ISSN 1821-1046
UDK 630

INSTITUTE OF FORESTRY
BELGRADE

INSTITUT ZA ŠUMARSTVO
BEOGRAD

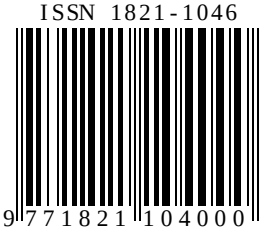
SUSTAINABLE FORESTRY ODRŽIVO ŠUMARSTVO

COLLECTION
Vol. 92

ZBORNIK RADOVA
Vol. 92

BELGRADE BEOGRAD
2025.

ISSN 1821-1046



ISSN 1821-1046
UDK 630

INSTITUTE OF FORESTRY
BELGRADE

INSTITUT ZA ŠUMARSTVO
BEOGRAD

SUSTAINABLE FORESTRY

COLLECTION
Vol. 92

ODRŽIVO ŠUMARSTVO

ZBORNIK RADOVA
Vol. 92

BELGRADE BEOGRAD
2025.

INSTITUTE OF FORESTRY BELGRADE
COLLECTION OF PAPERS

INSTITUT ZA ŠUMARSTVO BEOGRAD
ZBORNIK RADOVA

Publisher
Institute of Forestry
Belgrade, Serbia

Izdavač
Institut za šumarstvo
Beograd, Srbija

For Publisher
Ljubinko Rakonjac, Ph.D.

Za izdavača
Dr Ljubinko Rakonjac

Editor-in-Chief
Tatjana Ćirković-Mitrović, Ph.D.

Glavni i odgovorni urednik
Dr Tatjana Ćirković-Mitrović

Technical Editor and Layout	**Tehnički urednik i prelom teksta**
Ljiljana Brašanac-Bosanac, Ph.D.	Dr Ljiljana Brašanac-Bosanac
Secretary	**Sekretar Zbornika**
M.Sc. Jelena Božović	Mst. Jelena Božović
Printed in	**Tiraž**
100 copies	100 primeraka
Printed by	**Štampa**
Black and White Belgrade	Black and White Beograd

Cover Page: River Vučjanka, Author of the Photo B.Sc. Nenad Šurjanac

Naslovna strana: Reka Vučjanka, autor fotografije Nenad Šurjanac, dipl. inž.

CONTENT SADRŽAJ

Vol. 92

DOI: 10.5937/SustFor2592047C
UDK: 630*232.322.4:582.713=111
Original scientific paper

EFFECTS OF A CONTROLLED-RELEAS FERTILISER ON HEIGHT GROWTH OF TWO-YEAR-OLD TRANSPLANTED (1+1) WILD CHERRY (*Prunus avium* L.) SEEDLINGS

Tatjana ĆIRKOVIĆ-MITROVIĆ[1], Dragica VILOTIĆ[2], Milan REBIĆ[3], Ljiljana BRAŠANAC-BOSANAC[1]*

Abstract: *Previous research has shown that, besides an appropriate species selection, the characteristics of planting material play a key role in the success of reforestation efforts. The application of fertilisation products in modern nursery production represents an important factor in producing high-quality seedlings. This study aimed to examine the effect of a controlled-release fertiliser, marketed under the commercial name Osmocote® Exact Standard 5–6 M, on the height growth and survival of two-year-old wild cherry (Prunus avium L.) transplants (1+1). Shoot height was measured at the beginning of the growing season, during the season, and at its end. Based on these measurements, the height increment and the survival rate of two-year-old transplanted seedlings were calculated. The results indicate a positive influence of the fertiliser on all examined parameters. The mean height at the end of the growing season was 68.8 cm in unfertilised seedlings compared with 80.4 cm in fertilised ones. The relative height increment in the second year amounted to 69.6% in unfertilised seedlings and 101.6% in fertilised seedlings. Thus, the application of controlled-release fertiliser can enhance height growth and improve the survival of wild cherry seedlings.*

Keywords: transplanted seedlings, seedling growth, reforestation techniques, nursery production, Osmocote.

UTICAJ ĐUBRIVA SA KONTROLISANIM OSLOBAĐANJEM NA VISINSKI PRIRAST DVOGODIŠNJIH ŠKOLOVANIH (1+1) SADNICA DIVLJE TREŠNJE (*Prunus avium* L.)

Sažetak: *Dosadašnja iskustva pokazala su da se pri pošumljavanju, osim pravilnog izbora vrste, mora voditi računa i o karakteristikama sadnog materijala koje su od značaja za uspeh pošumljavanja. Primena preparata ishrane u savremenoj rasadničkoj proizvodnji je značajan faktor u proizvodnji visokokvalitetnog sadnog materijala. Cilj ovog rada bio je da istraži uticaj đubriva sa kontrolisanim oslobađanjem komercijalnog naziva Osmocote® Exact Standard 5-6 M na visinski prirast i preživljavanje dvogodišnjih presađenih sadnica*

[1] Institute of Forestry, 3 Kneza Višeslava, 11000 Belgrade, Serbia
[2] Faculty of Forestry, 1 Kneza Višeslava, 11000 Belgrade, Serbia
[3] Provincial Secretariat for Agriculture, Water Management and Forestry, 25 Mihajla Pupina Boulevard, 3/II, 21000 Novi Sad, Serbia
*Corresponding author. E-mail: tanjacirk@yahoo.com

divlje trešnje (Prunus avium L.) tipa 1+1. Izmerene su visina izbojka na početku vegetacionog perioda, u toku i na kraju vegetacionog perioda. Na osnovu izmerenih visina izračunat je visinski prirast i utvrđen procenat preživljavanjea dvogodišnjih školovanih sadnica. Dobijeni rezultati pokazuju pozitivan uticaj preparata ishrane na sve ispitivane parametre. Prosečna visina na kraju vegetacionog perioda netretiranih sadnica bila je 68,8 cm, a tretiranih 80,4 cm. Relativna vrednost visinskog prirasta netretiranih školovanih dvogodišnjih sadnica u drugoj godini je bila 69,6%, a tretiranih 101,6%. Dakle, primena đubriva đubriva sa kontrolisanim oslobađanjem može poboljšati visinski prirast i preživljavanje sadnica trešnje (Prunus avium).

Ključne reči: školovana sadnica, rast sadnica, tehnike pošumljavanja, rasadnik, Osmocote.

1. INTRODUCTION

Improving the production of tree and shrub planting material is one of the strategic priorities in forestry. This requires a well-organised nursery system capable of producing the planting stock intended for afforestation and reforestation programmes.

Wild cherry (*Prunus avium* L.) is a native broadleaved tree species growing in the mixed European forests. It has a wide elevation range, from lowland areas up to the submontane belts. On larger mountain massifs, it can be found up to 2000 m a.s.l. (Russell, 2003). According to Tomić (2004) and Tomić, Rakonjac (2012), in Serbia it is an autochthonous species occurring as scattered individuals within mixed secondary stands of the oak belt forests *Querco-Castanetum sativae* (Ht. 38) Glišić 1975., *Carpino betuli-Quercetum roboris* (Anić 59) Rauš 1971.s.l., *Carpino betuli-Quercetum roboris* (Anić 59) Rauš 1971. var. geograph. *Tilia cordata+Tilia argentea* B. Jovanović 1979., and mesophilic beech forests *Aceri-Fraxinetum illyricum* Ht. 1938., *Fagetum submontanum moesiacum* (Rudski 49) B. Jovanović 1976., *Fago moesiacae-Castanetum sativae* (Glišić 1975) Matović 1986.

Globally, up to half of plant and animal species inhabiting the world's most biodiverse regions (such as the Amazon, the Arctic and the Galapagos, and in Europe, the Mediterranean and the Black Sea Basin) could face local extinction by the turn of the century due to climate change if carbon emissions continue to rise unchecked (WWF, 2014). According to Holz et al. (2022), 7% to 9% of European vascular plant diversity is threatened in its entire range, the majority of which are single-country endemics. Of these globally threatened species, 84% currently have no assessment in the global Red List. The high demand and increasing use of wild cherry wood are putting constant pressure on existing populations of this species (Pilipović et al., 2011). Therefore, it is necessary to preserve the cherry gene pool.

Seed collection, nursery production of wild cherry seedlings, and their introduction into existing forests and afforestation of unstocked areas contribute to improving biodiversity status and enhancing the natural biological richness. This species is significant not only for the conservation of plant diversity but also for wildlife, as it provides a valuable food source for many animal species.

Previous experience has shown that in afforestation, in addition to proper species selection, it is necessary to consider characteristics of the planting material that are crucial for successful establishment (root system development, tolerance to temperature extremes, etc.). Several studies dealing with nursery production, growth,

development and morphological traits of wild cherry seedlings were conducted by Mikić (2007), Jarni et al. (2012), Stjepanović (2012), Drvodelić et al. (2012), Stjepanović & Ivetić (2013), Ćirković-Mitrović (2014), Pérez-Jiménez et al. (2017), Stanković-Nedić et al. (2018), Popović et al. (2021), Shayesteh Pahangeh et al. (2022), Stojnić et al. (2022), EFSA Panel on Plant Health (PLH) (2024), Kerkez-Janković et al. (2024), etc.

Planted broadleaved tree species, including wild cherry, frequently experience transplant stress, reducing their survival (Hemery et al., 2008; Savill et al., 2009; Eşen et al., 2012). Research results indicate that nursery-grown seedlings have higher survival rates when outplanted in sites with more demanding environmental conditions (Eşen et al., 2012).

Fertilisation is the most common method used to enhance the soil's nutritional status. In modern nursery production, the application of nutritional preparations is not only a supplementary source of nutrients but also a powerful means and an important factor in producing high-quality planting material.

The aim of this study was to investigate the effect of a controlled-release fertiliser, commercially known as Osmocote® Exact Standard 5–6 M, on the height growth and survival of two-year-old transplanted (1+1) wild cherry seedlings (*Prunus avium* L.). A simple method of applying the nutritional preparation by incorporating it into the substrate would certainly justify its use in mass production of high-quality planting material (Ćirković-Mitrović et al., 2012).

2. MATERIAL AND METHODS

2.1. Field Characteristics and Nursery Experiment

For the purposes of this study, 1+0 wild cherry (*Prunus avium* L.) seedlings produced from selected seed were used. The seed originated from the Fruit and Ornamental Plant Research Institute (NARIC), Cegléd Research Station (Cegléd, Hungary – 47.175063N, 19.820214E). In early autumn 2023, the seed was sown in nursery beds at the "Grower" Nursery (Ada, Vojvodina, Serbia – 45.769559N, 20.129032E). Prior to sowing (late summer 2023), the seed was placed in moist sand for stratification in a climate chamber for a period of two months at 2°C. The experiment was established in the "Eco-Nimi" Nursery (Zrenjanin, Vojvodina, Serbia – 45.399263N, 20.395358E).

According to data from the Republic Hydrometeorological Service of Serbia, the territory of the Zrenjanin municipality is characterised by a temperate continental climate, specifically the steppe-continental subtype. A common feature of all climatic elements in this region is the pronounced annual amplitude and considerable intra-annual variability in their values.

To assess the climatic characteristics of the area, the meteorological data used for analysis were taken from the Meteorological yearbooks of the Republic Hydrometeorological Service of Serbia, covering the period 1990 to 2024.

The climatic characteristics of the area in which the nursery is located, for the year in which the experiment was conducted, are presented in Table 1.

Table 1. *Monthly temperature and precipitation in Zrenjanin in 2024, annual averages (AA) and growing season (GS) values, and their deviations from the 1990-2020 reference period*

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	AA	GS
Temperature [°C]	2.5	**9.5**	10.9	15.0	18.7	24.1	**26.4**	**26.8**	19.1	13.2	4.4	2.7	14.4	21.7
Deviation (Reference value)	↑1.8	**↑7.1**	↑3.9	↑2.4	↑1.2	↑2.9	↑3.5	↑4.1	↑1.6	↑1.0	↑2.6	↑1.0	↑2.3	↑2.6
	0,7	2,4	7,0	12,6	17,5	21,2	22,9	22,7	17,5	12,2	7,0	1,7	12,1	19,1
Precipitation [mm]	39.5	6.6	27.2	30.7	89.8	42.4	53.5	**2.4**	**109.8**	33.6	52.1	47.7	535.3	328.6
Deviation (Reference value)	↑0.8	↓27.1	↓8.9	↓9.8	↑27.8	↓38.7	↓5.0	**↓47.2**	**↑55.4**	↓17.2	↓5.9	↑1.1	↓62.9	↓17.5
	38.7	33.7	36.1	40.5	62.0	81.1	58.5	49.6	54.4	50.8	46.2	46.6	598.2	346.1

Analysis of climatic parameters for 2024 indicates that this year was the warmest on record in Serbia, including the Zrenjanin area (the record highest values and deviations are marked in red). The winter, spring, and summer of 2024 were the warmest seasons recorded since the beginning of temperature measurements in the country.

The mean annual air temperature in Zrenjanin in 2024 was 14.4°C, which was 2.3°C higher than the normal value for the 1991-2020 period. All twelve months recorded higher mean monthly temperatures relative to the reference period, with anomalies ranging from +1.0°C (October and December) to +7.1°C (February). In February, July, and August, record values of both mean monthly and mean maximum air temperatures were observed. The mean air temperature during the growing season in 2024 was 21.7°C, exceeding the reference value by 2.6°C.

Total annual precipitation amounted to 535.5 mm, which was 62.9 mm below the 1991-2020 normal. Precipitation was distributed relatively evenly across seasons, although some deviations were recorded. January, May, September, and December had precipitation totals above the reference values (from +0.8 mm in January to +55.4 mm in September), while all other months showed deficits (from -5.0 mm in July to -47.2 mm in August). During the growing season, precipitation was 17.5 mm lower than the long-term average.

One-year-old bare-root seedlings were grown in this nursery. They were transplanted into 1.4-L containers filled with a substrate composed of a mixture of topsoil and peat (30:70). The peat consisted of a 50:50 mixture of light and dark peat originating from Lithuania, marketed under the commercial name REKYVA (https://rekyva.eu/en/). In 50 containers, no fertiliser was incorporated into the substrate prior to planting, while in the remaining 50 containers Osmocote was applied at a rate of 400 g per 100 L (4 kg/m³) of substrate (Figure 1).

Osmocote® Exact Standard 5–6 M is labelled 15+9+12+2MgO+TE, indicating the percentage content of nitrogen, phosphorus, potassium, magnesium, and essential micronutrients required for plant growth and development. The N–P–K ratio (15–9–12) corresponds to 15% nitrogen (N), 9% phosphorus (P), and 12% potassium (K), followed by 2% MgO and TE (trace elements). The essential micronutrients include iron (Fe) 0.47%, manganese (Mn) 0.065%, zinc (Zn) 0.028%, copper (Cu) 0.06%, molybdenum (Mo) 0.024%, and boron (B) 0.024%. The release of nutrients is unaffected by soil salinity, pH, microbial activity, or water quality

(including rainfall); it depends solely on temperature, which makes Osmocote® Exact highly reliable in use.

Figure 1. *Nursery experiment –Eco-Nimi Nursery in Zrenjanin (Photos by Milan Rebić)*

During the growing season, the seedlings were irrigated with water. Based on the climatic characteristics recorded for 2024, it can be concluded that the combination of record-high mean monthly temperatures and reduced precipitation could have negatively affected the growth and development of the seedlings if controlled irrigation had not been applied.

2.2. Seedlings measurement

Initial shoot height (h_0) was measured in April 2024, followed by a mid-growing season measurement (h_1) on 10 July 2024, and a final measurement at the end of the growing season (h_2) in October 2024 (all units of measures are in cm). Based on these measurements, height increment of the two-year-old seedlings was calculated. Seedling survival (S) of the two-year-old transplanted plants was estimated by comparing the number of one-year-old seedlings initially planted with the number of surviving seedlings at the end of the second growing season. The effect of the fertiliser treatment on the measured and calculated seedling parameters was assessed using analysis of variance (ANOVA). Statistical analyses were performed in Statgraphics Centurion XVI.I.

3. RESULTS AND DISCUSSION

The basic descriptive statistics of the measured heights are presented in Table 2.

Table 2. *Descriptive statistics for height and height increment of wild cherry seedlings in the second year*

Treatment	Measurement time	N	h (cm)	Sd	Cv	Min	Max
UT	April	50	40.4	6.4	15.8	28.2	50.7
	July	48	52.2	6.5	12.5	39.7	72.2
	October	41	68.6	8.6	12.5	52.5	89.2
T	April	50	39.9	6.3	15.8	26.3	49.3
	July	48	58.3	6.3	10.9	45.2	70.5
	October	45	80.4	5.6	7.0	68.8	93.0

Abbreviations: N – number of seedlings; h – mean height; Sd – standard deviation; Cv – coefficient of variation; Min – minimum measured height; Max – maximum measured height; UT – untreated seedlings; T – seedlings treated with fertiliser.

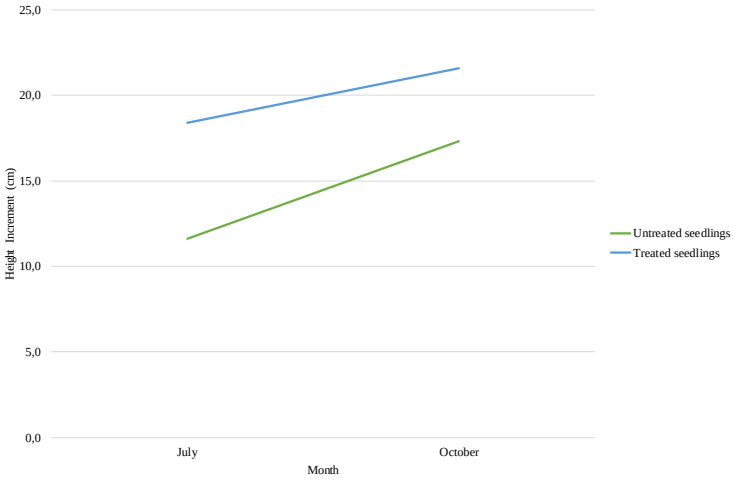
The initial height measurements of one-year-old seedlings indicate that there was no statistically significant difference at the beginning of the growing season (in April). During the second measurement, conducted in July, divergence between the treatments became evident in favour of the seedlings treated with slow-release fertiliser. The mean height of the untreated seedlings was 52.2 cm, whereas the treated seedlings reached 58.3 cm. This difference continued to increase, and by the end of the growing season the untreated seedlings reached an average height of 68.6 cm, while the treated seedlings attained 80.4 cm.

Table 3. *Differences in height increment of wild cherry seedlings in the second year during the 2024 growing season*

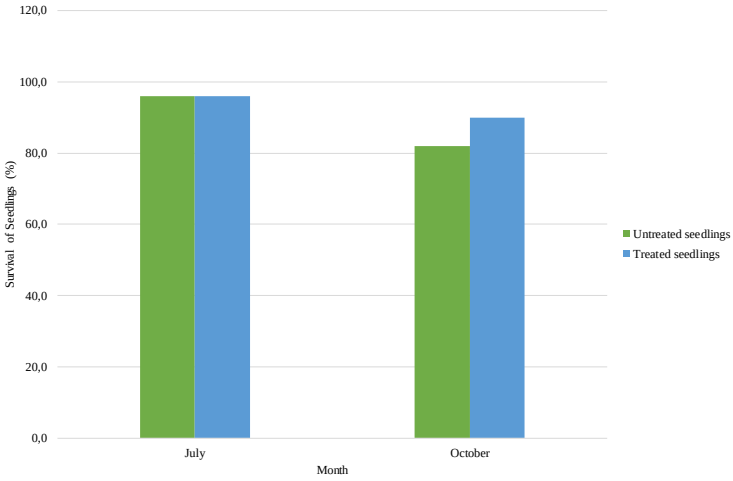
Treatment	Count	Mean (cm)	F-Ratio	P-Value
h				
h_0				
UT	50	40.4[a]	0.21	0.6490
T	50	39.9[a]		
h_1				
UT	48	52.2[a]	21.48	0.0000
T	48	58.3[b]		
h_2				
UT	41	68.6[a]	57.89	0.0000
T	45	80.4[b]		
ih				
ih_{0-1}				
NT	48	11.6[a]	56.51	0.0000
T	48	18.4[b]		
ih_{1-2}				
NT	41	16.3[a]	24.35	0.0000
T	45	21.6[b]		
ih				
UT	41	27.3[a]	81.35	0.0000
T	45	40.1[b]		

Abbreviations: h_0 – initial shoot height; h_1 – shoot height during the growing season (10 July 2024); h_2 – shoot height at the end of the growing season; ih_{0-1} – height increment during the first part of the growing season (April–July); ih_{1-2} – height increment during the second part of the growing season (July–October); ih – total height increment; NT – untreated seedlings; T – seedlings treated with fertiliser.
*Mean values in the same column followed by different letters are statistically different at $p < 0.05$

Height increment also shows a statistically significant difference in favour of the treated seedlings – calculated for the first half of the growing season, the second half of the growing season, and for the total height increment (Table 3, Graph 1).



Graph 1. *Height increment of two-year-old seedlings in the second year, untreated and treated with fertiliser*



Graph 2. *Survival of seedlings during the second growing season, untreated and treated with fertiliser*

The percentage of height increment in untreated seedlings in the second year was 29.1% during the first half of the growing season (April–July), 31.4% during the second half (July–October), and 69.6% for the entire growing season. In treated seedlings, the relative height increment was 46.2% for the April–July period, 37.9% for the July–October period, and 101.6% for the whole growing season.

Seedling survival after transplanting, when they experience considerable stress, was higher at the end of the growing season in the fertilised seedlings, with a

survival rate of 90%. In contrast, the survival rate of the untreated seedlings was 82% (Graph 2).

In studies investigating the effects of the controlled slow-release fertiliser Osmocote on the growth and survival of hardwood seedlings of black walnut (*Juglans nigra L.*), white ash (*Fraxinus americana* L.), and yellow-poplar (*Liriodendron tulipifera* L.), Jacobs et al. (2005) reported a positive influence of the fertiliser regardless of species. Nacheva et al. (2015) also documented a positive effect of Osmocote on the growth and development of *Ginkgo biloba* L. seedlings, while Tatun Ya and Nosnikov (2025) reported similar effects on silver birch (*Betula pubescens* Ehrh.) seedlings. Eşen et al. (2012) examined the early effects of a controlled-release fertiliser on the survival and growth of wild cherry (*Prunus avium* L.) seedlings in the western Black Sea Region of Turkey. Fertilised seedlings had significantly greater heights than untreated seedlings both in the first and the second year. Pérez-Jiménez et al. (2017) similarly reported that fertilisation can improve the quality, growth, and survival of cherry seedlings.

The positive impact of fertilisation on the development and nutrient uptake of black locust (*Robinia pseudoacacia* L.) seedlings was confirmed by Ombódi et al. (2020). Jasik et al. (2025) and Rotowa et al. (2025, 2025a) investigated the growth of European beech (*Fagus sylvatica* L.) and pedunculate oak (*Quercus robur* L.) seedlings on an innovative peat-free organic substrate treated with Osmocote. Their results showed strong correlations between soil nutrient content and seedling growth parameters. The importance of seedling cultivation for afforestation success, including its positive effect on survival rate and height increment in the wild pear (*Pyrus pyraster* Burgsd.), was demonstrated by Drvodelić et al. (2012).

4. CONCLUSIONS

One-year-old wild cherry seedlings responded to the application of slow-release fertiliser during the second year after transplanting. The effect of the fertiliser was reflected in significantly greater seedling height, height increment, and survival rate after planting and nursery cultivation. At the end of the growing season, the mean height of untreated seedlings was 68.8 cm, whereas fertilised seedlings reached 80.4 cm. The relative height increment of untreated two-year-old nursery grown plants in the second year was 69.6%, while in the treated seedlings, it reached 101.6%.

Slow-release fertilisers can improve seedling performance in nursery production. The findings of this study may support further improvements in the cultivation of wild cherry seedlings through the use of controlled-release fertilisers during the nursery stage. This approach could contribute to better planning of afforestation and the restoration of natural forest ecosystems on harsh sites, where post-planting survival of seedlings is generally lower.

Acknowledgement: *This study was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, Contract No. 451-03-136/2025-03/200027.*

REFERENCES

Ćirković-Mitrović, T. (2014): *Uticaj različitih preparata ishrane na morfoanatomske karakteristike sadnica šumskih voćkarica.* Doktorska disertacija, Šumarski fakultet Univerziteta u Beogradu, 0-315.

Ćirković-Mitrović, T., Brašanac-Bosanac, Lj., Popović, V. (2012): Effect of fertiliser application on morphological characteristics of walnut (Juglans regia L.) juvenile seedlings, International Conference on BioScience: Biotechnology and Biodiversity – Step in the Future, The Fourth Joint UNS–PSU Conference, Novi Sad, June 18-20, 2012. Book of the Proceedings, p. 149-164.
https://semenarska.rs/UNS-PSU/radovi/1/13%20CIRKOVIC%20149-164.pdf

Drvodelić, D., Oršanić, M., & Zeman, Z. (2012). *Field performance after reforestation with one year old non-transplanted (1+ 0) and transplanted (1+ 1) seedlings of wild pear (Pyrus pyraster Burgsd.).* Šumarski list, 136(7-8), 355-366. https://hrcak.srce.hr/86972

EFSA Panel on Plant Health (PLH), Bragard, C., Baptista, P., Chatzivassiliou, E., Gonthier, P., Jaques Miret, J. A., ... & Yuen, J. (2024). *Commodity risk assessment of Prunus avium plants from United Kingdom.* EFSA Journal, 22(7), e8836. https://doi.org/10.2903/j.efsa.2024.8836

Eşen, D., Ediş, S., Esen, U., Çetintaş, C., and Yıldız, O. (2012). *Early effects of a control-release fertilizer on the survival and growth of wild cherry (Prunus avium L.) seedlings in Düzce.* Journal of Bartin Faculty of Forestry 14:77-83

Holz, H., Segar, J., Valdez, J., & Staude, I. R. (2022). *Assessing extinction risk across the geographic ranges of plant species in Europe.* Plants, People, Planet, 4(3), 303-311. https://doi.org/10.1002/ppp3.10251

Jacobs, D.F., Salifu, K.F. and Seifert, J.R. (2005). Growth and Nutritional Response of Hardwood Seedlings to Controlled-Release Fertilisation at Outplanting. For. Ecol. Manage. 214(1-3), 28-39. https://doi.org/10.1016/j.foreco.2005.03.053

Jasik, M., Staszel-Szlachta, K. & Małek, S. *Leaf stoichiometry of European beech (Fagus sylvatica L.) and pedunculate oak (Quercus robur L.) seedlings grown on an innovative peat-free organic substrate.* Sci Rep 15, 39674 (2025). https://doi.org/10.1038/s41598-025-23221-6

Kerkez-Janković, I., Popović, V., Nonić, M., & Šijačić-Nikolić, M. (2024). *Divlja trešnja (Prunus avium L.) – od rasadnika do predela Velikog ratnog ostrva.* Simpozijum sa međunarodnim učešćem Pejzažna hortikultura 2024 "Sadni materijal kao resurs–od rasadnika do predela ", 9. https://omorika.sfb.bg.ac.rs/handle/123456789/1586

Meteorological yearbooks of the Republic Hydrometeorological Service of Serbia (1990-2024)
https://www.hidmet.gov.rs/latin/meteorologija/klimatologija_godisnjaci.php

Nacheva, L., Gercheva, P., & Ivanova, V. (2015). *Effect of the controlled-release fertiliser osmocote on the growth and development of Ginkgo biloba L. seedlings*. Agricultural University – Plovdiv, Scientific Works, vol. LIX, book 4, 2015 Jubilee Scientific Conference

with International Participation Traditions and Challenges of Agricultural Education, Science and Business, 143-147.

Ombódi, A., Csorbai Gógán, A., Papp, B., & Posta, K. (2020). *Effects of fertilisation on development and nutrient uptake of black locust saplings grown in pots.* COLUMELLA: JOURNAL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES, 7(2), 43-52. https://doi.org/10.18380/SZIE.COLUM.2020.7.2.43

Pérez-Jiménez, M., Bayo-Canha, A., López-Ortega, G., & del Amor, F. M. (2017). *Growth, Plant Quality, and Survival of Sweet Cherry (Prunus avium L.) Seedlings are Enhanced by CO2 Enrichment.* HortScience, 52(12), 1650–1654. https://doi.org/10.21273/HORTSCI12337-17

Pérez-Jiménez, M., Bayo-Canha, A., López-Ortega, G., & del Amor, F. M. (2017). Growth, Plant Quality, and Survival of Sweet Cherry (Prunus avium L.) Seedlings are Enhanced by CO2 Enrichment. HortScience, 52(12), 1650–1654. https://doi.org/10.21273/HORTSCI12337-17

Pilipović, A., Orlović, S., Stojnić, S., Galović, V., Marković, M. (2011): *Inventarizacija genofonda divlje trešnje (Prunus avium) u Srbiji u cilju usmerenog korišćenja genetičkog potencijala.* Topola 187/188: 53-63.

Popović, V., Rakonjac, L., Lazarević, I., & Lučić, A. (2021): *Morphological characteristics and variability of the seedlings of wild cherry (Prunus avium L.) in Serbia*. Proceedings of the XII International Scientific Agricultural Symposium "Agrosym 2021", 1405-1414.

Rotowa, O. J., Małek, S., Jasik, M., & Staszel-Szlachta, K. (2025). *Effect of innovative peat-free organic growing media and fertiliser on nutrient allocation in pedunculate oak (Quercus robur L.) and European beech (Fagus sylvatica L.) seedlings*. New Forests, 56(1),17. https://doi.org/10.1007/s11056-024-10079-1

Rotowa, O. J., Małek, S., Kupka, D., Pach, M., & Banach, J. (2025). *Innovative Peat-Free Organic Substrates and Fertilisers Influence Growth Dynamics and Root Morphology of Fagus sylvatica L. and Quercus robur L. Seedlings One Year After Planting*. Forests, 16(5),800. https://doi.org/10.3390/f16050800

Russell, K. (2003): EUFORGEN *Technical Guidelines for Genetic Conservation and Use for Wild Cherry (Prunus avium).* International Plant Genetic Resources Institute, Rome, Italy. www.bioversityinternational.org/fileadmin/bioversity/publications/.../859.pdf

Shayesteh Pahangeh, E., Aliarab, A., Sadati, S. E., Espahbodi, K., & Karimian, Z. (2022). *Effect of soil moisture content on survival, growth, and physiological characteristics of wild cherry (Prunus avium L.) seedlings*. Iranian journal of Forest 13(5), 57-69.

Stanković-Nedić, M., Stojnić, S., Orlović, S., Čolić, H., Petrović, D., Isajev, V. (2018). *Varijabilnost klijavosti sjemena i morfoloških osobina sadnica divlje trešnje porijeklom iz Republike Srpske (BiH).* Topola 201-202, 213-225.

Stojnić, S., Kovačević, B., Kebert, M., Vasić, V., Vuksanović, V., Trudić, B., & Orlović, S. (2022*). Genetic differentiation in functional traits among wild cherry (Prunus avium L.) half-sib lines.* Journal of Forestry Research, 33(3), 991-1003.

Tatun Ya. U., Nosnikov V. V. (2025). *Use of slow-release fertilisers in growing containerized silver birch seedlings.* Proceedings of BSTU, issue 1, Forestry. Nature Management. Processing of Renewable Resources, no. 2 (294), pp. 69-77 (In Russian). https://doi.org/10.52065/2519-402X-2025-294-8

Tomić, Z. (2004): *Šumarska fitocenologija, Šumarski fakultet Univerziteta u Beogradu, Beograd, (133-174).* [Tomić, Z. (2004): Forest Phytocoenology, Faculty of Forestry, University of Belgrade, Belgrade, (133-174).]

World Wildlife Fund (WWF) 2014 https://www.wwf.mg/?324571/Half-of-plant-and-animal-species-at-risk-from-climate-change

https://www.statgraphics.com/centurion-xvi

https://www.hidmet.gov.rs/eng/meteorologija/klimatologija.php

REKYVA https://rekyva.eu/en/

EFFECTS OF A CONTROLLED-RELEASE FERTILISER ON HEIGHT GROWTH OF TWO-YEAR-OLD TRANSPLANTED (1+1) WILD CHERRY (*Prunus avium* L.) SEEDLINGS

Tatjana ĆIRKOVIĆ-MITROVIĆ, Dragica VILOTIĆ, Milan REBIĆ, Ljiljana BRAŠANAC-BOSANAC

Summary

Wild cherry (*Prunus avium* L.) is a native broadleaved tree species growing in mixed European forests. It has a wide elevation range, from lowland sites up to submontane belts, and on larger mountain massifs it may be found at elevations up to 2000 m (Russell, 2003).

Seed collection, nursery production of wild cherry seedlings, and their introduction into existing forests and afforestation of unstocked areas contribute to improving biodiversity status and enhancing the natural biological richness of Serbia. This species is significant not only for the conservation of plant diversity but also for wildlife, as it provides a valuable food source for many animal species. Previoius experience has shown that in afforestation, in addition to proper species selection, it is necessary to consider characteristics of the planting material that are crucial for successful establishment (root system development, tolerance to temperature extremes, etc.). Planted broadleaved seedlings, including wild cherry, frequently experience transplant stress, which reduces their survival (Hemery et al., 2008; Savill et al., 2009; Eşen et al., 2012).

Fertilisation is one of the most common methods used to improve soil nutrient status. In modern nursery production, the application of nutritional preparations is not only a supplementary source of nutrients but also a powerful means and an important factor in producing high-quality planting stock.

The aim of this study was to examine the effect of a controlled-release fertiliser, marketed as Osmocote® Exact Standard 5-6 M, on height growth and survival of two-year-old transplanted (1+1) wild cherry seedlings (*Prunus avium* L.). Shoot height was measured at the beginning of the growing season, during the season, and at its end. Based on these

measurements, height increment was calculated, and the survival percentage of the two-year-old nursery-grown seedlings was determined. The results showed a positive effect of the fertiliser on all assessed parameters. At the end of the growing season, the mean height of untreated seedlings was 68.8 cm, whereas treated seedlings reached 80.4 cm. The relative height increment of untreated two-year-old nursery-grown seedlings in the second year was 69.6%, while that of treated seedlings was 101.6%. Thus, control-release fertiliser application can enhance height growth and survival of wild cherry seedlings.

Slow-release fertilisers can improve seedling performance in nursery production. The findings of this study may support further improvements in the cultivation of wild cherry seedlings through the use of controlled-release fertilisers during the nursery stage. This approach could contribute to better planning of afforestation and the restoration of natural forest ecosystems on harsh sites, where post-planting survival of seedlings is generally lower.

UTICAJ ĐUBRIVA SA KONTROLISANIM OSLOBAĐANJEM NA VISINSKI PRIRAST DVOGODIŠNJIH ŠKOLOVANIH (1+1) SADNICA DIVLJE TREŠNJE (*Prunus avium* L.)

Tatjana ĆIRKOVIĆ-MITROVIĆ, Dragica VILOTIĆ, Milan REBIĆ, Ljiljana BRAŠANAC-BOSANAC

Rezime

Divlja trešnja (*Prunus avium* L.) je autohtona lišćarska vrsta koja raste u mešovitim šumama Evrope. Ima širok raspon nadmorske visine, od nizijskih područja do submontanih pojaseva. Na većim planinskim masivima može se naći i do 2.000 metara nadmorske visine (Russell, 2003).

Sakupljanje semena, proizvodnja sadnica divlje trešnje i njihovo unošenje u postojeće šume i pri pošumljavanju neobraslih površina doprinosi poboljšavanju stanja biodiverziteta i unapređenju prirodnog biološkog bogatstva Srbije. Ova biljna vrsta nije značajna samo za očuvanje biodiverziteta flore, već i za faunu, jer mnogim životinjskim vrstama služi kao hrana. Dosadašnja iskustva pokazala su da se pri pošumljavanju, osim pravilnog izbora vrste, mora voditi računa i o karakteristikama sadnog materijala koje su od značaja za uspeh pošumljavanja (razvijenost korenovog sistema, otpornost na temperaturne ekstreme i dr.). Sadnice lišćara (uključujući i divlju trešnju) često dožive stres prilikom presadnje, što smanjuje njihovo preživljavanje na terenu (Hemery et al., 2008, Savill et al., 2009, Eşen et al. 2012).

Đubrenje je najčešći način za poboljšanje hranljivog statusa zemljišta. Primena preparata ishrane u savremenoj rasadničkoj proizvodnji ne predstavlja samo dopunski izvor hranljivih materija, već i moćno sredstvo i značajan faktor u proizvodnji visokokvalitetnog sadnog materijala. Cilj ovog rada bio je da istraži uticaj đubriva sa kontrolisanim oslobađanjem komercijalnog naziva Osmocote® Exact Standard 5-6 M na visinski rast i preživljavanje dvogodišnjih školovanih (1+1) sadnica divlje trešnje (*Prunus avium* L.). Izmerene su visina izdanka na početku vegetacionog perioda, u toku i na kraju vegetacionog perioda. Na osnovu izmerenih visina izračunat je visinski prirast i utvrđen procenat preživljavanjea dvogodišnjih školovanih sadnica. Dobijeni rezultati pokazuju pozitivan uticaj preparata ishrane na sve ispitivane parametre. Prosečna visina na kraju vegetacionog perioda netretiranih sadnica bila je 68,8 cm, a tretiranih 80,4 cm. Relativna vrednost visinskog prirasta netretiranih školovanih dvogodišnjih sadnica u drugoj godini je bila 69,6%, a tretiranih 101,6%. Dakle, primena đubriva đubriva sa kontrolisanim oslobađanjem može poboljšati visinski prirast i preživljavanje sadnica divlje trešnje.

Spororazlagajuće đubrivo može poboljšati performanse sadnica u rasadniku. Istraživanja će omogućiti dalje unapređenje i poboljšanje rasadničke proizvodnje sadnica divlje trešnje kroz upotrebu đubriva sa kontrolisanim oslobađanjem kod školovanja sadnica. Ovaj pristup mogao bi doprineti planiranju pošumljavanja i obnovi prirodnih šumskih ekosistema na ekstremnim staništima školovanim sadnicama, jer je preživljavanje nakon sadnje na ovakvim staništima manje.