STUDY ON THE EFFICIENCY OF COMMON STORAGE SOLUTIONS FOR CUT ROSES (ROSA HYBRIDA CV. AVALANCHE)

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Abstract

The aim of this study was to evaluate the effectiveness of different storage solutions, easy to find in markets and prepare by florists or by end customer, in order to enjoy the beauty of the roses for several days. As a secondary goal, the amplitude of bud opening was monitored by measuring the diameter and weight of the flowers, the consumption of the solution and the chlorophyll content. The storage solutions were prepared, all based on tap water, which is the usual water used by florists and end customers. Four experimental variations resulted: V1 – 2% sucrose - control, V2 – 2% sucrose + 0.5% acetic acid (9°), V3 - 2% sucrose + 0,025% Chlorine, V4 – 0.1% Vitamin C + 0.001% zinc. The storage solution with vitamin C and zinc led to an increase in the fresh weight of the flowers, from 29g to 32.4g, in the first three days of the experiment. Solution consumption increased for all variants, with a maximum on the 3rd day. Even from the first day, higher chlorophyll values had been noted in the flowers from the storage solution with 2% sucrose and acetic acid, 55.3 μmol m^{-2}, compared to the other experimental variants, chlorophyll content between 46.1-47.4 μmol m^{-2}. It is concluded that the best results were obtained for V4, storage solution with vitamin C with zinc. The flowers maintained their freshness until the 6th day.

Key words: acetic acid, flower diameter, sucrose, vase life, vitamin C

Roses are the most sold flowers in the world, and they represent a significant share of the imported goods, with the Netherlands and Ecuador as main producers. Their harvesting, handling and transportation from producer to the flower shops must comply with strict temperature, humidity, storage solutions' content and conditioning criteria in order to maximise their vase life (Draghia L., 2011). Temperature fluctuation during transportation and handling may affect this. Storage solution and the degree of plant maturity at harvesting may also significantly reduce the vase life (Thakur N., 2020).

The duration of vase life is reduced if the flowers are kept at a temperature higher than the optimum or if they are kept for a longer period but at the correct temperature. During this period, the flowers consume their reserves and their lifespan in the vase will be greatly reduced. Keeping roses in water for a period of 7-10 days at a temperature between 0 and 2°Celsius leads to a lifespan of 3-4 days (Amariutei A., 1987)

To maximise the vase vase life of cut flowers, preservative solutions are being used. These solutions contain sucrose, ethylene inhibitors, growth regulators and antimicrobial agents. Carbohydrates represents the source of food for plants, both for the opening of the buds and for the prolonging their life. Among the carbohydrates, the most used is sucrose and it is recommended in boosting solutions, in different concentrations depending on the species of cut flowers. For roses, the recommended concentration is 2-5% sucrose (Toma F., 2009). The longer the cut flowers are kept in vase, the lower concentration of the sucrose in the storage solution is recommended. Not enough carbohydrates in the solution may have not the desired effect, while too much can have negative effects, speeding up the senescence of the flowers (Amariutei A., 2017). In a study, Bajpav et al. (2022) noted best results for vase life roses in a storage solution with 3% sucrose + 50ppm 8HQS (8-hydroxy quinolene sulphate).

It has been noted that sucrose in preservative solutions encourages the bacterial and fungal growth and that will lead to blockage of water absorption through the stem channels. Doorn and Woltering (1991) found that 70% of the bacterial growth in vase and in stems are Pseudomonas species. Lowering the pH under 4 will prevent the development of microorganisms in the solution (Marousky F.J., 1971). Storage solution can be treated antimicrobial by adding 8HQS, silver

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nitrate, silver thiosulphate, compounds with chlorine. Jones R. (2001) recommends using sodium hypochlorite with sucrose and citric acid in the storage solutions with better results compared to the use of simple chlorine compounds.

The aim of this study was to evaluate the effectiveness of different storage solutions, easy to find in markets and prepare by florists or by end customer, in order to enjoy the beauty of the roses for several days. As a secondary goal, the amplitude of bud opening was monitored by measuring the diameter and weight of the flowers, as well as the consumption of the solution and the chlorophyll content.

MATERIAL AND METHOD

For this study, white roses *Rosa hybrida* cv. Avalanche were purchased from a flower shop that brings the flowers from Holland, in April 2022, in order to monitor their behavior in different storage solutions in vases. The solutions used for this experiment were according to the recipes vehiculated on social media and easily available to florists and end customers.

The experiment has been carried out in the Agrochemistry laboratory within IULS Romania, where the stems of the flowers were shortened under a stream of water with an oblique cut to the same length (30cm), and the first four leaves from the top were left on the stem. The storage solutions were prepared, all based on tap water, which is the water used by florists and customers. Four experimental variations resulted: V1 – 2% sucrose - control, V2 – 2% sucrose + 0.5% acetic acid (9°), V3 - 2% sucrose + (0,025% Cl), V4 – 0.1% vitamin C + 0.001% Zinc. The roses were placed in Erlenmeyer flasks to reduce solution loss through evaporation, with 500 ml of storage solution added. Measurements were taken daily for the amount of solution consumed, plant weight, flower diameter, and chlorophyll content in the leaves.

The amount of solution consumed was determined by weighing the vessel with the solution and flower, then subtracting the weight of the flower and the glass. The flower diameter was measured in the lower third of the flower using a vernier caliper. The flower weight was determined with an electronic balance, and the chlorophyll content was determined using chlorophyll meter (CCM-200 plus from Opti-Science).

The room temperature where the experiment was conducted varied between 21-22.5°C, with an air humidity of 40-45%. The experiment lasted 5 days or until the flower had a 45-degree inclination from its upright position. The experiment was replicated 5 times with a single flower per replication.

RESULTS AND DISCUSSIONS

In this study, each experimental variant registered a specific behavior. The storage solution with vitamin C and zinc (V4) had an increase in the fresh weight of the flowers, from 29g to 32.4g, in the first three days of the experiment. Later on, their weight slowly decreased by approximately one gram per day. A faster decline of the fresh weight was noted in the solution with sucrose and acetic acid on the first and second day, 2-3g each day, and on the 3rd day weight loss was 4.8g and the flowers had a 45-degree inclination from its upright position. Roses from V3 had a stronger decrease in weight on 4th and 5th day (*figure 1*).

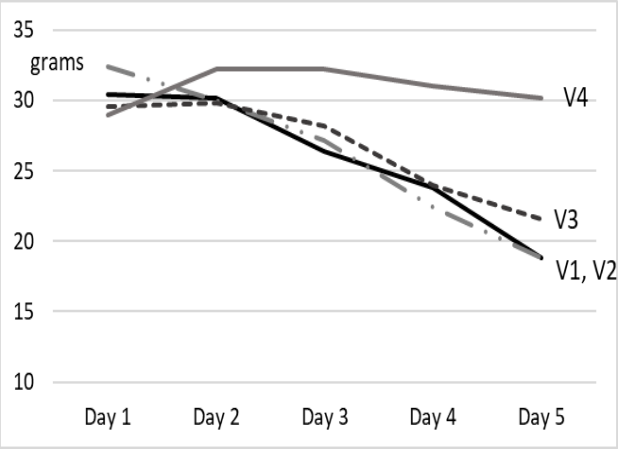

Figure 1 **Weight loss of cut roses during the 5 days of the experiment**

Solution consumption increases for all variants, with a maximum on the 3rd day, of 19.8 - 20.4ml for the solution with sucrose and the solution with sucrose and acetic acid, 27.8ml for the flowers from the solution with sucrose and chlorine, and 36ml for the storage solution with vitamin C and Zn. On the 4th day, only V4 recorded a solution consumption of 21.8 ml, the flowers from the other three variants of storage solution being withered (*figure 2*).

The maximum diameter of the flowers was reached on 2nd day for the storage solutions with 2% sucrose (V1), increasing by 2.36mm and by 3.06mm in the solution with 2% sucrose and acetic acid (V2). The flowers from V3 – 2% sucrose and chlorine recorded increases in flower diameter until the 3rd day, with a maximum increase of 1.78mm. In the solution with vitamin C and zinc, roses diameter increased in the first four days by approximately 2-3mm each day (*figure 3*).

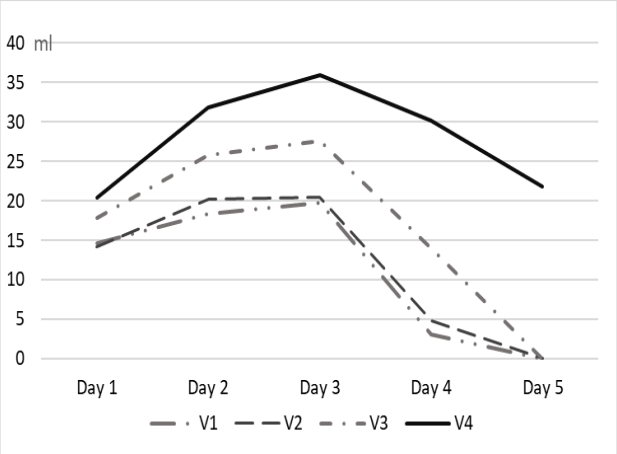

Figure 2 **Consumed solution (ml), mean values, during the 5 days of the experiment**

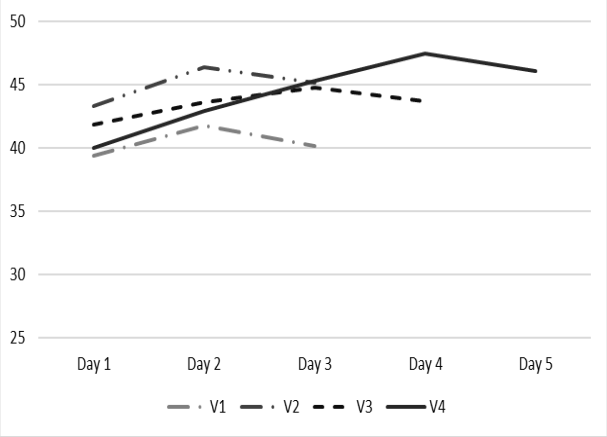

Figure 3 **Effect of storage solution on flower diameter during the 5 days of the experiment**

Chlorophyll is a green pigment found in chloroplasts with a major role in photosynthesis. Its concentration in plants is dependent on the nutritional environment, storage solution in the case of cut flowers. Even from the first day, higher chlorophyll values can be noted in the flowers from the storage solution with 2% sucrose and acetic acid (V2), 55.3 µmol m^{-2}, compared to the other experimental variants with a chlorophyll content between 46.1-47.4 µmol m^{-2} (Figure 4). Variants V3 - 2% sucrose with chlorine and V4 - vitamin C with zinc have the same trend of chlorophyll accumulation. During the preparation of the V3 solution, a deposition of a white precipitate was noted, through which the carbohydrates became unavailable to the plant, thus the chlorophyll content in the leaves similar to that of V4 can be explained (*figure 4*).

In a study carried out on the quality of the roses, Casierra-Posada *et al* (2022) applied foliar spraying with ascorbic acid on plants, in different doses and they noticed a length increase and thickening of the flower stem but without any effect on the chlorophyll content and the diameter of the flower.

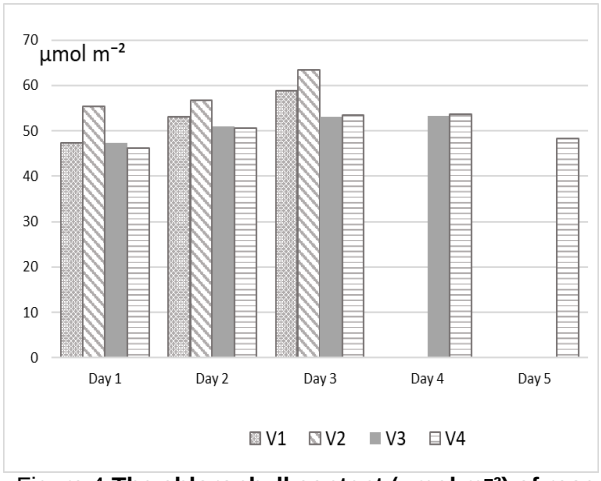

Figure 4 **The chlorophyll content (µmol m^{-2}) of rose leaves during the 5 days of the experiment**

During the experiment, roses from the V1 and V2 storage solutions withered after 3 days, V3 solution prolonged flowers vase life to 4 days and the flowers from V4 lasted for 6 days (*figure 5*).

Figure 5 **Flower stage on 4th day of experiment in different storage solutions**

CONCLUSIONS

Following the study, it is concluded that the best results were obtained for V4, storage solution with vitamin C with zinc. The flowers maintained their freshness until the 6th day. This solution can be easily prepared with vitamin C tablets from pharmacies.

Using acetic acid (vinegar) in the storage solution to lower its pH had a negative effect on the flowers, causing their early senescence.

The chlorine in the sugar storage solution led to the formation of a white precipitate that settled, and the flowers' vase life was 24 hours

longer compared to variations V1 and V2. Although it better results, the smell of chlorine in living spaces is not desirable.

In the case of the storage solution with sucrose, the expected results were not reached, the decrease in the weight of the flowers and the weak opening of the buds indicate that the flowers were most likely kept for several days in the warehouse and consumed their reserves, thus the number of days in the vase was much reduced.

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