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Vase life extension of four cut roses cultivars (Rosa x hybrida)

Tincuța GOCAN[1], Ileana ANDREICA[1], Daniela POȘTA[2]*, Roxana STOIAN[1], Sándor RÓZSA[1]*

[1]Faculty of Horticulture and Business in Rural Development, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Mănăștur St. 3-5, Cluj, Cluj-Napoca, Romania
[2]Faculty of Enginering and Applied Technologies, University of Life Sciences "King Mihai I" from Timisoara, Aradului St. 119, Timisoara, Timis, Romania

*Corresponding author e-mail: rozsa.sandor@usamvcluj.ro, posta.daniela@gmail.com

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Abstract
Cut flowers are very important products for the horticultural industry due to their multiple uses for different occasions. Handling cut flowers from the moment of harvest to dispatch it is a critical process in order to maintain the quality of the product. Transportation and environmental conditions from farm to market have a great impact on the quality of cut flowers. The quality of cut flowers and foliage reaches its maximum in the moment of harvest and the deteriorates very fast unless the products are handled properly. The shelf life of cut flowers highly depends on postharvest factors which affect cut flowers' quality and respiration. Besides, their depletion of organic compounds is also influenced by several other factors, such as the variety itself, storage conditions, water supply and absorption, endogenous levels of total soluble carbohydrates and the presence of microorganisms. Therefore, the main aim of this research was to investigate the morphological characters of cut roses and their soluble carbohydrates' content during their vase life. The results suggest that the level of carbohydrates did not have a linear association with the vase life of the cut roses. Moreover, the high number of leaves/stem did not increase the ornamental value of the cut roses and nor the length of their vase life.

Key words: roses, carbohydrates, vase life, extension, ornamental value

Introduction

Consumers are looking for freshness and senescence as criteria for the quality of cut flowers. Several scientific studies suggest that the plants ca stimulate, especially flowers, but also a certain style of floral arrangement can improve the activity and well-being of the brain [2, 12, 16]. In the cut flower industry, vase life of the cut flowers is the most important quality that guarantees for costumers. Over 200 different types of cut flowers are sold only in the United States [15, 9, 23]. Depending on the flower type, the global cut flower market has been divided into alstroemeria, roses, bird of paradise, carnation, lavender, lilies, sunflower and others such as iris or gladiolus. According to the cut flower market forecast, roses seem to dominate the market in the near future as well. Currently, 300 species of roses and around 30 000 rose varieties are enriching the global market.

Due to differences in the developmental stage and the vase life of each flower, every flower exhibits a different behavior. The period of time a flower remains fully open and functional varies among species from one day to several weeks, depending on its adaptations to the environmental conditions [4, 5]. The vase life of flowers differs depending on the species and variety. "Vase life" is a variable used to indicate the longevity of the cut flower [6]. The life span of a cut flower in a vase is given by the number of days until the flower is preserved in a good stage until the end of their use by the costumer [14]. The vase life of certain mixed flower bouquets can be extended over seven days with proper handling after harvest [15].

Several previous studies investigated already the extension of vase life of cut flowers and factors which might influence their life in a vase. Cut flowers deteriorate quickly and can become unattractive due to their yellowing aspect of the sepal, bluish of the petals, wilting and abscission of the petals, loss of the opening of floral buds and bending of the peduncle (bent neck). These symptoms are caused by various processes and mechanisms that occur during the senescence of the flower. Symptoms of fresh weight loss of floral tissue, such as dryness and wrinkling, appear in the final phase of senescence. Cut flowers may lose water during the vase lifespan, indicating a loss of membrane integrity and increased permeability and leakage. Increased leakage of solutes from cells is related to loss of turgidity and visible wilting. It has been suggested that this

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increase in leakage is due to increased membrane permeability [18, 10]. Flowers arranged in bouquets often consist of such various features as a single flower (rose, gerberas, sunflower) and inflorescence-type flower (lily, gladioli, carnation).

Moreover, customers sometimes buy flowers or bouquets on impulse. Thus, the immediate appearance (e.g., stem length, color, shape of flowers and leaves, packaging and presentation flowers) is of a great importance [14, 16, 19]. The largest markets for cut flowers are in Germany, the United States, Great Britain, France and the Netherlands [14]. The rose (*Rosa hybrida*) is one of the most popular and used as cut flower as single flower, in bouquets and floral decorations. Its vase life, in general, ranges from 5-14 days [14,8]. There are many factors that influence the longevity of cut roses, such as variety, stage of development, growing medium and post-harvest handling (placing the stems in warm water, using high-quality water with an appropriate pH, using sucrose preservatives, antimicrobials, ethylene inhibitors, air temperature, humidity and light). The temperature should be kept between 0 and 1°C during handling. Optimum humidity must be kept at almost 80% to reduce transpiration [3]. In roses, occlusions have been found to occur due to physical obstruction of pores in membranes colonized by bacteria, bacterial exo-polysaccharides, and degradation products of dead bacteria [20, 7]. Previous studies demonstrated that sugars are responsible for corolla pigmentation by promoting anthocyanin biosynthesis [11, 1].

Post-harvest physiological processes in rose flowers take place in the leaves, stems, floral buds and foliar peduncle, which connect the bud to the stem. The floral bud and peduncle highly depend on the water supply through the stem. Therefore, a major factor in senescence is the water condition of the stem, which is a result of water absorption through the base of the stem. Loss of water absorption will lead to a decrease in water potential in the stem and leaves. An improvement in water balance can be achieved in some cases by an increase in water absorption and water conductivity by immersing the stem base in water, acidifying water and degassing water [22, 7].

Material and Method

To carry out this experiment, cut roses were purchased from a local store. Cut roses were then selected to provide uniformity for the experiment. All damaged samples were eliminated. The stem lengths of roses were cut at 35 cm length, underwater using a sterile blade [21]. The leaves were removed from the bottom third part of the stem. To eliminate the effect of exogenous sugar on the investigated relationships between sugar content and vase life, 4 cut roses were placed in separate vases containing 1 L of distilled water to which Flora Life cut flower food was added.

Figure 1. Cut roses in different colors used for the experiment

A plastic wrap was used to cover the top of the vases to avoid water loss [16]. The vases were placed in a chamber and maintained at 20°C with a 12-hour light/dark cycle until the end of the experiment. In roses, the petals of uncut flowers abscise without symptoms of senescence. In contrast, the petals of these flowers often wither due to an occlusion in the xylem that blocks the flow of water to the petals (Figure 2).

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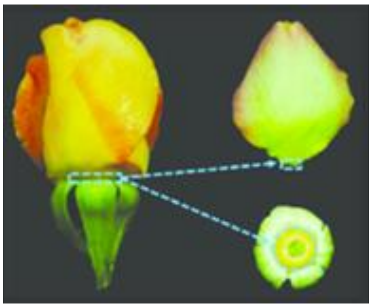

Figure 2. The abscission zone of petals in rose flowers

Thus, this experiment aimed to investigate the changes in appearance of the flowers based on bud and flower appearance, and leaves were scored accordingly to assess the evolution of flowers over the duration of the experiment [13, 15,]. The main characters investigated through measurements included stem length, bud length and initial diameter of the flowers. The measurements were carried out with the help of a measuring tape for stem length and an electronic caliper to determine the initial and final diameter of the flowers.

Minimum and maximum values were recorded, and then the means were calculated for all parameters. The data were assessed by applying ANOVA test.

Results and Discussions

The cut roses that have been studied belong to the category of single stem cut flowers, used mostly in mixed bouquet and flower arrangements (Figure 3).

Figure 3. Flower opening observation during the experiment

The flower bud opening was monitored all through the experiment until the full opening of the flowers. The results show that most of the flowers did not open completely until the end of the experimental period while others wilted before full opening. This might be explained by the loss of stiffness peduncle, known as bent neck. The development of this symptom is thought to be caused by vascular occlusion, which inhibits the water supply to flowers [20].

Regarding the characters for the stem, different values were recorded (Table 1), especially for the ones which more intervention was made due to the obturation of the vessels and to avoid bending of the neck (bent neck). Despite the fact that stems of the orange roses were longer the vase life of the flowers was shorter as confirmed by the coefficient of variation with its highest value of 3.62%. The length of the flower buds ranged from 245 mm to 396 mm.

In Figure 4, the flower quality parameters are presented until the end of the experimental period, when flowers were scored with 6. It was found that the cut roses at the end of the different decoration period were scored differently; the best ranked was the white variety which recorded a decoration period of 12 days, followed by the red one (10 days). In fact, in these experiments, flower quality reached stage 6 before leaves in all four varieties. This means that the flower was significantly degraded from ornamental point of view, while the quality of the leaves was still acceptable.

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Table 1. Characteristics of flower evolution during the experimental period regarding stem length

Characteristics	Parameters		Flower color			
			Yellow	White	Orange	Red
Final stem length [mm]	Value	Minimum	215	245	242	246
		Maximum	238	263	280	259
		Average	225.40	256.40	269.20	251.60
	Standard deviation		9.0	5.2	9.7	4.9
	Standard error		2.8	1.6	3.0	1.5
	Coefficient of variation [%]		4.32	2.60	3.62	1.97
Length of flower bud [mm]	Value	Minimum	289	377	245	259
		Maximum	323	396	379	388
		Average	308.6	387.3	360.9	370.0
	Standard deviation		12.34	5.64	11.82	9.87
	Standard error		3.90	1.78	3.73	3.12
	Coefficient of variation [%]		3.99	1.45	4.53	2.66

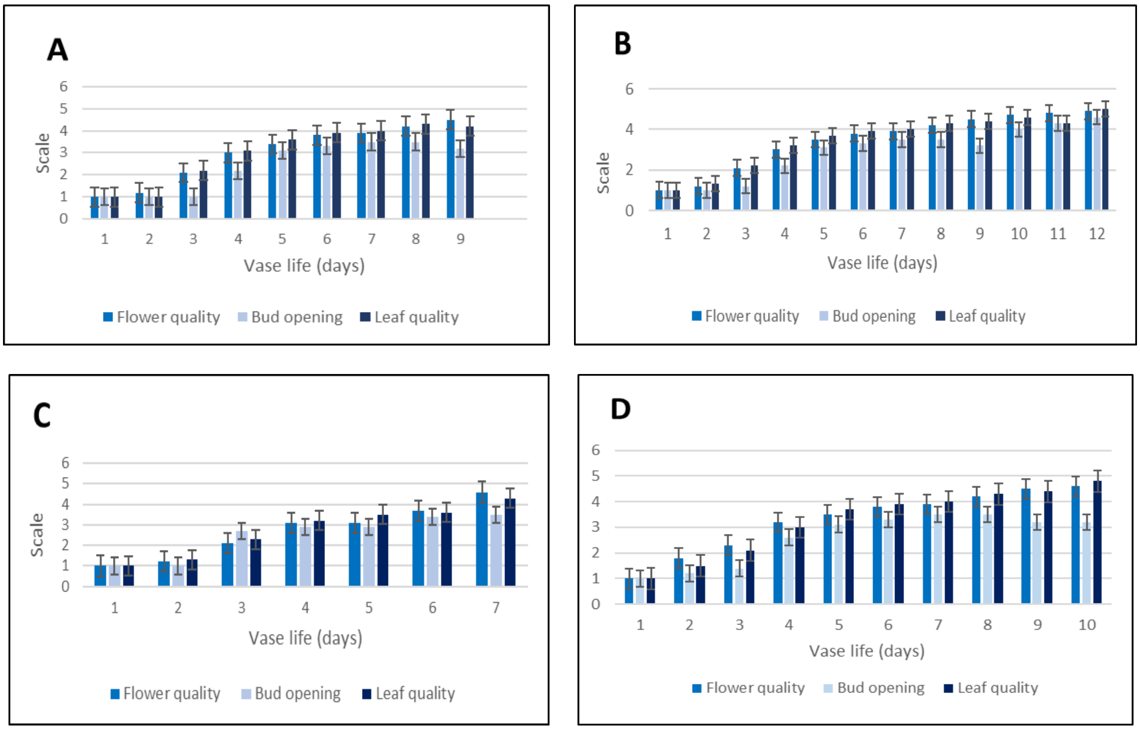

Figure 4. Changes for flower quality, bud opening and leaf quality during decoration (A, B, C and D).

The investigation of carbohydrate changes was followed during the first seven days of the decoration period of the roses. It was found that the total sugars in almost all flowers decreased slightly in both petals and leaves. When the total sugars from flowers were compared with those from the petals and leaves it was found that the total sugar content in the orange flowers was lower than in others. The total sugar content in the leaves was higher in those with white flowers than in other colours (Figures 5 and 6), lasting even longer. These results confirm the longest vase life of white roses as compared to the others recommending it for flower arrangements.

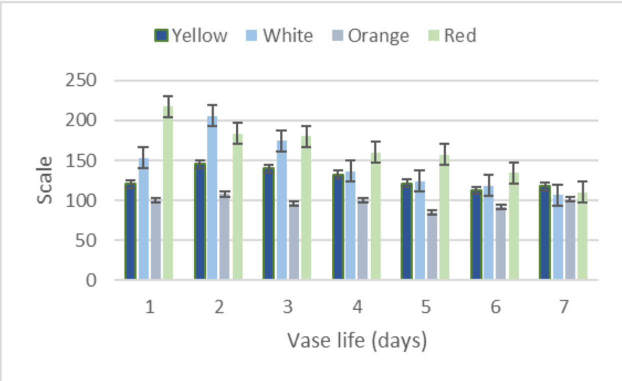

Figure 5. Changes in total carbohydrate content of petals of the cut roses under study

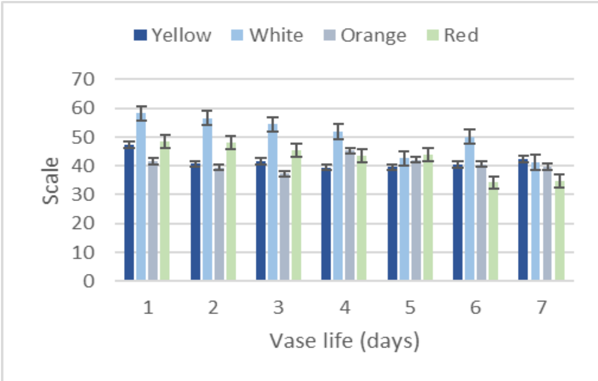

Figure 6. Changes in total leaf carbohydrate content of the cut roses under study

It is worth mentioning that that some of the cut flowers subjected to analyses did not have entirely open flowers in the moment of purchase, which indicates the possibility of successive flowering over a longer period of time. The measurements were made using the electronic caliper to determine the initial and final diameter of flowers undergoing the study (Table 2).

Table 2. Characteristics concerning the evolution of flowers during their vase life

Characteristics	Parameter		Flower color			
			Yellow	White	Orange	Red
Initial diameter of the flower [mm]	Value	Minimum	17.94	13.13	15.72	17,93
		Maximum	26.83	20.7	31.30	28,88
		Average	21.24	16.46	23.48	22,57
	Standard deviation		3,62	2.67	5.40	3.62
	Standard error		1,14	0.84	1.71	1.14
	Coefficient of variation [%]		14.27	12.57	23.03	16.07
Final diameter of the flower [mm]	Value	Value	21.54	17.28	20.14	27,06
		Maximum	62.95	63.73	61.45	68,64
		Average	35.54	27.80	39.95	41,34
	Standard deviation		18.48	16.61	13.67	10.75
	Standard error		6.14	5.25	4.32	3.40
	Coefficient of variation [%]		37.22	46.75	34.23	26.01

Conclusions

As a conclusion, our findings show that the vase life of roses may vary depending on the variety showing slight differences in their evolution even if they undergo the same conditions. The carbohydrate content of the cut flowers which was determined in both petals and leaves shows us a close connection.

Such studies may provide clearer data to explain the influence of chemical exudates on vase life of cut flowers. In addition, chemical compounds are exudate in water should be investigated.

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