UDC 575
https://doi.org/10.2298/GENSR180249M
Original scientific paper

SELECTION OF GARDEN ROSE CULTIVARS FOR USE AS A CUT FLOWER

Emina MLADENOVIĆ[1] Jelena ČUKANOVIĆ[1], Biljana BOŽANIĆ-TANJGA[2], Lazar PAVLOVIĆ[1], Ksenija HIEL[1], Mirjana MIRIĆ[2]

[1]Department of Fruit growing, Viticulture, Horticulture and Landscape Architecture, Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia
[2]Pheno Geno Roses d.o.o. Novi Sad, Serbia

Mladenović E., J. Čukanović, B. Božanić-Tanjga, L. Pavlović, K. Hiel, M. Mirić (2018): *Selection of garden rose cultivars for use as a cut flower*.- Genetika, Vol 50, No.2, 495-502.

Efficacy of preservative solutions on vase life of garden roses has not been researched before. Vast variability and morphological characteristics of this group of roses are very important, making them suitable for their use in bouquets, arrangements and vases. This research was carried out to examine the influence of five preservative solutions on vase life of garden rose cut flowers. The aim of research was to determine best preservative solution for prolonging of vase life of garden rose cut flower. The experiment included 8 rose cultivars cultivated for garden use. Each treatment consisted of 10 cut garden roses. The cut garden rose flowers with vase solution containing $Al_2(SO_4)_3$+ethanol+sucrose register longer vase life and higher values in water uptake. Vase life of flowers held in tap water (control) was lowest (4.38 days). This research backs the assumption that with the use of preservative solutions, garden rose also can be used as a cut flower.

Key words: cut flower, garden roses, postharvest, preservative solutions, vase life

INTRODUCTION

Cut flower of rose is one of the most frequently used flower species for making arrangements and bouquets. Production of rose is rapidly increasing globally. According to BUTT (2003) special aspect of rose production is to get cut flowers, as a part of floricultural business. Because of this, the quality of cut flower is very important, especially their vase life. The vase life of rose cut flower is very short, especially when it comes to garden roses to which this mode

Corresponding author: Emina Mladenović, University of Novi Sad, Faculty of Agriculture, Sq. Dositeja Obradovića 8, 21000 Novi Sad, Serbia, Phone: +381 21 485 3269, e-mail: eminam@polj.uns.ac.rs

of use is not primary. There are numerous studies on extending vase life of cut flower roses (AHMAD *et al*., 2014; LI *et al*., 2012; BORDA *et al*., 2011). There is no research that studies use of garden roses like it is case for cut roses. Although their original purpose is not cut flower, the reason for their use is diversity in color and dimensions of the flower. One of the most important traits which affects consumer demands are color and fragrance (SHAHRIN *et al*., 2015). In practice, garden roses are in recent decades strongly represented in bouquets and arrangements. Advantage of garden roses relative to cut roses is expressed fragrance.

Time elapsed from the moment of harvesting of flowers to final users often take several days, and the negative impacts on the quality of the cut flowers are usually quite visible. During this period, development of micro-organisms, production of ethylene and loss of energy is noted. According to ASFANANI *et al*. (2008) cut flowers lose their quality while passing through the market. In order to improve the production and quality of cut flowers, it is necessary to examine the possibility of using preservative solutions that affect the longer duration and freshness of cut flower.

The first signs of wilting of cut flower are visible on neck of rose that bents and typically is called "bent neck". Bent neck is caused due to blockage of xylem vessels by microorganisms which cause blockade of continuing transpiration by the leaves (KNEE, 2000). This leads to water stress and disturbs the balance between water uptake and transpiration, which resulted in wilting flowers.

The use of biocides can reduce the number of microorganisms and thus slow down the flowers wilt. $Al_2(SO_4)_3$ is used like an antimicrobial compound in commercial preservative solutions (ICHIMURA *et al*., 2006). MARYAM *et al*. (2012) treatments consisted of different amount of aluminum sulfate had higher relative fresh weight and extended vase life compared with control. According to the research of SKOG *et al*. (2001), in closed areas where a cut flower is stored, ethylene intensively accumulates in the plant tissue. As SÄRKKÄ (2005) stated ethanol has the role of inhibitor of ethylene biosynthesis.

Carbohydrates are necessary for turgor pressure maintenance and also, they are important energy sources facilitating flower opening (SÄRKKÄ, 2005). Many authors concluded that low carbohydrate levels in stem and leaves will reduce vase life which can be partially remedied by presence of sugar in the holding and vase solutions (WILKINS *et al*., 1996; GAST, 1997; SÄRKKÄ, 2005; HASHEMABADI *et al*., 2006). Many experiments show application of aluminum sulfate, or in a combination with sucrose, and their positive influence on vase life of cut flowers at postharvest stage (REDDY *et al*., 1996; HASSANPOUR *et al*., 2004; ICHIMURA *et al*., 2006).

MATERIALS AND METHODS

Garden roses used in experiment were growth on field in company Pheno Geno Roses, in Temerin (45°24′19″N 19°53′13″E/45.105166°N 19.886833°E). Selected cultivars of garden roses were: from Frayla Collection (Jelena, Mileva, Lenka, Katarina), Lady of Belgrade and 091 0292 0373 091 (shorted 3-091), 11 1 0164 0392 001 (2-001) and 10 1 0233 0458 001 (8-001) based on good quality of flowers, disease resistance, their assumptions and possibility of usage as a cut flower.

Garden rose (Rose hybrida) cultivars were grown under natural day length conditions on an open field. Flowers were cut and transported to the lab early in morning to avoid high temperature conditions. Time of transport from the field to the laboratory was maximum 10 min.

Stems was cut diagonally with sharp knife. Flowers were placed in separate glass jars according to treatments. Flower stems were trimmed to 20 cm underwater to avoid air embolisms (VAN LEPEREN *et al*., 2001). All leaves on the lower section of the stem were removed. The flowers were kept at experimental room temperature (22+1°C) at normal day light and natural ventilation.

The treatments were consisted of five preservative solutions. Preservative solutions were tested on eight cultivars of garden rose, with ten repetitions.

Treatments were: T1- $Al_2(SO_4)_3$+ethanol, T2- $Al_2(SO_4)_3$+ sucrose, T3- ethanol + sucrose, T4- $Al_2(SO_4)_3$+ethanol+sucrose, T5-tap water. Aluminium sulphate was added to glass jars (2 l) in an amount of 0.5 g/l, ethanol was 7%, while sucrose was added with 20 g/l.

Morphological characteristics of eight cultivars of garden rose were measured in the moment of full open flowers. According to way of use all investigated cultivars belong to shrubs with possibility of use as cut flowers. Considering that roses are rich in color, these cultivars represent only one small part of the color palette. Other measured traits were: fragrance, flower diameter, leaf color, anthocyanin presence in stems, as well as vase life of cultivars kept only in tap water and in some of the used preservative solutions.

After cutting the flower, and before it was immersed in the solution, fresh weight was measured. This was repeated every four days to the end of the experiment. To measure fresh weight, cut flowers were taken from the glass jars for 20 seconds. According to JOYCE *et al*. (1992) fresh weight of each flower was expressed relative to the initial weight to represent the water status of the flower.

Solution uptake is expressed as the ratio of the difference in the solution weight of the control and the solution weight at time 1, 4, 8 and the initial fresh weight. It's made in percentages.

Solution uptake=((St-1)-St)/Initial Fresh Weight x 100%

St-1 = solution weight of the control (g); St= solution weight at time 1,4,8 (g)

RESULTS AND DISCUSSION

Cultivars of garden roses used in experiment show high variability in all measured traits. All visual traits, especially color of flower and flower diameter are important for use of these cultivars like cut flowers. In table 1. are shown vase life of cut flowers for all eight cultivars only in tap water and in some of used preservatives. Main characteristics of examined rose cultivars are estimated based on the UPOV descriptor for roses (UPOV, 2010). In all cultivars vase life was longer in preservative solutions compared to tap water. This indicates that preservatives influence positively on longevity and quality of flowers. Cultivars of garden roses have good characteristics for use like cut flower (Picture 1).

The vase life of investigated cultivars in tap water was 5 days, while vase life increased with use of treatment 4 ($Al_2(SO_4)_3$+ethanol+sucrose). Vase life and solution uptake were lower in tap water than in all other treatments. That indicates that aluminium sulphate action as an antimicrobial agent in the solution. Sugar supply influences positively on longevity of vase life because it is a source of energy. SÄRKKÄ (2005) states that sucrose is main transporting form of sugar to flower bud.

Picture 1. Variability in qualitative characteristics of garden roses

Table 1. Main characteristics of examined rose cultivars

Cultivar	Grown type	Flower: Color use	Flower Fragrance:	Flower diameter	No. petals	Leaf color	Anthocian presence	VL (day)♦	VLP
Frayla Jelena	Shrub	Apricot	Strong	Medium	Medium	Medium	Absent	6	8
FraylaMileva	Shrub	Pink	Medium	Medium	Medium	Light	Absent	7	9
FraylaLenka	Shrub	White	Poor	Medium	Medium	Dark	Absent	7	9
Frayla Katarina	Shrub	Medium Pink	Strong	Medium	Very many	Dark	Present	6	7
Lady of Belgrade	Shrub	Orange	Poor	Medium	Very many	Dark	Absent	7	9
3-091	Shrub	Pink	Pink	Small	Very many	Medium	Present	2	8
2-001	Shrub	Red	Poor	Small	Medium	Light	Absent	3	8
8-001	Shrub	Violet	Medium	Large	Very many	Dark	Absent	2	8
Mean	-	-	-	-	-	-	-	5	7.9

♦VL-presented vase life are for roses keep only in water, VLP- vase life with some of used preservative solutions

As MARIAIM *et al*. (2012) stated application of some germicides has been suggested to prevent rapid proliferation of microorganisms and to decrease the longevity of cut flowers. Aluminium sulphate has been recommended for maintaining the vase life of several cut flowers

(LIAO *et al*., 2001; ICHIMURA *et al*., 2006). As in this research aluminium sulphate gives positive results on prolonging of vase live of garden rose for 1-6 days depending on genotype and treatment. This prolonging is big opportunity for using a flowers of garden roses in arrangements, vases, bouquets and other. According to Table 2., RFW was varied depending on preservative solution. In all treatments there is a noticeable decrease of RFW with the time. Cut flowers treated with preservative solutions, RFW remained above 100% until day 4 after harvest, while in treatment 4 (Al+sucrose+ethanol) remained above 100% until day 8 after harvest. Similar findings were reported by BAYLEYEGN *et al*. (2012). This is not case with RFW in tap water. This is in line with research of TSEGAW *et al*. (2011), who research influence of HQS on RFW, and stated that it was above 100% until day 9. But they also noticed that other biocides and preservative solutions remained above 100% up to day 5. Lowest value of RFW was in control at the end of vase life. This is in compliance with HAJIZADEH *et al*. (2012) and GEBREMEDHIN *et al*. (2013) who came to similar results in cut rose.

Table 2. Influence of preservative solutions and cultivar on RFW, solution uptake and flower head diameter of garden rose cut flower.

	RFW (%)			Solution uptake (ml/day/g)			Flower head diameter (cm)	
Treatment				Vase life (days)				
	1	**4**	**8**	**1**	**4**	**8**	**1**	**8**
Al+ethanol	110.37^{a*}	106.07^{b}	94.02^{b}	0.44^{a}	0.36^{b}	0.30^{b}	1.76^{a}	5.98^{a}
Al+sucrose	117.01^{b}	112.22^{b}	90.14^{b}	0.42^{a}	0.35^{b}	0.31^{b}	1.90^{b}	6.99^{b}
ethanol+sucrose	117.12^{b}	113.54^{b}	90.05^{b}	0.43^{a}	0.33^{b}	0.29^{b}	1.85^{b}	6.96^{b}
Al+ethanol+sucrose	119.25^{b}	110.85^{b}	100.73^{b}	0.45^{a}	0.32^{b}	0.28^{b}	1.94^{b}	7.02^{b}
Tap water	108.72^{a}	98.73^{a}	87.64^{a}	0.31^{a}	0.28^{a}	0.21^{a}	1.87^{b}	5.65^{a}
LSD (0.05)	6.12	5.91	6.45	ns	0.05	0.04	0.04	0.59
Cultivar								
Frayla Jelena	109.98^{b}	105.67^{a}	93.72^{a}	0.45^{b}	0.32^{a}	0.30^{b}	1.75^{a}	6.45^{a}
FraylaMileva	109.34^{b}	104.96^{a}	92.45^{a}	0.40^{a}	0.29^{a}	0.24^{a}	1.84^{a}	6.55^{a}
FraylaLenka	108.97^{a}	104.79^{a}	92.33^{a}	0.38^{a}	0.36^{a}	0.27^{a}	1.91^{a}	6.98^{b}
Frayla Katarina	109.02^{b}	105.73^{a}	94.01^{a}	0.45^{b}	0.34^{a}	0.32^{b}	1.97^{a}	6.74^{b}
Lady of Belgrade	110.32^{c}	105.63^{a}	93.99^{a}	0.44^{b}	0.35^{a}	0.31^{b}	1.73^{a}	6.56^{a}
3-091	109.67^{b}	105.47^{a}	93.72^{a}	0.43^{b}	0.34^{a}	0.29^{b}	1.83^{a}	6.49^{a}
2-001	108.89^{a}	104.59^{a}	92.15^{a}	0.39^{a}	0.30^{a}	0.24^{a}	1.75^{a}	6.37^{a}
8-001	109.4^{b}	105.33^{a}	93.67^{a}	0.32^{a}	0.29^{a}	0.22^{a}	1.59^{a}	6.68^{b}
LSD (0.05)	5.43	ns	ns	0.05	ns	0.03	ns	0.30

*Data letters indicate significant differences at level 0.05.

Solution uptake of the cut flowers treated with all preservative solutions on 4 and 8 days were higher than cut flowers kept in tap water. It is obviously that solution uptake depends on

the type of preservative solutions and the cultivars. With increase of storage days solution uptake decreased. The reason for this maybe can be explained with air embolism of cut stem, proliferation of microbes and plant reaction to wounding (TSEGAW *et al*., 2011).

Flower head diameter is trait that was affected by preservative solution. The largest diameter were in cut flowers treated with Al+ethanol+sucrose (7.02 cm), while the smallest were in tap water (5.65 cm).The difference between Al+sucrose and ethanol+sucrose was not statistically significant. SÄRKKÄ (2005) suggested that carbohydrates are necessary for turgor pressure maintenance, and it is important energy source for flower opening. This conclusion can be applied on this research, were preservative solution with sucrose show high value of flower head diameter on 8 day of vase life. Compared the relationship between the flower head diameter and cultivars it can be observed that flower diameter can vary due to variation in genetic structure of phenotype.

CONCLUSION

The results of this study are the first to show influence of preservative solutions on vase life of cut garden roses. As best preservative solution for vase life can be recommended combination of $Al_2(SO_4)_3$, ethanol and sucrose. $Al_2(SO_4)_3$ influence like antimicrobial compound, sucrose increase the longevity of cut garden rose as a source of nutrition for tissues. Act of ethanol is to decrease ethylene production. Important result of this research is evidence that examined cultivars of garden rose can be used like cut roses with vase life of 8 days depending of preservative solution and cultivar.

ACKNOWLEDGEMENTS:

This paper was realized with help of Pheno Geno Roses in materials and experiment place.

Received, November 28th, 2017
Accepted February 18th, 2018

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SELEKCIJA GENOTIPOVA BAŠTENSKE RUŽE ZA UPOTREBU KAO REZAN CVET

Emina MLADENOVIĆ[1], Jelena ČUKANOVIĆ[1], Biljana BOŽANIĆ-TANJGA[2], Lazar PAVLOVIĆ[1], Ksenija HIEL[1], Mirjana MIRIĆ[2]

[1]Departman za voćarstvo, vinogradarstvo, hortikulturu i pejzažnu arhitekturu, Poljoprivredni fakultet, Univerzitet u Novom Sadu, Novi Sad, Srbija
[2]Pheno Geno Roses d.o.o.,Novi Sad, Srbija

Izvod

Uticaj rastvora za održavanje svežine rezanog cveta na dužinu trajanja rezanog cveta baštenske ruže nije do sada ispitan. Velika varijabilnost morfoloških karakteristika ove grupe cveća je veoma važna i čini ih pogodnim za upotrebu u buketima, aranžmanima i u vazi. Istraživanje je sprovedeno sa ciljem da se ispita uticaj pet rastvora za održavanje svežine rezanog cveta na dužinu trajanja rezanog cveta baštenske ruže. Ekperiment je uključio 8 kultivara baštenske ruže. U svaki tretman uključeno je 10 komada rezanog cveta baštenske ruže. Rezultati su pokazali da su kultivari imali veću dužinu trajanja kada se u vazi nalazio rastvor koji se sastojao od $Al_2(SO_4)_3$+etanol+saharoza. Dužina trajanja cveta bila je najmanja kod kontrolnih biljaka koje su stajale u običnoj vodi. Ovo istraživanje potvrdilo je hipotezu da se baštenske ruže mogu koristiti kao rezan cvet, i da im se dužina trajanja u vazi povećava upotrebom rastvora za održavanje svežine rezanog cveta.

Primljeno 18.XI.2017.
Odobreno 18. II. 2018.