively high total carbohydrate contents (0.805–0.806%). The response of chlorophyll A and B differed across treatments, indicating that pigment retention was not uniform.

These results support the use of sucrose–citric acid preservative solutions to extend the marketable life of cut roses, although the optimal formulation depends on the quality attribute being prioritized. Further studies should assess additional cultivars, storage conditions, microbial growth, and the practical performance of the treatments under commercial handling conditions.

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