Original scientific paper
Originalan naučni rad
UDK: 635.91:631.535
DOI: 10.7251/AGREN1204573P

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Growing *Pelargonium peltatum* and *Pelargonium x hortum* from Cuttings

Nada Parađiković[1], Monika Tkalec[1], Jadranka Mustapić-Karlić[2], Ivana Križan[1], Tomislav Vinković[1]

[1]*University of J. J. Strosmayer, Faculty of Agriculture, Osijek, Croatia*
[2]*Technical school Ruđer Bošković, Vinkovci, Croatia*

Abstract

Pelargoniums are plants from the family *Geraniaceae*, and one of the most popular summer flowering species that adorn balconies and windows of the houses and are present on the market since the 18th century. In Croatia, the most commonly grown are ivy-geraniums (*P. peltatum*) and zonal (*P. zonale*) geraniums. They reproduce vegetatively because propagating by seeds is expensive and only large horticultural companies can afford it. Every year new cultivars are produced, but geraniums still have a very simple genotype and are grown very successfully, adhering to a few basic rules for their cultivation. The aim of this study with the species *Pelargonium peltatum* and *Pelargonium x hortorum* was to assess the effects of the use of hormones to stimulate root growth when planting cuttings to obtain plants and to monitor the development of cuttings. The cuttings of two different types of pelargonium were treated with Rhizopon hormone to stimulate growth and rooting. Results showed that hormone therapy has no significant effect on growth of these geranium species. Differences between treated and control seedlings were very small, hormone-treated cuttings had faster growth of their roots, although at all stages of measuring the length of P. Peltatum cuttings was significantly higher compared to the P. x hortorum cuttings ($p=0.01$).

Key words: geraniums, cuttings, hormone therapy, rooting, seedlings.

Introduction

Geraniums are easily grown and propagated and that is why their cultivation and popularity have vastly expanded among the fans of flowers. Geraniums are mostly propagated vegetatively by cuttings. The first botanists have classified *Pelargonium zonale* (*Pelargonium x hortum*) in *Geranium* genus, but with further observation and

after differences were detected in relation to other members of this genus, they have established a new genus *Pelargonium*. Different flower structure clearly points to the fact that these are two separate genuses. Thus, a geranium flower has a regular shape with five petals of equal shape and size, and at pelargonium flower, the two upper petals are clearly separated from the bottom three (Pagliarini, 2003; Knežević, 2007.). The major groups of pelargoniums are flowering and scented-leaf pelargoniums. Flowering pelargoniums are further divided into two main groups: *Pelargonium zonale* (vertical) and *Pelargonium peltatum* (cascade and ivy-leaved). Pelargoniums are best grown on soil or substrates with a pH from 5.5 to 6.5 depending on the species. It is best to use specially prepared substrates for pelargoniums (Kessler, 1998.). Optimal values of EC (electrical conductivity) for pelargoniums are 1.0 - 2.5 mS/cm. Ivy-leaved pelargoniums have values from 1.5 to 2.5 mS/cm, while *zonale* pelargoniums include EC values from 1.0 to 2.0 mS/cm. With reduced fertilisation rate, the value of EC also reduces and vice versa, i.e. if it is necessary to increase the conductivity, pelargonium fertilisation should be increased as well (Whipker, 1998) (Table 1.).

Tab. 1. Display of the optimal amount of basic nutrients, PH and EC in the substrate during the cultivation of geranium (Whipker, 1998).
Prikaz optimalnih količina osnovnih hraniva i vrijednosti pH i EC u supstratu pri uzgoju pelargonija (Whipker, 1998.)

		Optimal values *Optimalne vrijednosti*	
	Measurment Unit *Mjerna jedinica*	Ivy-leaved *Baršljanolisne*	Zonale *Zonale*
pH		5,8 – 6,3	5,5 – 6,0
EC	mS/cm	1,5 – 2,5	1,0 – 2,0
Nitrogen *Dušik*	ppm	200 – 250	200 – 250
Phosphorus *Fosfor*	ppm	5 – 19	5 – 19
Potassium *Kalij*	ppm	150 – 250	150 – 250
Calcium *Kalcij*	ppm	50 – 100	50 – 100
Magnesium *Magnezij*	ppm	25 – 50	25 – 50

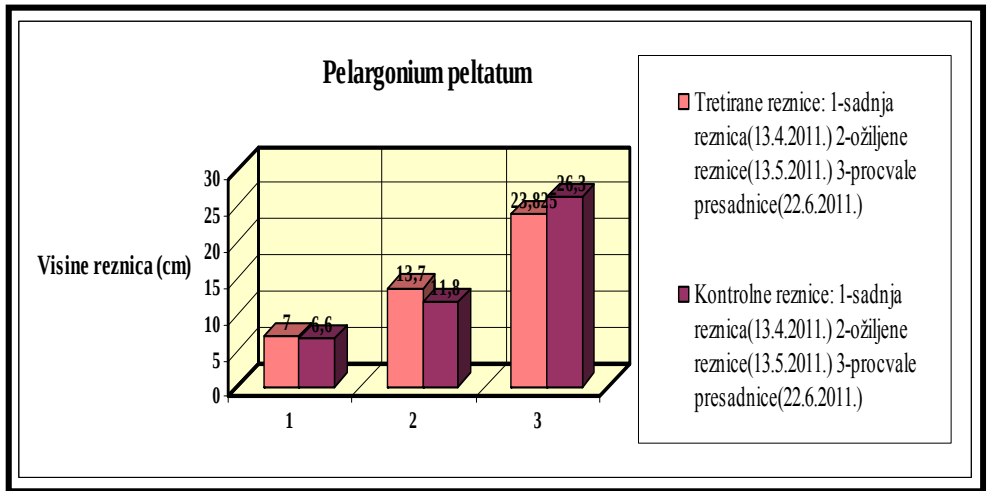
Through a period of intense growth and flowering (April-September), plants should be watered twice a month with water with addition of a complex liquid fertiliser for flowering (rich in nitrogen and iron, and then potassium and phosphorus and with microelements, NPK-Plantella 4:6:8). For better and bushy plant growth, it is advisable to cut short shoot tips periodically. If the plants start to elongate unnaturally, they should be treated with a growth retardant such as cikocel (CCC) and daminozide (ALAR) in concentration of 0.25 to 0.50 percent (Kessler, 1998). Geraniums are easily

propagated vegetatively by cuttings. Parent plants (the best plants are two years old) that we take cuttings from need to be healthy, strong and well-developed. The advantage of vegetative propagation is the production of new plants that are identical to the mother plant, which, when grown from seeds, cannot be achieved, and this is of great importance for the market (Lindgren and Toodle, 2002). Selected cuttings can be immersed in a hormone powder for faster rooting, but even without the use of hormones, reproductive success of cuttings is almost always 100%. Cuttings should be put in a place without direct sunlight. During the first two weeks of rooting, cuttings must be exposed to light of 1800-2800 lx, while subsequent exposure to light should be around 2800-3600 lx. For successful and faster rooting, cuttings need a daily temperature of 22 to 26°C and night temperatures 20-21°C. Planted cuttings should be watered regularly. After two weeks, they will begin to form roots, and after a month, the cuttings are rooted and can be transplanted into individual pots (Kessler, 1998). If there is not enough natural light, HID lamps are used as a supplementary light source. Young plants need weekly fertilisation (e.g. NPK 10-20-20, 150-200 ppm N) (Jauron., 1994). Propagation by seeds (generative) (Lindgren and Toodle, 2002.) is also possible, but is very expensive and usually only affordable to large horticultural companies that have their own seed banks that are used in the production of new varieties. Propagation by seeds is more common in upright pelargonium (*Pelargonium zonale*).

Materials and methods

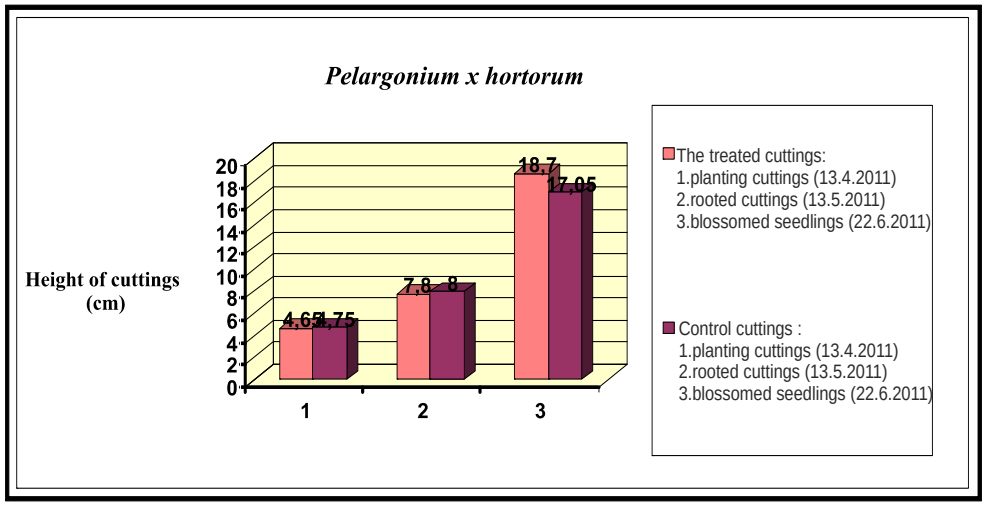
The experiment was set on 13 April 2011 in a greenhouse on the Iljkić family farm, Josipovac, Croatia. Final sampling was performed on 22 June 2011 and thus the study was completed. The experiment was set up in a split-plot design with four replications for both species. A major factor was treatment with a rooting hormone whereas a sub factor referred to different types of pelargonium. For the production of seedlings, stem cuttings of mother plants of *Pelargonium peltatum* and *Pelargonium x hortorum* species were used. 20 cuttings were treated with a hormone for leaf and herbaceous cuttings, Rhizopon I (dust formulation, active substance, indole butyric acid 0.5%, of the Plantella manufacturer, The Netherlands), which serves as a means to stimulate root growth, or to root cuttings. The remaining 20 cuttings were used as a control. Before planting in the substrate, the base of cuttings was drenched in the Rhizopon hormone powder and control cuttings were planted in the substrate without the hormone. The procedure was the same for both types of pelargonium. Cuttings were planted in a multipot plate with 40 planting places, 530 x 310 x 60 mm, with holes for the cuttings size ø 53/33 x 55 mm and a volume of 78 ml per opening. Brill Type 4 substrate was used for planting. Brill Substrate-Type 4 is characterized by good drainage and buffering capacity due to the presence of particles of black peat in the composition and particle holding capacity and has a firm structure. This substrate contains 80% black peat, 20% white peat and NPK-1600g fertiliser/m^3 including microelements and molybdenum. Before the last sampling of seedlings, substrate was thoroughly removed around the roots of each one in order to be able to measure the total length of the plant and the length of the root. Each plant was weighed on a digital

scale, as well as their roots. The data were statistically analysed using analysis of variance and the differences between treatments specifically with F-test using a VVSTAT computer program (Vukadinović, 1994).



Graph. 1. Comparison of the height of treated and control cuttings (cm) at planting, rooting and flowering of *Pelargonium peltatum*

Usporedba visine tretiranih i kontrolnih reznica (cm) pri sadnji, ožiljavanju i cvatnji vrste Pelargonium peltatum



Graph. 2. Comparison of the height of treated and control cuttings (cm) at planting, rooting and flowering of Pelargonium x hortorum

Usporedba visine tretiranih i kontrolnih reznica (cm) pri sadnji, ožiljavanju i cvatnji vrste Pelargonium x hortorum

Results and discussion

Graphs 1 and 2 show the mean height values of cuttings, rooted plants and grown seedlings. Seedlings of *Pelargonium peltatum* species had twice the height in every measurement, rooted treated plants showed slightly better growth and blossomed transplants had a greater increase in control plants. In *Pelargonium x hortorum* seedlings, rooted cuttings were more successful in the control than in the treated ones, and blossomed transplants had better growth in treated plants (Kessler, 1998).

Tab. 2. Influence of treatment and cultivar on Pelargonia cuttings height during planting stage
Utjecaj tretmana i kultivara na visinu reznice Pelargonija tijekom sadnje

Variant (A)	Cuttings height (cm) *Visina reznica (cm)*		
	P. peltatum (B1)	*P. x hortorum* (B2)	Mean *Prosjek*
Tretment (A1) *Tretman(A1)*	6.950	4.640	5.795
Control (A2) *Kontrola (A2)*	6.575	4.735	5.655
Mean *Prosjek*	6.762	4.688	5.725

LSD	Cuttings height *Visina reznica*		
	Treatment (A) *Tretman (A)*	Cultivar (B) *Kultivar (B)*	Interactions *Interakcije* A x B
0,01	ns	0.4480	ns
0,05	ns	0.2958	ns

A statistical analysis showed that the height of the cuttings when planting was under statistically significant influence of the cultivars ($p = 0.01$). Cuttings of *P. peltatum* cultivars had 44.24% greater length than the *P. x hortorum* cultivar. The greatest length of the cuttings was 6.950 cm while the lowest was 4.735 cm (Table 4.).

Tab. 3. Influence of treatment and cultivar on the height of Pelargonia cuttings during rooting stage
Utjecaj tretmana i kultivara na visinu reznice Pelargonije tijekom ukorjenjavanja

Variant (A)	Cuttings height (cm) *Visina reznica (cm)*		
	P. peltatum (B1)	*P. x hortorum* (B2)	Mean *Prosjek*
Tretment (A1) *Tretman(A1)*	14.375	7.800	11.088
Control (A2) *Kontrola (A2)*	11.750	7.990	9.870
Mean *Prosjek*	13.063	7.895	10.478
	Cuttings height *Visina reznica*		
LSD	Treatment (A) *Tretman (A)*	Cultivar (B) *Kultivar (B)*	Interactions *Interakcije* A x B
0,01	ns	1.1344	2.1175
0,05	1.1148	0.7488	1.2737

Tab. 4. Influence of treatment and cultivar on the height of Pelargonia cuttings during flowering stage
Utjecaj tretmana i kultivara na visinu reznice Pelargonije tijekom cvatnje

Variant (A)	Cuttings height (cm) *Visina reznica (cm)*		
	P. peltatum (B1)	*P. x hortorum* (B2)	Mean *Prosjek*
Tretment (A1) *Tretman(A1)*	24.425	18.700	21.562
Control (A2) *Kontrola (A2)*	26.213	17.050	21.631
Mean *Prosjek*	25.319	17.875	21.5969
	Cuttings height *Visina reznica*		
LSD	Treatment (A) *Tretman (A)*	Cultivar (B) *Kultivar (B)*	Interactions *Interakcije* A x B
0,01	ns	3.7737	ns
0,05	ns	2.4910	ns

Treatment on rooting pelargonium cuttings gave significantly higher cuttings compared to the untreated cuttings ($p = 0.01$). It was also found that there was a statistically significant effect of cultivars ($p = 0.01$) on the length of cuttings, with the ones of *P. peltatum* being 65.45% higher compared to cuttings of *P. x hortorum*.

The maximum cuttings height recorded was 14.375 cm and belonged to the treated cuttings of *P. peltatum* cultivar while the lowest height, 7.800 cm, belonged to the treated *P. x hortorum*. During this part of the study, there was a statistically significant interaction between the examined factors. During the last phase of the study and the last sampling, a statistical analysis of the data revealed statistically significant effects of cultivars while the significance of treatment was not proved. The length of *P. peltatum* cuttings was significantly higher than in the *P. x hortorum* cultivar ($p = 0.01$). The greatest height of cuttings was found in the *P. peltatum* cultivar, the control cuttings, and totalled 26.213 cm. The minimum height of cuttings was recorded in control cuttings of *P. x hortorum*.

Upon a completion of the research, growth of the whole plant and root growth was determined on all pelargoniums. The results showed that the treated plants had slightly longer root growth, while the control plants had higher aboveground growth. According to the Kessler (1998) study, the hormone probably influenced root activity of treated cuttings. The resulting increase in the mean height of the above ground parts of plants and their roots in the *Pelargonium x hortorum* species showed a slightly higher increase of root and stem of treated cuttings the control once. Hormone effects induced early rooting of cuttings, so the above-ground part of the plant could start early with growth and development, that way treated seedlings showed better and stronger growth than the control seedlings (Table 3) (Kessler, 1998).

Conclusion

By analysing the results obtained experimentally, it was determined that the use of hormones for rooting did not achieve significant increase in the percentage of receipt cuttings because untreated cuttings tend to have the same success at reception, if grown in controlled conditions. Growth and development of the aboveground parts of plants was very successful even without hormone treatment, but treated plants still had better growth of the whole plant. At all measuring stages, the length of *P. peltatum* cuttings was significantly higher than in *P. x hortorum* ($p = 0.01$). Planted cuttings rooted after four weeks. *Pelargonium peltatum* had 100% reception of control cuttings, and 95% reception of treated cuttings. *Pelargonium x hortorum* had 100% reception of both control and treated cuttings. Both species had well-developed adventitious roots and achieved remarkable growth of the plants, and have blossomed with more flowers. During the experiment, there was no application of complex liquid manure or other fertiliser formulations. During the research, the plants were grown in containers so that the increase in height was greater than usual, and growth retardants were not applied because of the focus of research on the observation of root development. Seedlings were equally successful in terms of growth and development. Sampling showed very little difference between the treated and control cuttings. From these experiment

results, we can assume that pelargoniums are very simple genetic plants and that their vegetative propagation by cuttings and further growth and development can be very successful without application of growth hormones while maintaining optimal environmental growth conditions.

References

1. *Jauron R.* (1995.): Growing Geraniums From Seed, Department of Horticulture, Iowa State University of Science and Technology.
2. *J.R. Kessler, Jr.* (1998.): Greenhouse Production of Zonal Geraniums, Auburn University, U.S.
3. *Knežević M.* (2007.): Sistematika bilja – skripta (Morfologija generativnih organa kritosjemenjača: 49-57 str.); Poljoprivredni fakultet u Osijeku.
4. *Lindgren D., Tood K.* (2002.): Geranium, Published by cooperative extension Institute of Agriculture, Nebraska, U.S.
5. *Pagliarini N., Vrdoljak A.* (2003.): Pelargonije - Uzgoj i zaštita, priručnik (11-18 str.); ¨Stanek¨ d.o.o., Varaždin.
6. *Vukadinović, V.* (1994.): VVSTAT - računalni program za statističku obradu podataka. Poljoprivredni fakultet Osijek.
7. *Whipker, Brian E.* (1998.): Fertility Management for Geraniums, Department of Agriculture, North Carolina State University at Raleigh, North Carolina A&T State University, U.S.

Uzgoj *Pelargonium peltatum* i *Pelargonium hortum* iz reznica

Nada Parađiković[1], Monika Tkalec[1], Jadranka Mustapić-Karlić[2], Ivana Križan[1], Tomislav Vinković[1]

[1]*Sveučilište J. J. Strossmayera u Osijeku, Poljoprivredni fakultet, Osijek, Hrvatska*
[2]*Tehnička škola Ruđer Bošković, Vinkovci, Hrvatska*

Sažetak

Pelargonije su biljke iz porodice *Geraniaceae* i jedne su od najomiljenijih vrsta ljetnjeg cvijeća koje ukrašava balkone i prozore kuća, a na tržištu su prisutne od 18. vijeka. U Hrvatskoj se najčešće gaje puzave pelargonije (*P. peltatum*) i uspravne pelargonije (*P. zonale*). Razmnožavaju se vegetativnim putem zato što je uzgoj iz sjemena skup i samo velika hortikulturna preduzeća mogu priuštiti takvo uzgajanje. Svake godine se proizvode nove sorte, ali geranijumi još uvijek imaju veoma jednostavan genotip i uspješno se uzgajaju na osnovu nekoliko osnovnih pravila ključnih za njihov uzgoj. Cilj ovog istraživanja vrsta *Pelargonium peltatum* i *Pelargonium x hortorum* bio je da se procijeni uticaj upotrebe hormona kojima se stimuliše rast korijena kada se sade reznice kako bi se dobile biljke i da bi se pratio razvoj reznica. Dva različita tipa reznica su tretirana hormonom Rizoponom kako bi se stimulisao rast i ukorjenjivanje. Rezultati su pokazali da hormonska terapija nema značajan uticaj na rast ovih vrsta geranijuma. Razlike između tretiranih i kontrolnih sadnica su bile veoma male pri čemu su renice tretirane hormonom imale brži rast korijena iako je u svim fazama mjerenja dužina reznica P. peltatum bila znatno veća od reznica P. x hortorum ($p=0.01$).

Ključne riječi: geranijumi, reznice, hormonska terapija, ukorjenjivanje, sadnice.

Monika Tkalec
E-mail Address:
monikat@pfos.hr