Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 23, Issue 1, 2023
PRINT ISSN 2284-7995, E-ISSN 2285-3952

CUTTING SYSTEM INFLUENCE ON THE QUALITY OF ROSE FLOWERS

Cristina TOȚA[*], Maria BALA[*], Florin SALA[**]

University of Life Sciences "King Mihai I" from Timisoara, [*]Horticulture, [**]Soil Science and Plant Nutrition, Timisoara, 300645, Romania
Emails: cristina.tota@yahoo.com, mariabalamonicabala@yahoo.com, florin_sala@usab-tm.ro

***Corresponding author**: florin_sala@usab-tm.ro*

Abstract

This study evaluated the quality of rose flowers, based on the length of the floral stem, according to the cutting system, as a plant maintenance work. The researches were organized during 2017 - 2018 at the Teaching and Research Base of the University of Life Sciences "King Mihai I" from Timisoara. Six rose varieties were studied: Acapella (Aca), Barkarole (Bar), Double Delight (D De), Golden Elegance (G El), Lady in Purple (L Pu), and Pascali (Pas). Three cutting systems were performed, at two buds, at five buds, and at seven buds. The varieties Acapella, Barkarole and Golden Elegance provided flowers with a longer stem, and the varieties Double Delight, Lady in Purple and Pascali provided flowers with a shorter stem, in all three cutting systems. The system of cutting at two buds facilitated obtaining the longest flower stems (eg 118.00 cm for the Barkarole variety). On the basis of PCA (correlation), a diagram was resulted that contained the distribution of the experimental variants (represented by rose varieties) in relation to the cutting system (2; 5; 7 buds - as biplot). According to PCA, PC1 explained 93.597% of variance and PC2 explained 5.635% of variance. Cluster analysis generated a dendrogram of the variants association, based on the Euclidean distances, according to each cutting system (Coph.corr.=0.828 for cutting to 2 buds; Coph.corr=0.884 for cutting to 5 buds; Coph.corr=0.732 for cutting to 7 buds).

***Key words:** floral stem length, maintenance cutting, PCA, quality indices, roses, variable buds number*

INTRODUCTION

The rose (*Rosa* spp.) is part of the Rosaceae Family, Genus Rosa which includes a large number of species, about 200 species [21].
As an ornamental plant, the rose has been cultivated since ancient times, since 3000 years BC in China, the Mediterranean countries, West Asia (Persia) [4, 15]. In the Northern Hemisphere, about 150 rose species are known and cultivated, with an ornamental purpose but also as a raw material resource for different economic sectors [8]. It is estimated that between 8 and 20 rose species contributed to obtaining the current complex hybrid rose forms, namely 'Rosa × hybrida' [21].
The rose is often considered the 'Queen of the Flowers' and has been studied in relation to the presence, role and importance of this flower in art and symbolism [17]. In addition to the ornamental properties of the rose, many pharmaceutical and medicinal properties (antioxidant, antibacterial, antitussive, antidiabetic, hypnotic, etc.) have been found based on active principles identified in different species of rose [5, 8, 18]. As a result of the high content of natural molecules, with various biological properties, the rose represents a valuable resource for perfumery and cosmetics [19]. The content of vitamins, minerals, and bioactive substances determined over time the study and use of the rose for food purposes (dyes, flavours, functional foods, etc.) [8, 19, 26].
Most often, however, the rose is used for ornamental purposes, and as a result of the importance of the rose in this direction, some studies have investigated the genetic diversity and selection of the continuous flowering gene (RoKSN) in the rose [25].
As an ornamental plant, the rose is cultivated for its decorative role in open spaces (gardens, parks, etc.), in pots, or for cut flowers with different uses [9, 10, 28].
The rose is present in ornamental spaces of urban ecosystems, in different proportions, together with other plant species [28]. For

urban areas, information obtained on the basis of test plants [11], can be useful for indicative purposes in characterizing the biotope conditions of urban ecosystems, when establishing floristic compositions in ornamental spaces and intervention measures.

The relationship of the rose with soil conditions and growing substrate, with the regime of nutrients and the regime of water was studied [14, 24, 29]. The relationship of rose plants with different pathogens was also evaluated [20], and the imaging analysis facilitates the quick and non-destructive identification of symptoms at the foliar level [13].

As a result of the importance of the rose for multiple uses, the improvement and production of biological material has shown interest [12], and some studies have analyzed certain trends for the rose market [9, 27], and for sustainable practices of cultivating ornamental plants [9].

The quality of rose flowers is ensured primarily through genetics, but also culturally (technologically), according to the purpose of the flowers use.

The present study evaluated the rose flowers quality, according to the floral stem length, as an effect of maintenance cutting works, on a variable number of buds.

MATERIALS AND METHODS

The study took place between 2017 and 2018 at the Teaching and Research Base of the Faculty of Engineering and Applied Technologies Timisoara, University of Life Sciences "King Mihai I" from Timisoara. Six varieties of rose were studied, the abbreviations used in the study are presented in brackets: Acapella (Aca), Barkarole (Bar), Double Delight (D De), Golden Elegance (G El), Lady in Purple (L Pu), and Pascali (Pas). Three cutting systems were performed at two buds, at five buds and at seven buds, figure 1.

Fig. 1. The cutting system and examples of rose varieties studied; A – (a) cut to two buds, (b) cut to five buds, (c) cut to seven buds; B – the rose varieties studied: (1) – Acapella, (2) – Barkarole; (3) – Double Delight, (4) – Golden elegance, (5) – Lady in Purple, (6) – Pascali; C – single stem rose flower
Source: original figure.

Adequate maintenance of the plants was ensured by tilling the soil and watering, as appropriate. The length of the rose flower stems was evaluated according to the cutting system made. Observations were made on 15 plants, in three repetitions. For the comparative analysis of the data, the average value per experiment was considered as the control variant, in the case of each cutting system (two buds, five buds, or seven buds).

The recorded values, for each variety and cutting system, were analyzed mathematically and statistically by appropriate methods. For the comparative evaluation of the differences between the variants, the LSD values (significance limit of the differences) were calculated, in relation to safety thresholds of 5 %, 1 % and 0.1 %. The ANOVA test was applied in order to evaluate the presence of the variance, and the safety of the obtained data. Principal Component Analysis was applied, in order to obtain the variants distribution according to the cutting system (two buds; five buds; seven buds) as biplot. Cluster Analysis was applied, in order to obtain the dendrogram of the variants, based on similarity according to the length of the floral stem, within each cutting system. Appropriate statistical safety parameters were considered for the certainty of the results. The PAST software [16] and the statistical calculation module in EXCEL were used for data analysis and graphical representations.

RESULTS AND DISCUSSIONS

The maintenance of roses by cutting at a variable number of buds (two, five, and seven buds) led to the formation of flower stems with variable lengths within the six rose varieties considered in the study. The differentiated variation of the values for floral stems length was recorded, both according to the cutting system (number of buds) and to the varieties of roses used in the study. The average values recorded during the study period, the differences and the level of significance, are presented in Tables 1, 2 and 3.

Table 1. Values of the rose flower stem in the case of cuttings at two buds

Experimental variants	Experimental years							
	2017				2018			
	Average values	Percentage values	Differences	Significance	Average values	Percentage values	Differences	Significance
Acapella	91.30	103.05	2.70		92.00	102.42	2.17	
Barkarole	117.33	132.43	28.73	***	118.00	131.36	28.17	***
Double Delight	65.66	74.11	-22.94	oo	67.35	74.97	-22.48	oo
Golden Elegance	111.66	126.03	23.06	**	114.33	127.27	24.50	***
Lady in Purple	62.33	70.35	-26.27	ooo	63.33	70.50	-26.50	ooo
Pascali	83.33	94.05	-5.27		84.00	93.51	-5.83	
Control	88.60	100.00			89.83	100.00		
Limits of significance of differences	LSD5%=12.44; LSD1%=17.46; LSD0.1%=24.66				LSD5%=11.84; LSD1%=16.63; LSD0.1%=23.47			

Source: original data.

Table 2. Values of the rose flower stem in the case of cuttings at five buds

Experimental variants	Experimental years							
	2017				2018			
	Average values	Percentage values	Differences	Significance	Average values	Percentage values	Differences	Significance
Acapella	89.66	119.72	14.77	***	91.00	120.35	15.39	***
Barkarole	95.00	126.85	20.11	***	95.66	126.53	20.06	***
Double Delight	49.66	66.31	-25.23	ooo	51.00	67.45	-24.60	ooo
Golden Elegance	95.00	126.85	20.11	***	95.66	126.53	20.06	***
Lady in Purple	48.00	64.09	-26.89	ooo	48.33	63.92	-27.27	ooo
Pascali	72.03	96.18	-2.86		72.00	92.22	-3.60	
Control	74.89	100.00			75.60	100		
Limits of significance of differences	LSD5%=5.66; LSD1%=7.95, LSD0.1%=11.22				LSD5%=7.44; LSD1%=10.44; LSD0.1%=14.75			

Source: original data.

Table 3. Values of the rose flower stem in the case of cuttings at seven buds

Experimental variants	Experimental years							
	2017				2018			
	Average values	Percentage values	Differences	Significance	Average values	Percentage values	Differences	Significance
Acapella	82.33	124.95	16.44	***	84.63	121.40	14.92	***
Barkarole	70.66	107.24	4.77		73.66	105.67	3.95	
Double Delight	47.66	72.33	-18.23	ooo	56.00	80.33	-13.71	ooo
Golden Elegance	90.35	137.12	24.46	***	93.33	133.88	23.62	***
Lady in Purple	42.00	63.74	-23.89	ooo	44.33	63.59	25.38	ooo
Pascali	62.33	94.60	-3.56		66.33	95.15	-3.38	
Control	65.89	100.00			69.71	100.00		
Limits of significance of differences	LSD5%=7.52; LSD1%=10.56; LSD0.1%=14.91				LSD5%=4.57; LSD1%=6.41; LSD0.1%=9.06			

Source: original data.

The analysis of the experimental data safety, and the presence of variance, was done by the Anova test (Alpha=0.001), and the results obtained are presented in Tables 4, 5 and 6. In all three cases, the safety of the recorded results, and as well as the presence of the variance were confirmed (F>Fcrit, p<0.001).

Based on PCA (correlation), the diagram in Figure 2 resulted, which includes the distribution of the experimental variants (rose varieties) according to the cutting system (two, five or seven buds, as biplot). PC1 explained 93.597% of variance, and PC2 explained 5.635% of variance. In the neutral position (center of the diagram) the control variant was positioned (as the average of the experience values). Associated with seven buds (ace biplot) the variety Acapella (Aca) and the variety Golden Elegance (G El) were positioned. Associated with two buds (ace biplot) the variety Barkarole (Bar) was positioned. The other three varieties Pascali (Pas), Lady in Purple (L Pu) and Double Delight (D De) were positioned independently of the analysis parameters, as a biplot (two buds, five buds, seven buds).

Table 4. ANOVA test for the data series (cuttings at two buds)

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	15743.89	6	2623.981	48.77558	1.46E-15	4.894189
Within Groups	1882.896	35	53.79704			
Total	17626.79	41				

Source: original data.

Table 5. ANOVA test for the data series (cuttings at five buds)

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	14394.58	6	2399.097	239.5075	6.59E-27	4.894189
Within Groups	350.5878	35	10.01679			
Total	14745.17	41				

Source: Original data

Table 6. ANOVA test for the data series (cuttings at seven buds)

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	10301.47	6	1716.912	111.3459	2.59E-21	4.894189
Within Groups	539.6869	35	15.41962			
Total	10841.16	41				

Source: original data.

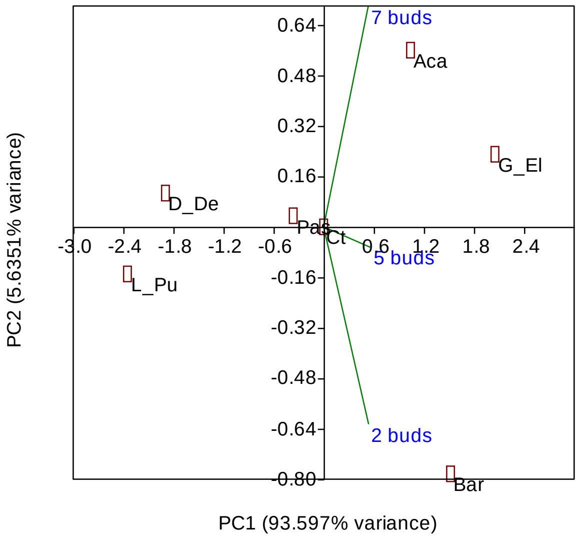

Fig. 2. PCA diagram, correlation, for the rose varieties studied according to the cutting system
Source: original figure.

Cluster analysis have facilitate to obtaining the variants dendrogram, based on the Euclidean distances, Figure 3, in relation to each cutting system (Coph.corr.=0.828 for cutting to two buds; Coph.corr=0.884 for cutting to five buds; Coph.corr= 0.732 for cutting to seven buds). From comparative analysis of the statistical safety coefficient values (Coph.corr), it was found that in the case of the cutting system at five buds, the association of the variants (of the studied rose varieties) was obtained in higher statistical safety conditions according to Coph.corr=0.884, compared with the results from the other two cutting systems (Coph.corr.=0.828 for cutting to two buds, respectively Coph.corr.=0.732 for cutting to seven buds). Also, within these series of data, related to this cutting system (cuttings to five buds), the highest level of similarity was recorded regarding the response of the varieties studied by the floral stems length, the rose varieties Barkarole (Bar) with Golden Elegance (G He), in which case SDI=0.00.

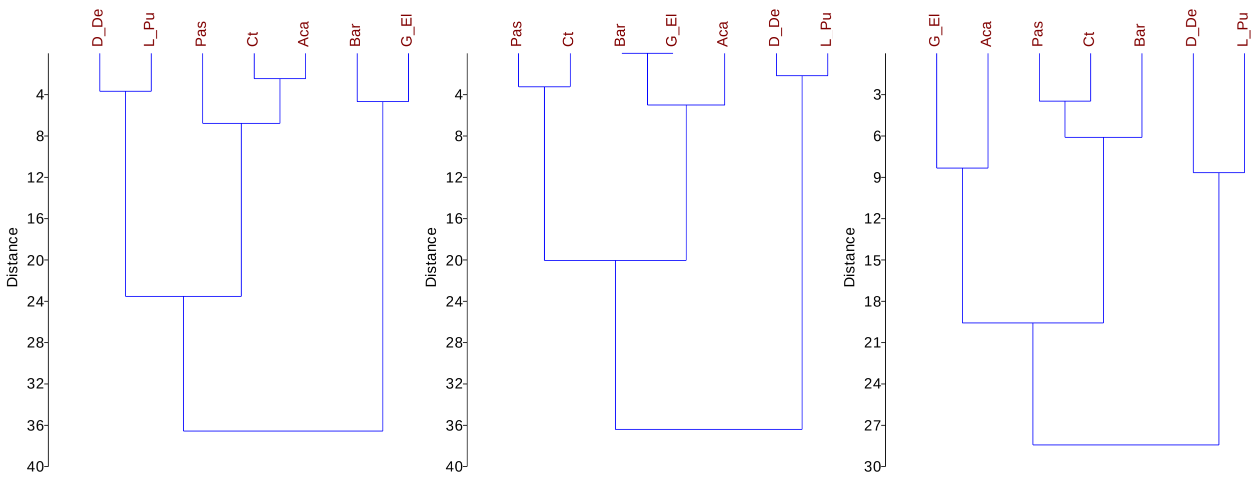

Fig. 3. Cluster dendrogram of the rose studied varieties, based on the Euclidean distances, according to the cutting system; (a) cutting to two buds; (b) cutting to five buds; (c) cutting to seven buds
Source: original figure.

High level of similarity was recorded, in the case of the cutting system at two buds, for the rose variety Acapella (Aca) with the control variant (Ct), in which case SDI=2.45; this was followed by the roses varieties Lady in Purple (L Pu), and Double Delight (D De), in which case SDI=3.67. In the case of the rose cutting system at seven buds, high level of similarity was recorded between the Pascali (Pas) variety and the control variant (Ct), SDI=3.47, followed by the Pascali (Pas) and Barcarole (Bar) varieties, SDI=7.83.

In all three cases, given the cutting system (two buds, five buds, and seven buds), the cultivars Lady in Purple (L Pu) and Double Delight (D De) were in the same subcluster, with comparatively shorter floral stems with the other rose varieties studied. High level of similarity of these varieties (L Pu and D De) was recorded in the case of the rose cutting system at five buds (SDI=2.16), and followed by the rose cutting system at two buds (SDI=3.67), and then, in the case of the system of cutting at seven buds (SDI=8.66). These varieties showed a high independence from the cutting system, in relation to the rose floral stem length.

Depending on the rose variety, and the cut flowers destination, one, or another cutting system can be chosen, according to the buds number, in order to obtain different flowers, with variable stem length. Graphic representation of the stem length in the varieties of roses studied, compared to the average value, is presented in Figure 4 for the cutting system at two buds, Figure 5 for the cutting system at five buds and in Figure 6 for the cutting system at seven buds.

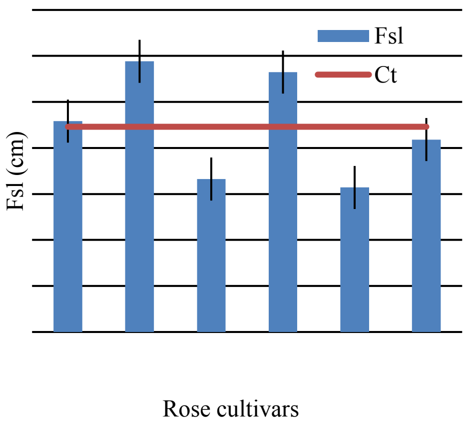

Fig. 4. The graphic distribution of the values for the flower stem length, in the rose varieties analysed (cuttings at two buds)
Source: original figure.

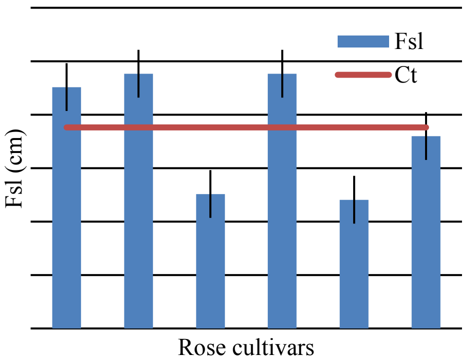

Fig. 5. The graphic distribution of the flower stem length values, in the rose varieties analysed (cuttings at five buds)
Source: original figure.

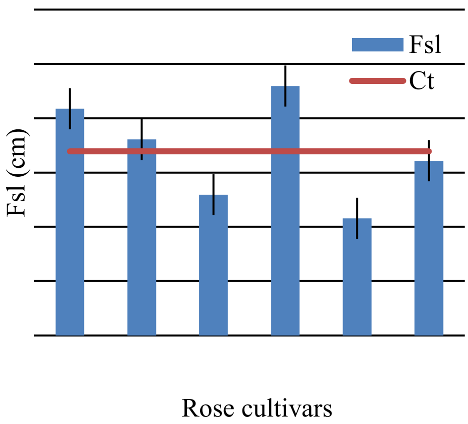

Fig. 6. The graphic distribution of the flower stem length values, in the rose varieties analysed (cuttings at seven buds)
Source: original figure.

In species with a woody architectural structure, the maturation of woody tissues, the accumulation of mineral elements in the shoot structure and the quality of buds depend on vegetation factors, among which the fertilization system and plant nutrition play an important role [2, 22]. Rose flower quality has been studied and associated with calcium (Ca) nutrition, but also in relation to other nutrients, such as Na, K and Mg [3]. Cabrera et al. (2009)[7] studied the production of rose flowers and the accumulation of ions in greenhouse conditions, in relation to stress under experimentally controlled salinity conditions ($NaCl$ + $CaCl_2$) and found the negative influence of salinity on biomass, cut flower production and quality the leaves. The dynamics of nutrients (N, K) and phytoassimilates, in terms of transport and storage in the structure of rose plants for cut flowers, were studied in a hydroponic culture system [1].

Rose maintenance cuts, as integrated works in culture technology, are made, usually, in relation to the cultivated genotype, according to the architectural system of the plant, in relation to the landscaping in which it fits, but also in the relations to the purpose and destination of the flower production (ornamental; source of raw material for different industries, such as cosmetic, food, medicinal, perfumery, pharmaceutical, etc.) [23].

In the case of roses plants, cultivated for cut flowers, in relation to the rose genotype, flowers colour, and the ornamental frame or context, different type of flowers, with a long, medium or short stem are used [6].

In order to study the optimization the rose flower production (the number and the quality of the leaves) according to the main determinants (genotype characteristics, plant structure, growing environment, maintenance techniques), Buck-Sorlin et al. (2011)[6] used a 3D modeling approach for structural and functional growth of rose plants.

Based on some structural-functional models of plants, by techniques of driving some shoots (bending) Zhang et al. (2020) [30] obtained vertical shoots with a better growth (35 and 59%), compared to the control plants (without bent shoots), a fact that can contribute to the increase in the quality of the stems of the rose shoots and the quality of the rose flowers.

In the case of this study, the quality of the rose floral stems (shoots with flowers), was evaluated according to the rose plants maintenance cuts, and different results was obtained which showed that the quality of the flowers can be controlled through the accessible work technique.

CONCLUSIONS

The quality of rose flowers, assessed in this study, based on the floral stem length, varied according to the cutting system (two buds; five buds; seven buds), but also in accordance with rose variety studied.

The cutting system at two buds facilitated obtaining the longest flower stems (eg 118.00 cm in the Barkarole variety), compared to the other two cutting systems, at five buds and at seven buds.

The rose varieties Acapella, Barkarole and Golden Elegance provided flowers with a long stem, and the varieties Double Delight, Lady in Purple and Pascali provided flowers with a shorter stem, in all three cutting systems.

Based on PCA (correlation), PC1 explained 93.597% of variance, and PC2 explained 5.635% of variance, depending on the cutting system (two, five, or seven buds, as biplot).

Cluster analysis ansured the grouping of rose varieties based on the length of the flower stalks, in relation to each cutting system, thus facilitating the choice of that cutting system that offers the quality of the flowers in relation to their use.

ACKNOWLEDGEMENTS

The authors thank to the staff of the Didactic and Research Base of the University of Life Sciences "King Mihai I" from Timisoara, Romania to facilitate this research.

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