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EFFECTS OF CUTTING SIZE AND EXOGENOUS HORMONES ON ROOTING OF SOFTWOOD CUTTINGS OF *CORNUS MAS L.*

Abstract: In this study, the effect of cutting size and IBA concentration on rooting of softwood cuttings of cornelian cherry was examined. Eight types of cuttings were taken from mother trees in the urban forest in Belgrade area (terminal and node cuttings with current season's wood only, and terminal and node cuttings with a small section of 2-year-old wood) and rooted under intermittent mist. Rooting rate was not affected significantly by a cutting size, but larger cuttings had better developed root system. Therefore, it is recommended to use longer cuttings (terminal with one node, or two-nodal) treated with 1% IBA (90–96% rooting rate).

Key words: *Cornus mas, IBA, green cuttings, Cornelian cherry*

1. INTRODUCTION

The cornelian cherry (*Cornus mas* L., fam. *Cornaceae*) is a medium to large deciduous shrub or small tree, growing on warm and sunny forest margins, open forests, and coppices on dry and warm slopes, in altitudes of up to 1400 meters. It is native to Southern Europe and Southwest Asia. The Cornelian cherry is low maintenance, undemanding plant, which can grow on the different soil types, from sandy to clay soils, as well as on shallow soils. Also, it is drought-resistant species, suitable for hedges, anti-erosion protection and for planting in urban areas, tolerating high levels of air pollution (Mratinić and Kojić, 1998, Bijelić et al., 2012 b, Dokupil and Řezniček, 2012). Furthermore, Cornelian cherry is important honey plant, which blooms early in the spring. Its fruit is red drupe, ripening from August to September. *C. mas* has high potential for organic production as valuable fruit species, having good yield potential even without special care (Demir

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and Kalyoncu, 2003, Cakmakci and Tosun, 2010, Bijelić et al., 2012 b). Its wood is strong and extremely dense, and valuable in carpentry (Mratinić and Kojić, 1998).

The Cornelian cherry could be mass-propagated by seed or cuttings (Piotto and Di Noi, 2001). Generative propagation is complicated and time demanding due to long stratification period (18–36 weeks) and not very high germination rate (50–60%) (Piotto and Di Noi, 2001). The propagation by softwood cuttings is simple method which could be recommended for production of *C. mas* (Bijelić et al., 2012 a, Klimenko, 2004, Korszun and Kolasinski, 2002, Marković et al., 2014 a, b, Yalcinkaya et al., 1999).

C. mas is rarely grown species in the Belgrade area, and its planting should be promoted according to the principles of natural landscaping which promote the use of native plant species instead of neophytes as way of "creative conservation" of the wild, local genotypes (Marković, 2013). Therefore, possibility of propagation of local superior genotypes in Belgrade area was investigated in order to establish the method for obtaining high quality and well adapted planting material (Marković et al., 2014 a, b). Previous research investigated the effect of application method and concentration of indole-3-butyric acid (IBA), the influence of cutting type (apical or single-node) and the influence of time of taking cuttings on rooting of softwood cuttings of selected *C. mas* trees from the Belgrade area (Marković et al., 2014 a, b). However, some researchers report that cutting size have considerable influence on rooting and the futher survival of rooted cuttings (Beyl et al., 1995, Burgess et al., 1990, Gerrakakis and Özkaya, 2005, Gopale and Zunjarrao, 2011, Vigl and Rewald, 2014, Yang et al., 2015). Thus, the aim of this study was to investigate the influence of cutting size on rooting of selected *C. mas* trees.

2. MATERIAL AND METHOD

The group of *C. mas* vigorous and healthy trees in the natural population in Belgrade area (Miljakovacka forest) was selected. On 19. 7. 2012., from the selected trees, 2 groups of cutting were taken. The first group consisted of 4 types of cuttings: (1) terminal cuttings with current season's wood only, (2) terminal cuttings with a section of 2-year-old wood, (3) single-node cuttings with current season's wood only, (4) single-node cuttings with a section of 2-year-old wood, and the second group consisted of same types of cuttings as first one, but all cuttings were longer with one more node. The cuttings were treated by 0,15% dilution of fungicide Previcur and then their base was dipped in dust preparation of 0.2% or 1% IBA. In the control the Auxin treatment was omitted. The rooting was performed in sand, under intermittent mist, in greenhouse of the Faculty of Forestry, Belgrade.

Rooting percentage and other parameters such as the number and length of primary roots, as well as the frequency and the number of secondary roots were determined 10 weeks after placing of cuttings. Eight explants were used per treatment with three replications. The significance of differences between the means was determined by the analysis of variance (ANOVA, $p < 0.05$) and the least significant difference (LSD) test. Before the analysis, arcsine transformation was used to convert the percentage data.

3. RESULTS

After the removal from sand, the cuttings were classified into four categories: rooted cuttings, unrooted with callus, necrotic, unchanged cuttings. The obtained results varied depending on cutting type and IBA concentration (Table 1). However,

Table 1. State of cuttings ten weeks after sticking

Cutting type	Hormone	State of cuttings			
		rooted (%)	unchanged (%)	callusing (%)	necrotic (%)
nodal cuttings	0.2% IBA	75.0 ef	0.0 a	0.0 a	25.0 bcd
nodal cuttings + node		50.0 cde	0.0 a	0.0 a	50.0 e
nodal cuttings with 2-year-old wood		20.8 abc	66.8 e	0.0 a	12.4 abc
nodal cuttings with 2-year-old wood + node		29.0 abc	0.0 a	0.0 a	71.0 f
terminal cuttings		29.2 abc	12.5 b	8.3 abc	55.0 e
terminal cuttings + node		87.5 g	0.0 a	8.3 abc	4.2 ab
terminal cuttings with 2-year-old wood		25.0 abc	8.3 ab	8.3 abc	58.4 e
terminal cuttings with 2-year-old wood + node		41.8 bcd	8.3 ab	4.2 ab	45.7 e
nodal cuttings	1% IBA	89.7 fg	0.0 a	0.0 a	10.3 abc
nodal cuttings + node		88.0 fg	0.0 a	0.0 a	12.0 abcd
nodal cuttings with 2-year-old wood		63.1 de	0.0 a	4.2 ab	32.7 cd
nodal cuttings with 2-year-old wood + node		95.8 g	0.0 a	0.0 a	4.2 ab
terminal cuttings		90.3 fg	0.0 a	5.5 ab	4.2 ab
terminal cuttings + node		91.7 g	0.0 a	0.0 a	8.3 abc
terminal cuttings with 2-year-old wood		95.8 g	0.0 a	0.0 a	4.2 ab
terminal cuttings with 2-year-old wood + node		70.8 def	0.0 a	0.0 a	29.2 cd
nodal cuttings	control	20.8 abc	29.2 c	50.0 g	0.0 a
nodal cuttings + node		16.7 abc	50.0 d	33.3 f	0.0 a
nodal cuttings with 2-year-old wood		50.0 cde	0.0 a	16.6 bcd	33.4 cd
nodal cuttings with 2-year-old wood + node		33.4 abcd	0.0 a	29.2 ef	37.4 de
terminal cuttings		12.5 ab	0.0 a	83.3 h	4.2 ab
terminal cuttings + node		37.8 bcd	0.0 a	62.2 g	0.0 a
terminal cuttings with 2-year-old wood		12.5 ab	0.0 a	25.3 def	62.2 f
terminal cuttings with 2-year-old wood + node		0.0 a	0.0 a	28.7 cde	71.3 f

Values followed by different letters are significantly different at the $P < 0.05$ level according to the LSD test

Table 2. Number and lenght of primary roots

Cutting type	Hormone	Mean No. of roots	Mean length of roots (mm) $\overline{X}$±se
nodal cuttings	0,2% IBA	4,3 a	20,1 a
nodal cuttings + node		6,2 abc	46,2 cd
nodal cuttings with 2-year-old wood		2,3 a	35,6 ab
nodal cuttings with 2-year-old wood + node		4,0 a	19,6 a
terminal cuttings		6,7 abc	30,9 ab
terminal cuttings + node		8,8 bcd	29,8 ab
terminal cuttings with 2-year-old wood		5,7 abc	24,8 a
terminal cuttings with 2-year-old wood + node		6,6 abc	27,8 ab
nodal cuttings	1% IBA	11,5 de	29,5 a
nodal cuttings + node		11,6 de	34,4 ab
nodal cuttings with 2-year-old wood		9,6 bcd	23,0 a
nodal cuttings with 2-year-old wood + node		14,3 e	27,3 ab
terminal cuttings		9,6 bcd	29,7 ab
terminal cuttings + node		10,6 cd	27,6 ab
terminal cuttings with 2-year-old wood		6,3 abc	26,6 ab
terminal cuttings with 2-year-old wood + node		7,3 abc	24,9 a
nodal cuttings	control	6,0 abc	56,3 d
nodal cuttings + node		8,0 abc	41,5 c
nodal cuttings with 2-year-old wood		5,7 abc	38,3 bc
nodal cuttings with 2-year-old wood + node		5,3 abc	57,7 d
terminal cuttings		2,0 a	17,0 a
terminal cuttings + node		5,3 abc	33,8 ab
terminal cuttings with 2-year-old wood		6,0 abc	30,5 ab
terminal cuttings with 2-year-old wood + node		—	—

Values followed by different letters are significantly different at the P < 0,05 level according to the LSD test

IBA concentration strongly affected rooting rate, and the best results were achieved with cuttings treated with 1% IBA where rooting percentage was higher than 63%, in most cases ranging between 87% and 97% (Table 1). Cuttings treated with 0.2% IBA had lower rooting percentage, but the obtained results differed depending on cutting type, and the better results were achieved with terminal and nodal cuttings

Table 3. Number of secondary roots

Cutting type	Hormone	Frequency* (%)	Mean No. of roots
nodal cuttings	0,2% IBA	33,3	3,3 a
nodal cuttings + node		50,0	14,7 c
nodal cuttings with 2-year-old wood		50,0	6,0 ab
nodal cuttings with 2-year-old wood + node		0,0	—
terminal cuttings		57,1	11,5 bc
terminal cuttings + node		55,0	7,0 ab
terminal cuttings with 2-year-old wood		50,0	14,0 bc
terminal cuttings with 2-year-old wood + node		40,0	10,2 bc
nodal cuttings	1% IBA	28,6	7,0 ab
nodal cuttings + node		30,0	4,3 a
nodal cuttings with 2-year-old wood		21,4	6,3 ab
nodal cuttings with 2-year-old wood + node		25,0	3,7 a
terminal cuttings		75,0	7,3 ab
terminal cuttings + node		40,9	4,5 a
terminal cuttings with 2-year-old wood		37,5	6,3 ab
terminal cuttings with 2-year-old wood + node		25,0	1,3 a
nodal cuttings	control	50,0	17,0 cd
nodal cuttings + node		100,0	22,7 d
nodal cuttings with 2-year-old wood		100,0	15,5 c
nodal cuttings with 2-year-old wood + node		33,3	26,3 d
terminal cuttings		0,0	—
terminal cuttings + node		66,7	6,0 ab
terminal cuttings with 2-year-old wood		100,0	6,0 ab
terminal cuttings with 2-year-old wood + node		0,0	—

Values followed by different letters are significantly different at the $P < 0,05$ level according to the LSD test
* Frequency represent the percentage of rooted cuttings which have formed secondary roots

only with current season's wood than with cuttings containing a section of 2-year-old wood. However, in the control, the nodal cuttings with 2-year-old wood had highest rooting rate.

Nodal cuttings treated with 1% IBA formed the highest mean number of roots (9,6–14,3) (Table 2). Similarly, terminal cuttings with only current season's wood also formed high number of roots in 1% IBA treatment (9,6–10,6). However, the mean number of primary roots of all types of cutting was low in the 0,2% IBA treatment and control, and obtained values mostly varied between 2,3 and 6,7. The mean length of roots ranged between 17,0 mm and 57,7 mm, and the longest roots were developed from nodal cuttings in control treatment (38,3–57,7 mm) (Table 2). However, there was no statistically significant difference among mean length of roots developed from any of types of cuttings treated with 0,2% or 1% IBA (19,6–35,6 mm), with the exception of two-nodal cuttings treated with 0,2% IBA (46,2 mm).

The mean number of secondary roots was very variable, ranging from 1,3 to 26,3 (Table 3). Nevertheless, in the 1% IBA treatment it was quite low, not exceeding 7,3, without statistically significant difference among different cutting types. On the contrary, the best results were achieved in the control treatment where number of secondary roots developed from nodal cuttings ranged between 15,5 and 26,3, but two-nodal cutting had more secondary roots (22,7–26,3) than single node cuttings (15,5–17,0).

4. DISCUSSION

Results obtained in our research showed that the highest influence on rooting had IBA concentration, because rooting percentage and mean number of primary roots were noticeably high for all cutting types in 1% IBA treatment. Differences in rooting rate and mean number of primary roots for nodal and terminal cuttings were recorded, but in most cases they were not statistically significant. This is contrary to the results obtained during propagation of this species using cuttings taken earlier in June where cutting type strongly influenced rooting percentage, and the terminal cuttings with current season wood were rooted in higher percentage (96,7%) than terminal cuttings with 2-year-old wood (38,4%) or nodal cuttings (37,5–58,3%) in the 1% IBA treatment (Marković et al., 2014 a). However, in presented research, in the 1% IBA treatment rooting rate was high for terminal as well as for nodal cuttings (88,0–95,8%) with the exception of the nodal cuttings with 2-year-old wood (63,1%) and the terminal cuttings with 2-year-old wood with node (70,8%).

Influence of hormone concentration and time of taking cuttings on rooting rate was previously described for Cornelian cherry (Bijelic at al., 2012 a, Kosina and Baudyšová, 2011, Korszun and Kolasinski, 2002, Marković et al., 2014 a, b, Pirlak, 2000), but optimal concentrations differed depending on author. On the other hand, in the mentioned researched different cutting types of *C. mas* were used, in some cases two-nodal green cuttings (Bijelic at al., 2012, Korszun and Kolasinski, 2002), but in some cases hardwood cuttings were used (Hassanpour and Ali Shiri, 2014, Pirlak, 2000). However, there were no investigations of influence of cutting size on rooting rate. In our research, length of cuttings influenced the rooting rate differently, depending on cutting type and hormone concentration. The most obvious difference was in 0,2% IBA treatment, where terminal cuttings with node was rooted in noticeably higher percentage (87,5%) than terminal cuttings with apical bud only (29,2%), but in the control this difference was smaller (37,8% and 12,5%), and finally in the 1% IBA treatment there were almost no difference (91,7%

and 90,3%). Although some authors (Beyl et al., 1995, Burgess et al., 1990, Gopale and Zunjarrao, 2011, Vigl and Rewald, 2014, Yang et al., 2015) emphasize the importance of cutting size for the succesfull rooting and growth of some species, for some other species cutting length didn't affect their rooting percentage (Bona et al., 2012, Miller et al., 1982, Owuor et al., 2009), but affected the number of primary roots and the longer cuttings had more primary roots (Bona et al., 2012, Miller et al., 1982) which can be also observed in our research. Previous investigations also showed that cutting diameter have significant influence on rooting, more important than cutting length, probably due to higher carbohydrate reserves in cuttings with greater thickness relative to thinner cuttings (Beyl et al., 1995, Biondi et al., 2008, Zhang et al., 2010). However, in some cases rooting percentage could decrease with increasing cutting diameter (Howard and Ridout, 1991).

5. CONCLUSIONS

According to the results obtained in our research, it can be concluded that the selected elite trees can be propagated by softwood cuttings treated with 1% IBA taken in July. For propagation, terminal as well as nodal cuttings can be used. Rooting rate was not affected by a cutting size, but larger cuttings should be used in order to obtain better developed root system.

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