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Udruženje za Pejzažnu hortikulturu

Šumarski fakultet

Simpozijum

Pejzažna hortikultura 2024

SADNI MATERIJAL
KAO RESURS –
OD RASADNIKA DO
PREDELA

Beograd, 8-9 Februar



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Simpozijum:

Pejzažna hortikultura 2024

“SADNI MATERIJAL KAO RESURS - OD RASADNIKA DO PREDELA”

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Univerzitet u Beogradu - Šumarski fakultet Beograd

08. i 09. februar 2024. godine

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PEJZAŽNA HORTIKULTURA 2024

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Pejzažna hortikultura 2024

“SADNI MATERIJAL KAO RESURS - OD RASADNIKA DO PREDELA“

Naučni odbor Simpozijuma: prof dr Milka Glavendekić, dr Dragana Skočajić, van. prof., dr Marija Nešić, van. prof., dr Dragana Čavlović, naučni saradnik, dr Ivana Bjedov, van. prof., dr Marija Marković, van. prof., dr Jelena Lazarević, Biotehnički fakultet Univerziteta Crne Gore, dr Ivana Živojinović, viši naučni saradnik EFI Vienna, dr Silvija Krajter Ostoić, naučni saradnik Hrvatski šumarski institut, dr Anna María Pálsdóttir, van.prof, Švedski Univerzitet Polj. Nauka (SLU), dr Jaroslav Kolarik, Arboristička Akademija, Univerzitet Prag.

Organizacioni odbor Simpozijuma: dr Danijela Đunisijević Bojović, van. prof, prof dr Jelena Tomićević Dubljević, dr Slavica Čepić, naučni saradnik, Msc Marijana Milutinović, Vladimir Milutinović dipl. inž., Jovan Topalović, dipl. inž., Jovan Sremčević dipl. inž., Milena Trmčić dipl. inž., Marija Pešikan dipl. inž., Kristina Đorđević dipl. inž.

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08:00 – 08:45	Registracija učesnika, PRVI DAN: 08.02.2024. godina	
08:45 – 09:00	Uvodna reč: XXI Simpozijum Pejzažna hortikultura 2024	Dragana Skočajić, predsednik UPHS
	Otvaranje Simpozijuma	predstavnik Uprave Šumarskog fakulteta
SADNI MATERIJAL		Moderatori: Dragana Skočajić, Danijela Đunisijević – Bojović, Dragana Čavlović
09:00 – 09:20	Izbor baštenskih ruža i usluge ekosistema koje pružaju	Msc Biljana Božanić Tanjga, dr Mirjana Ljubojević, Aleksandar Đukić, Mirjana Vukosavljev, Olivera Ilić i Tijana Narandžić, Pheno Geno Roses
09:20 – 09:40	Novi pravci selekcije i korišćenja ukrasnog bilja	dr Mirjana Ljubojević, Poljoprivredni Fakultet u Novom Sadu, Tijana Narandžić, Biljana Božanić Tanjga, Jovana Ostojić, Milica Grubač, Radenka Kolarov i Magdalena Pušić
09:40 – 10:20	Delivery of ecosystem services by urban vegetation - focus on urban hedges	Dr Tijana Blanuša, Royal Horticultural Society University of Reading
10:00 – 10:40	Orezivanje urbanog drveća i žbunja	Mirela Šatara, Stefan Lorberg, Ilya Ochnev - Rasadnik Lorberg
10:40 – 11:00	PAUZA + Poster sekcija: razgledanje postera i razgovor sa autorima, otvaranje glasanja za izbor najboljeg postera	
11:00 - 12:00	Praktični deo - RADIONICA: Orezivanje stablašica	Ilya Ochnev, Mirela Šatara, Stefan Lorberg - Rasadnik Lorberg
12:00 – 12:40	The importance of understanding tree nursery production systems	MSc Arb Keith Sacre, BSc (Hons) Arb, MICFor, Chartered Arboriculturist, Barcham Tree Nursery
12:40 – 13:20	"Drveće budućnosti"- argumenti za kupovinu kvalitetnog sadnog materijala - primeri dobre sadnje	Mirela Šatara, Stefan Lorberg, Ilya Ochnev - Rasadnik Lorberg
13:20 - 13:30	Komercijalna <i>in vitro</i> proizvodnja i mogućnosti saradnje	Superior d.o.o - Velika Plana
13:30 - 13:40	Lite Soil - Underground irrigation for plants in response to climate change	Hemcof d.o.o - Dragan Nikolić
13:40 – 14:00	Prezentacija: Gralo - holistički koncept edukacije - Divci	prof. dr Jelena Tomićević Dubljević, Vladimir Milutinović dipl. inž.p.a
14:00 – 15:00	RUČAK	
15:00 – 15:30	Zakon o semenu i sadnom materijalu EU - okrugli sto	dr Dragana Skočajić, Milan Topalović, dipl. ing., prof. dr Vladan Ivetić, prof.dr Mirjana Šijačić Nikolić, dr Jovana Devetaković, dr Vladan Popović, dr Jelena Lazarević
15:30 – 15:50	Značaj i prednosti upotrebe genetski kvalitetnog semena	dr Vladan Popović
15:50 – 16:10	Šumski sadni materijal u Srbiji – obim proizvodnje i kvalitet	dr Jovana Devetaković, prof. dr Vladan Ivetić
16:10 – 16:30	Divlja trešnja (<i>Prunus avium</i> L.) - od rasadnika do predela Velikog ratnog ostrva	Msc Ivona Kerkez, prof. dr Mirjana Šijačić Nikolić, dr Marina Nonić, dr Vladan Popović
16:30 - 17:00	Diskusija	

XXI SIMPOZIJUM Pejzažna hortikultura Srbije 2024 “SADNI MATERIJAL KAO RESURS - OD RASADNIKA DO PREDELA”		
08:45 – 09:00	Registracija učesnika, DRUGI DAN: 09.02.2024. godina	
ZAŠTITA BILJAKA I ARBORIKULTURA		Moderatori: prof dr Milka Glavendekić, prof dr Vesna Čurguz
09:00 – 09:20	Zdravstveno stanje drvoreda i drvorednih stabala u Crnoj Gori	dr Jelena Lazarević, Biotehnički fakultet Univerziteta Crne Gore
09:20 – 09:40	Sušenje borova u parkovima Ušće i Kalemegdan u Beogradu izazvano kompleksom patogenih i insekata	prof. dr Milka Glavendekić, prof. dr Vesna Golubović Čurguz, Šumarski fakultet, Maja Radovanović, dipl.inž.polj., Aleksandra Janković, dipl.inž.polj., JKP Zelenilo Beograd
09:40 – 10:20	Resistant clones of <i>Ulmus</i> spp.	Wim Van Dyck, Pieter Van Dyck, rasadnik ARBOR
10:20 – 10:40	Nove štetočine u Srbiji uvedene sa sadnim materijalom ukrasnih biljaka	prof. dr Milka Glavendekić, Šumarski fakultet
10:40 – 11:00	Značaj preventivnih mera u suzbijanju bolesti sezonskog cveća i ruža	dr Nemanja Stošić, Akademija strukovnih studija Šabac
11:00 – 11:10	AgroVerm - paleta proizvoda i Hortimet supstrati	Planta Sana d.o.o - dr Nemanja Stošić
11:10 – 11:30	PAUZA	
11:30 – 12:00	Education and certification of arborists in the Czech Republic	dr Jaroslav Kolarik, Arboristička Akademija
12:00 – 12:30	Large-scale urban planting - ecological revolution or vandalism?	dr Jaroslav Kolarik, Arboristička Akademija
12:30 – 13:10	Benefiti zelenih krovova u urbanim sredinama i bezbednosni sistemi zelenih krovova	Nenad Veličković, DIADEM Srbija
Prezentacija novih udžbeničkih izdanja:		
13:10 – 13:40	Praktikum iz Osnova ekologije i zaštite životne sredine	dr Marija Nešić, Šumarski fakultet
	Primena QR kodova u šumarstvu - na primeru Arboretuma Šumarske škole u Kraljevu	Msc Dragojla Kaplarević, Šumarska škola Kraljevo
	Atlas medonosnog bilja Crne Gore	dr Jelena Beloica, Šumarski fakultet
13:40 – 14:00	Poster sekcija, nagrađeni radovi	
14:00 - 15:00	RUČAK	
AKTIVNOSTI UPHS I SKUPŠTINA		Dragana Skočajić, Jovan Topalović
15:00 – 15:15	Rasprava o mogućnostima održavanja obuka iz oblasti Arboristike	Milka Glavendekić, Đurđa Petrov, Vladimir Milutinović, JKP, Privatni sektor
15:15 – 15:30	Hrvatska udruga za arborikulturu HUA 2023 - Izveštaj o poseti	dr Đurđa Petrov, Vladimir Milutinović
15:30 – 15:45	Poseta delegacije Italijanskih rasadnika A.N.V.E. Srbije, tokom juna 2024. godine	Dragana Skočajić, Jovan Topalović
15:45 – 16:15	Izveštaj o radu UPHS u 2023. god. Izbor novog rukovodstva UO UPHS	Dragana Skočajić
16:15 – 16:30	Zaključci Simpozijuma	

XXI Symposium Landscape Horticulture 2024 "PLANT MATERIAL AS A RESOURCE- FROM NURSERY TO LANDSCAPE"		
08:00 – 08:45	Registration of participants, DAY ONE: 08.02.2024.	
08:45 – 09:00	Introduction: XXI Symposium Landscape Horticulture 2024	Dragana Skočajić, chair of SLHS
	Symposium Opening	Representative of the Faculty of Forestry, University of Belgrade
PLANT MATERIAL		Moderators: Dragana Skočajić, Dragana Čavlović, Marija Nešić
09:00 – 09:20	Selection of the garden roses and ecosystem services they provide	Msc Biljana Božanić Tanjga, dr Mirjana Ljubojević, Aleksandar Đukić, Mirjana Vukosavljev, Olivera Ilić and Tijana Narandžić, Pheno Geno Roses
09:20 – 09:40	New directions in ornamental plants selection and use	Dr. Mirjana Ljubojević, Tijana Narandžić, Biljana Božanić Tanjga, Jovana Ostojić, Milica Grubač, Radenka Kolarov and Magdalena Pušić, University of Novi Sad – Faculty of Agriculture,
09:40 – 10:20	Delivery of ecosystem services by urban vegetation - focus on urban hedges	Dr. Tijana Blanuša, Royal Horticultural Society University of Reading
10:20 – 11:00	Pruning of urban trees and shrubs	Mirela Šatara, Stefan Lorberg, Ilya Ochnev – Lorberg nursery
11:00 – 11:30	COFFEE BREAK + Poster session: poster viewing, conversation with the authors, voting for the best student poster	
11:30 – 12:20	Practical part - WORKSHOP: Standard tree pruning	Ilya Ochnev, Mirela Šatara, Stefan Lorberg – Lorberg nursery
12:20 – 13:00	The importance of understanding tree nursery production systems	MSc Arb Keith Sacre, BSc (Hons) Arb, MICFor, Chartered Arboriculturist, Barcham Tree Nursery
13:00 – 13:30	"Trees for the future" - why buying a good quality plant material – examples of the good practice	Mirela Šatara, Stefan Lorberg, Ilya Ochnev – Lorberg nursery
13:30 – 13:45	<i>In vitro</i> production and planting possibilities	Superior d.o.o - Velika Plana
13:45 – 14:00	Presentation: Gralo – concept of the holistic education – Divci, Serbia	prof. dr. Jelena Tomićević Dubljević, Vladimir Milutinović g. e.
14:00 – 15:00	LUNCH	
15:00 – 15:30	EU Regulations on Plant and Forest Reproductive Material – round table	Dr. Dragana Skočajić, Milan Topalović, prof. dr. Vladan Ivetić, prof. dr. Mirjana Šijačić Nikolić, dr. Jovana Devetaković, dr. Vladan Popović, dr. Jelena Lazarević
15:30 – 15:50	Significance and advantages of using genetically quality seeds	Dr. Vladan Popović
15:50 – 16:10	Forest plant material in Serbia – production and quality	Dr. Jovana Devetaković, ass. prof, prof. dr Vladan Ivetić
16:10 – 16:30	Wild Cherry (<i>Prunus avium</i> L.) – from nursery to the landscape of Great War Island	Msc Ivona Kerkez, prof. dr Mirjana Šijačić Nikolić, dr Marina Nonić, dr. Vladan Popović
16:30 – 17:00	Discussion	

XXI Symposium Landscape Horticulture 2024 “PLANT MATERIAL AS A RESOURCE- FROM NURSERY TO LANDSCAPE”		
08:45 – 09:00	Registration of participants, DAY TWO: 09.02.2024.	
PLANT PROTECTION AND ARBORICULTURE		Moderators: prof dr. Milka Glavendekić, prof dr. Vesna Ćurguz
09:00 – 09:20	The health condition of tree rows in Montenegro	dr Jelena Lazarević, University of Montenegro - Biotechnical Faculty
09:20 – 09:40	Dying of pine trees in Ušće and Kalemegdan parks in Belgrade due to the complex of pathogens and insects	prof. dr Milka Glavendekić, prof. dr Vesna Golubović Ćurguz, Šumarski fakultet, Ljubimaja Radovanović, g.e.agri., Aleksandra Janković, g.e.agri, PE “Zelenilo” Beograd
09:40 – 10:20	<i>Ulmus</i> makes cities breathing, <i>Quercus</i> on calcareous soil	Wim Van Dyck, Pieter Van Dyck, ARBOR nursery
10:20 – 10:40	New pests in Serbia introduced with ornamental planting material	prof. dr Milka Glavendekić, Faculty of Forestry, University of Belgrade
10:40 – 11:00	Importance of preventive measures in diseases control of seasonal flowers and roses	Dr. Nemanja Stošić, Academy of Professional Studies Šabac
11:00 – 11:10	AgroVerm – products and Hortimet substrates	Planta Sana d.o.o – dr. Nemanja Stošić
11:10 – 11:25	Lite Soil - Underground irrigation for plants in response to climate change	Lite Soil Vienna –Dorothea Sulzbacher, Hemcof d.o.o - Dragan Nikolić
11:25 – 12:00	COFFEE BREAK	
12:00 – 12:30	Education and certification of arborists in the Czech Republic	Dr. Jaroslav Kolarik, Arboricultural Academy, Czech Republic
12:30 – 13:00	Large-scale urban planting - ecological revolution or vandalism?	Dr. Jaroslav Kolarik, Arboricultural Academy, Czech Republic
13:00 – 13:20	The benefits of Green roofs in urban areas and the safety systems of Green roofs	Nenad Veličković, DIADEM Srbija
Presentation of new books:		
13:20 – 13:50	Fundamentals of ecology and environmental protection workbook	Dr. Marija Nešić, ass. prof. Faculty of Forestry, University of Belgrade
	Application of QR codes in forestry – example of the Arboretum of Kraljevo Forestry School	Msc. Dragojla Roljević, Šumarska škola Kraljevo
	Atlas of honey plants of Montenegro	Dr. Jelena Beloica, ass. prof. Faculty of Forestry, University of Belgrade
13:50 – 14:10	Poster session, announcement of the awards	
14:10 – 15:00	LUNCH	
SLHS ACTIVITIES AND ELECTIONS		Dragana Skočajić, Jovan Topalović
15:00 – 15:15	Discussion about the possibilities of Arboriculture trainings.	Milka Glavendekić, Đurđa Petrov, Vladimir Milutinović, PE, Private sector
15:15 – 15:30	Croatian Arboricultural Society 2023 – Visit report	Dr. Đurđa Petrov, Vladimir Milutinović
15:30 – 15:45	Announced visit of the Delegation of Italian Nurseries, June 2024., Serbia	Dragana Skočajić, Jovan Topalović
15:45 – 16:15	Yearly SLHS 2023 report. Election of the new SLHS Board	Dragana Skočajić
16:15 – 16:30	Conclusions	

SADNI MATERIJAL

IZBOR BAŠTENSKIH RUŽA I USLUGE EKOSISTEMA KOJE PRUŽAJU

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Apstrakt:

Značaj ruža u ozelenjavanju javnih površina i dekoraciji enterijera kao i njihova primena u kulinarstvu, farmaciji, kozmetici i šire su od neprocenjive vrednosti. Ako se ovom dodaju i ekosistemske usluge koje nam neke baštenske ruže mogu pružiti, to je mnogo više od njihove estetske, senzorne i nutritivne vrednosti. Stoga je cilj ovog rada bio da se ispituju mogućnosti korišćenja novih sorti baštenskih ruža kao moguće ukrasne sorte, otporne na bolesti ali istovremeno i privlačne za pčele, dodajući njihove trenutne vrednosti uslugama ekosistema. Ciljevi istraživanja bili su utvrđivanje biodiverziteta i brojnosti medonosnih, divljih pčela i njihova korelacija sa morfološkim karakteristikama cveta ruža kolekcije 'Mella' i njihova mogućnost šire primene u urbanom zasadima. Biljni materijal je obuhvatio sedam sorti baštenskih ruža iz kolekcije 'Mella' nastale kao rezultat oplemenjivačkog rada kompanije Pheno Geno Roses u agroekološkim uslovima Vojvodine. Pored analiza morfoloških kvalitativnih i kvantitativnih osobina biljaka, praćenje su i otpornosti/tolerantnosti na bolesti u datim agroekološkim uslovima, kao i prisustvo, odnosno brojanje medonosnih, divljih pčela koje su posećivale proučavane ruže kao potencijalni oprašivači. Pored sveobuhvatne procene mirisa kao kvantitativnog svojstva, sprovedena je analiza panela mirisa kao i sadržaj najznačajnijih isparljivih komponenti cveta tokom perida posete polinatora. Na osnovu dobijenih rezultata uočena je značajna varijabilnost vegetativnih i generativnih karakteristika između sorti 'Mella' kolekcije. Sa svojim „naturalnim“ izgledom, u poređenju sa divljim ružama, sorte 'Mella' su se razlikovale po visini i habitusu biljaka, broju i tipu cvetova, boji listova i sjaju. Sorte 'Barbie Mella' i 'Rubi Mella' su se pokazale kao najdekorativnije. 'Barbi Mella' je dobila visoku ocenu za ukupan miris, sa najrazličitijim rezultatima na panelu mirisa za mirisne komponente, a odnos ispitivanih isparljivih jedinjenja bio je skoro uravnotežen (1:1:1) između aromatičnih alkohola + terpenoida, ravnolančanih alkana i dugolančanih alkana. Upoređujući odnos privlačnosti pčela u kombinaciji sa visinom biljaka, mirisom, tipom cveta, utvrđeno je da su prečnik i pristupačnost cveta presudni za posetu pčela u odnosu na druge proučavane karakteristike. Kao najatraktivnija za pčele pokazala se sorta 'Barbie Mella' koja pored dekorativnih i senzornih vrednosti može pružiti značajno stanište za pogodno za oprašivače. Zbog svojih estetskih vrednosti, otpornosti na bolesti i poseta pčela, sorte 'Mella' kolekcije 'Barbi', 'Rubi', 'Ducat' i 'Exotic' bi trebalo da budu zasade kao deo urbanih poluprirodnih vrtova/pejzaža, istovremeno doprinoseći višestrukim uslugama ekosistema. Do njihove šire upotrebe, treba nastaviti sa proučavanjem i promovisanjem divljih sorti ruža sličnih 'Mella' ružama kao uslova za dalji razvoj i unapređenje urbane hortikulture.

Gljučne reči: otpornost na bolesti, usluge ekosistema, privlačnost oprašivača, uzgoj ruža, održivost, urbani ekosistemi

SELECTION OF GARDEN ROSES AND ECOSYSTEM SERVICES THEY PROVIDE

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Abstract:

The role of roses in greening public spaces and interior decoration, as well as their use in cooking, pharmacy, and cosmetics, are of invaluable significance. When considering the ecosystem services that some garden roses can provide, their importance goes beyond their aesthetic, sensory, and nutritional values. Therefore, this study aimed to explore the possibilities of using new varieties of garden roses as potential ornamental varieties, resistant to diseases, yet attractive to bees, while adding their current values to ecosystem services. The research objectives were to determine the biodiversity and abundance of pollinating, particularly wild bees, and their correlation with morphological characteristics of the roses from the 'Mella' collection, as well as their potential broader application in urban plantations. The plant material included seven varieties of garden roses from the 'Mella' collection, the result of breeding work conducted by the Pheno Geno Roses company in the agro-ecological conditions of Vojvodina. Besides analysing the morphological qualitative and quantitative characteristics of plants, resistance/tolerance to diseases in given agro-ecological conditions, and the presence, or counting of pollinators, especially wild bees, were also monitored. Apart from a comprehensive assessment of the fragrance as a quantitative property, we analysed the fragrance panel and the content of the most significant volatile components emitted by the flower during the pollinator visit period. The results revealed significant variability in vegetative and generative characteristics among the 'Mella' collection varieties. With their "natural" appearance, 'Mella' varieties differed from wild roses in plant height, habit, number and type of flowers, leaf colour, and shine. 'Barbie Mella' and 'Rubi Mella' varieties proved to be the most decorative. 'Barbie Mella' received a high rating for overall fragrance, with the most diverse results on the fragrance panel for aromatic components where the ratio of investigated volatile compounds was almost balanced (1:1:1) for alcohols + terpenoids, straight-chain alkanes, and long-chain alkanes. Comparing their attractiveness to bees in combination with plant height, fragrance and flower type, it was found that the diameter and accessibility of the flower are crucial for bee visits compared to other studied characteristics. 'Barbie Mella' proved to be the most attractive for bees, providing a significant habitat for suitable pollinators, in addition to its decorative and sensory values. Due to their aesthetic values and resistance to diseases and bee visits, 'Mella' collection varieties 'Barbi', 'Rubi', 'Ducat', and 'Exotic' should be planted within urban semi-natural gardens/landscapes, simultaneously contributing to multiple ecosystem services. Before their broader use, further research and promotion of wild rose varieties similar to 'Mella' roses are necessary for the further development and improvement of urban horticulture.

Keywords: disease resistance; ecosystem services; attractiveness to pollinators; rose breeding; sustainability; urban ecosystems

NOVI PRAVCI SELEKCIJE I KORIŠĆENJA UKRASNOG BILJA

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Apstrakt:

Usklađivanje sa Evropskom Zelenom Agendom zahteva da se ciljevi oplemenjivanja hortikulturnog bilja i njihova primena preusmere ka zelenim ili prirodi bliskim rešenjima. Dosadašnji ciljevi oplemenjivanja bili su usmereni na osnovne pomološke, fiziološke, biohemijske i fenotipske karakteristike ukrasnih i voćnih vrsta, uzimajući profitabilnost kao krajnji parametar. Odgovarajući na savremene potrebe za približavanjem prirode svakodnevnom životu u gradu, kao i zahteve za povećanjem integralne i organske proizvodnje u ruralnim sredinama, redefinisani su ciljevi oplemenjivanja. U skladu sa izazovima 21. veka, istraživački interes se usmerio ka održivom korišćenju biljnih genetičkih resursa (autohtonih i alohtonih) kao i održivoj praksi i rešenjima zasnovanim na prirodi (proizvodnja biodizela i biopesticida iz ukrasnih biljnih vrsta, kišne bašte, zeleni krovovi i zeleni zidovi). Istraživanja koncentrisana na veće prinose i kvalitet plodova, brzo razmnožavanje biljaka i veću ukrasnu vrednost koja zadovoljava zahteve tržišta i profitabilnosti, nisu uključivala pitanja održivosti. Usled brzih društvenih, ekoloških i ekonomskih pritisaka, novi pravci istraživanja su: (1) selekcija na otpornost prema bolestima i štetocinima za potrebe jestivog ozelenjavanja; (2) selekcija cvetnih vrsta tolerantnih na stresne urbane sredine; (3) izbor vodoefikasnih i isplativih slabobujnih podloga za potrebe intenzivnih profesionalnih zasada i amaterskog urbanog baštovanstva; (4) mogućnosti korišćenja, a ne iskorenjivanje invazivnih i alergeničnih vrsta drveća i žbunja; (5) istraživanje prirodnih rešenja za ublažavanje negativnih klimatskih faktora; i (6) ublažavanje stresa izazvanog sušom kod vrsta na urbanim otvorenim prostorima. Iza svih navedenih aktivnosti leži održivo korišćenje biljnih genetičkih resursa i/ili održivih praksi za njihovu podršku, doprinoseći globalno definisanim ciljevima održivog razvoja.

Ovakvim pristupom istovremeno se doprinosi održivoj upotrebi hortikulturnog bilja, ali se stvara i nova ponuda na tržištu ukrasnog bilja uz mogućnost inoviranja i unapređenja rasadničke proizvodnje na otvorenom, stakleničke i plasteničke zaštićene proizvodnje. Selekcijom i stvaranjem otpornih/tolerantnih sorti na abiotičke i biotičke stresne faktore otvara se mogućnost pokretanja sasvim nove ili inoviranja stare rasadničarske proizvodnje. Sadni materijal sa svim navedenim pozitivnim karakteristikama definisanim ciljevima istraživanja predstavlja izuzetan potencijal za rasadničku proizvodnju. Kako su tržište i proizvodnja uzajamno zavisni, upoznavanje stanovništva sa benefitima koje takav materijal nosi, intenzivan marketing i popularizacija doprineli bi značajnijoj primeni otpornih sorti u proizvodnji ili na zelenim površinama, dok bi veća potražnja povoljno uticala na povećanje proizvodnje i zarade rasadničara.

Glavne reči: cirkularna ekonomija; prirodom inspirisana rešenja; oplemenjivanje ukrasnog bilja; održivost; urbana hortikultura

Zahvalnica: Istraživanje je sprovedeno u okviru četvorogodišnjeg projekta pod nazivom Biohemijski usmerena selekcija baštenskih ruža u cilju povećanja kvaliteta i tržišne kompetitivnosti vojvodanskih proizvođača, broj 142-451-3481/2023-01/1, finansiran od strane Pokrajinskog sekretarijata za visoko obrazovanje i naučnoistraživačku delatnost, Autonomna Pokrajina Vojvodina, Republika Srbija.

NEW DIRECTIONS IN SELECTION AND UTILISATION OF ORNAMENTAL PLANTS

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Abstract:

Aligning with the European Green Agenda requires redirecting breeding goals and applications of horticultural plants towards green or nature-based solutions. Traditional breeding goals have focused on basic pomological, physiological, biochemical, and phenotypic characteristics of ornamental and fruit species, with profitability as the final parameter. However, breeding goals have been redefined in response to contemporary needs for bringing nature closer to urban life and the requirements for increased integrated and organic production in rural environments. Following the challenges of the 21st century, research interest has shifted towards the sustainable use of plant genetic resources (autochthonous and allochthonous), sustainable practices and nature-based solutions (production of biodiesel and biopesticides from ornamental plant species, rain gardens, green roofs, and green walls). Research concentrated on higher fruit yields and quality, rapid plant reproduction, and higher ornamental value satisfying market and profitability demands, have often neglected sustainability issues. Due to rapid social, environmental, and economic pressures, new research directions include (1) selection for resistance to diseases and pests for edible landscaping; (2) selection of flowering species tolerant to stressful urban environments; (3) selection of water-efficient and cost-effective dwarf rootstocks for intensive professional plantations and amateur urban gardening; (4) exploring the use, rather than eradication, of invasive and allergenic tree and shrub species; (5) researching natural solutions to mitigate negative climate factors; and (6) alleviating drought stress in species on urban open spaces. Sustainable use of plant genetic resources and/or sustainable practices underlie all these activities, contributing to globally defined sustainable development goals.

This approach contributes to the sustainable use of horticultural plants and creates a new offering in the ornamental plant market, with possibilities for innovation and improvement in open-field and protected glasshouse and greenhouse production. Selection and creation of varieties resistant/tolerant to abiotic and biotic stress factors open the opportunity to initiate an entirely new or to innovate existing nursery production. The plant material with all the enumerated positive characteristics defined by research goals represents exceptional potential for nursery production. As the market and production are interdependent, introducing the population to the benefits of such material, intensive marketing, and popularisation would contribute to a significant application of resistant varieties in production or on green surfaces, potentially leading to increased production and profit for nursery growers.

Keywords: circular economy; nature-based solutions; ornamental plant breeding; sustainability; urban horticulture

Acknowledgement: The research was conducted within a four-year project titled "Biochemically Oriented Selection of Garden Roses to Increase the Quality and Market Competitiveness of Vojvodina Producers," number 142-451-3481/2023-01/1, financed by the Provincial Secretariat for Higher Education and Scientific Research, Autonomous Province of Vojvodina, Republic of Serbia.

DOPRINOS GRADSKOG ZELENILA ŽIVOTNOJ SREDINI - ISTRAŽIVANJA NA ŽIVIM OGRADAMA

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Apstrakt

Urbana vegetacija pruža višestruke koristi ljudima i živom svetu, velikim delom zbog svog efekta na smanjenje uticaja urbanog toplotnog ostrva, regulisanje protoka vode i poboljšanje kvaliteta vazduha. Koristeći urbane žive ograde kao model (zbog njihove popularnosti u pejzažu UK, niske cene instalacije i linearne prirode), u ovom predavanju ću podeliti neke detalje oko strukturnih i funkcionalnih karakteristika biljaka potrebnih za pružanje tih ekosistemskih 'usluga'. Takođe ću prikazati rezultate i uvide iz dve nedavne studije o ulozi živih ograda u hvatanju čestica zagađivača u vazduhu. Nalazi sugerišu da osobine lista kao što su dlakavost i hrapavost, i osobine krošnje kao što su veća gustina i lisna površina mogu biti povezane sa boljim hvatanjem čestičnog zagađenja. Ovo je bilo važnije u oblastima sa visokim intenzitetom saobraćaja u poređenju sa područjima sa niskim ili bez saobraćaja. Pored toga, razmatraće se i nalazi dobijeni u saradnji s kolegama na Univerzitetu u Warwick-u o uticaju zagađenja vazduha na obilje i raznovrsnost lisne bakterijske kompozicije.

Ključne reci: ekosistemske usluge, žive ograde, čestični zagađivači vazduha, lisne karakteristike

DELIVERY OF ECOSYSTEM SERVICES BY URBAN VEGETATION - FOCUS ON URBAN HEDGES

Tijana Blanus

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Abstract

Urban vegetation provides multiple benefits to people and wildlife, in large part due to its effect on reducing urban heat island effect, regulating water flows and improving the air quality. Using urban hedges as a model (due to their widespread use in the UK landscape, low cost of installation and linear nature), this talk will delve into some detail around the functional and structural plant traits required to provide those benefits. It will also provide results and insights from two recent studies around the role of hedges in the capture of airborne particulate pollutants. Findings suggest that leaf traits such as hairiness and roughness, and canopy traits like greater density and leaf area can be linked with better capture of particulate pollution. This was more important in areas with high traffic intensity compared with areas of low or no transport. Additionally, the impact of particulate pollution on leaf microbial abundance and diversity obtained in the collaborative research with the University of Warwick will be discussed.

Key words: ecosystem services, hedges, leaf traits, particulate pollution

OREZIVANJE URBANOG DRVEĆA I GRMLJA

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Apstrakt:

Prilikom presađivanja, drvo gubi značajan dio vlaknastog korijena koji je potreban za opskrbu vodom i hranjivim tvarima, uprkos redovnom i profesionalnom presađivanju u rasadniku. Stoga je, sa stanovišta rasadnika, profesionalna rezidba biljaka kako bi se uspostavila ravnoteža između korijena i krošnje neophodna kao pomoć u fazi rasta. Prorjeđivanjem krošnje uspostavlja se uravnotežen odnos listova i korijena za daljnji razvoj. Pokazalo se da što se snažnije provodi rezidba kako bi se smanjila masa isparavanja, to je novi rast jači i bolji rast stabla može biti zagarantovan.

Osnove rezidbe krošnje pratimo kroz nekoliko osnovnih koraka. Odgovarajući, oštri i dobro održavani alati dio su profesionalnog rezanja. Vršni izdanak ne skraćujemo, osim ako se proporcije krošnje ne uklapaju. Bočne grane se skraćuju samo u gornjem dijelu krošnje, stvarajući širok, piramidalni oblik, dok donje grane ostaju što je moguće duže. Ako se formira račva, konkurentni izdanci moraju se uredno odrezati, također ako se grane/grančice dodiruju, ili su previše blizu jedna drugoj, jednu treba ukloniti. Prilikom orezivanja treba voditi računa da novi rast usmjerite u željenom smjeru kroz pupoljke. Grane drugog reda koje rastu predebele ili preblizu deblu mogu se ukloniti. Što je drvo veće, orezivanje mora biti jače. Ako se radi vješto, smanjenje grana može biti i do 60% bez promjene habitusa drveta. Rez treba izvoditi na takav način, da se stvori glatka i ravna rana. Makaze moraju biti vođene na takav način, da nakon reza ne ostane žljeb, jer se ne mogu prekriti tkivom rane i tada stabljike umiru i formiraju ulazne tačke za gljivice i druge patogene truleži. Na rani ne bi trebalo ostati vode kako bi se izbjegla kolonizacija gljivica.

Izuzeci postoje za rodove: *Ailanthus*, *Juglans*, *Paulownia*, *Aesculus* i *Catalpa*, koji se lagano orezuju ili se ni ne režu. Nekim rodovima je potrebna zaštita debla uprkos pravovremenoj rezidbi, npr. *Carpinus*, *Fagus*, *Sorbus*, *Platanus*, *Acer* i sve voćke. U rasadniku se ove vrste štite od sunčeve svjetlosti ili vremenskih nepogoda prostirkama od rafije ili trske (položene u smjeru jugozapada).

Ključne riječi: orezivanje, krošnja, makaze, rane, izuzeci

PRUNING OF URBAN TREES AND SHRUBS

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Abstract:

A significant loss of fibrous roots crucial for water and nutrient intake inevitably occurs during transplanting despite regular and professional transplanting in the nursery. Therefore, from the nursery's perspective, professional pruning of plants to establish a balance between roots and crown is essential to improve growth. Thinning the crown establishes a balanced crown-to-root ratio necessary for further development. It has been proved that severe pruning to reduce water loss promotes vigorous regrowth and ensures the growth of healthier trees.

The basics of crown pruning are followed through several key steps. Proper, sharp, and well-maintained tools are integral to professional pruning. The terminal shoot is not cut unless the crown's proportions are not fitting. Lateral branches are only shortened in the upper part of the crown, creating a wide, pyramidal outline, while lower branches are kept as long as possible. If a fork is formed, competitive shoots must be neatly cut, and in case branches/twigs touch or are too close to each other, one should be removed. When pruning, care should be taken to direct new growth in the desired direction through buds. Second-order branches that are too thick or too close to the trunk can be removed. The larger the tree, the more severe the pruning must be. If done skillfully, branch reduction can be up to 60% without altering the tree habit. The cut should be made in such a way as to create a smooth and flat wound. Pruning scissors must be guided in a manner that leaves no groove after the cut, as they cannot be covered by wound tissue, leading to stem death and forming entry points for fungi and other pathogens. Water should not be left on the wound to avoid fungal colonisation.

There are exceptions for genera such as *Ailanthus*, *Juglans*, *Paulownia*, *Aesculus* and *Catalpa*, which are either lightly pruned or not pruned at all. Some genera require trunk protection despite timely pruning, e.g., *Carpinus*, *Fagus*, *Sorbus*, *Platanus*, *Acer* and all fruit trees. In the nursery, these species are protected from sunlight or adverse weather conditions using raffia or reed coverings (laid in the southwest direction).

Keywords: pruning, crown, pruning scissors, wounds, exceptions

ZNAČAJ RAZUMEVANJA SISTEMA PROIZVODNJE DRVEĆA U RASADNICIMA

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Apstrakt:

Način na koji je drveće proizvedeno u rasadniku može imati kritičnu ulogu u njihovom daljem razvitku i nezavisnosti nakon presađnje. Pak, poznavanje sistema proizvodnje oslanja se uglavnom na same rasadnike, dok “pejzažisti” i drugi, koji se bave sadnjom drveća, nisu u potpunosti svesni da svaki sistem proizvodnje ima svoje prednosti i mane, koji, svaki na svoj način, modifikuju samo drvo.

Te modifikacije, dalje utiču na tehnike sadnje i na održavanje i mere nege nakon sadnje. Manjak razumevanja sistema proizvodnje u rasadnicima često ima za posledicu i pripremanje neadekvatnih, ili loših specifikacija sadnog materijala.

Ova prezentacija će istražiti i objasniti najčešće sisteme proizvodnje u rasadnicima, modifikacije koje nastaju u toku tih sistema i posledice koje nastaju ako se ne adaptiraju tehnike sadnje i mere nege i održavanja drveća, nakon sadnje. Prezentacija će takođe prikazati i primere dobre prakse i ilustrovati, kako se mogu primeniti primeri dobre prakse. Takođe će se izneti sugestije vezane za samu specifikaciju sadnog materijala, odnosno šta se sve treba dodati i uključiti u specifikaciju da bi sadnice služile svojoj svrsi.

Ključne reči: proizvodni sistemi u rasadnicima, primeri dobre prakse, mere nege nakon sadnje, specifikacija sadnog materijala

THE IMPORTANCE OF UNDERSTANDING TREE NURSERY PRODUCTION SYSTEMS

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Abstract:

The way trees are produced on the nursery can be critical to their future success and independence in the landscape after transplanting. Yet knowledge of nursery production systems remains largely on the nursery with landscapers and others planting the trees not fully appreciating that each nursery production system has advantages and disadvantages with each making modifications to the tree.

These modifications have an impact on planting techniques and the post planting maintenance and management necessary. This lack of understanding of nursery production systems often results in the production of poor and inadequate specifications being prepared.

This presentation will explore and explain the most common nursery production systems, the modifications made during those systems and the implications of not adapting planting techniques and post planting management and maintenance. The presentation will also consider nursery best practice and illustrate what that best practice should look like. It will also offer suggestions as to what can be added to and included in specifications to ensure that trees supplied for the nursery are fit for purpose.

Key words: nursery production systems, nursery best practice, post planting management, specifications.

DRVEĆE BUDUĆNOSTI

Mirela Šatara

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Apstrakt:

Rasadnik Lorberg je osnovan od strane Gottlob Heinrich Lorberga 1843. godine kao rasadnik ruža u Berlinu, da bi se proizvodnja brzo proširila. Kroz sedam generacija rasadnik se selio više puta i rastao prema potrebama. Rasadnik u Tremmenu je zvanično nastao 1988. godine sa dolaskom trenutnog direktora Stefana Lorberga. Trenutno rasadnik proizvodi i prodaje sve vrste sadnog materijala na četiri lokacije u Njemačkoj i to u Tremenu, Kleinziethen-u, Baden-Baden-u i Seeth-Ekholt-u.

Zašto je drveće toliko važno? Navodimo samo neke razloge: hladi vazduh, (kako se temperature povećavaju kao rezultat klimatskih promena, svojom senkom i utiču na sprečavanje pregrevanja ulica i kuća), smanjuju buku, ovlažuje vazduh kroz vodu u lišću i tako nam pomaže da lakše dišemo; stanište su za insekte, ptice, sitne glodare i sisare; skladišti CO₂ i proizvodi kiseonik, služi kao oaza u parkovima - i tako doprinosi opuštanju i mentalnom zdravlju ljudi.

Promjene na tržištu i preispitivanja se dešavaju od 2018. godine. Čini se, kao da su klimatske promjene tek sada stigle u grad! Sada, svi prepoznaju da je zelenilo u gradu bitno. Dolazi do preispitivanja i među donosiocima odluka, a mnogo toga postoji što bi trebalo da se izmeni i nadoknadi. Lorbergov rasadnik je, također, započeo s preispitivanjima prije 25 godina. Zajedno sa arhitektima, Beuth Univerzitetom, Humboldt univerzitetom i drugim institutima učestvujemo u istraživanjima na temu drveća otpornog na sušu.

Posvećeni smo i biološkoj zaštiti bilja. Rezultat toga je smanjenje upotrebe pesticida do 50 %, kroz sadnju biranog sjemena koje privlači korisne insekte koji se hrane štetočinama. Lorbergov rasadnik je pionir u isplativom korištenju vode (počeli smo da postavljamo sisteme „kap po kap“ prije 30 godina). Planeri i pejzažni arhitekti, kao i mnogi drugi su sve više uključeni.

Dostupnost drveća je još jedno pitanje kojim se trebamo baviti u narednom periodu. Mnogi kupci vjeruju da je sve uvijek dostupno što nije slučaj. Potrebe su se promijenile, u periodu od 1990.-2018. potražnja je postepeno kroz projekte opadala. Od 2004. do 2018. godine broj rasadnika je pao sa 3.400 na 1.700 i dalje je u padu. Samim tim je i situacija na tržištu drugačija.

Učestvujemo u istraživačkom radu „Trees4streets“ gdje 21 klon iz 8 rodova (npr. *Tilia*, *Acer* i dr.) pratimo u *in vitro* kulturi, daljem uzgoju uličnog drveća otpornog na stres u Lorberg rasadniku i monitoringu na urbanim lokacijama.

Ključne reči: rasadnik Lorberg, drveće, biološka zaštita, promjene, potrebe, dostupnost, vegetativni „in vitro“

TREES OF THE FUTURE

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Abstract:

Lorberg Nursery was founded by Gottlob Heinrich Lorberg in Berlin in 1843. It started as a rose nursery but quickly expanded its production. Over seven generations, the nursery relocated several times and grew to meet the growing needs. The Tremmen Nursery officially originated in 1988 with the arrival of the current director, Stefan Lorberg. Currently, the nursery produces and sells a wide range of plant material at four locations in Germany: Tremmen, Kleinziethen, Baden-Baden, and Seeth-Ekholt.

Why are trees so important? Here are just a few reasons: they cool the air (with the temperature rise due to climate change, they prevent overheating of streets and houses with their shade), reduce noise, humidify the air by releasing water vapour through leaves and thus help us breathe, provide habitats for insects, birds, small rodents, and mammals, store CO₂ and produce oxygen and serve as oases in parks - thus promoting relaxation and enhancing people's mental health.

Market changes and reevaluations have been occurring since 2018. It seems that climate change has only recently reached urban areas! Finally, everybody recognises the importance of greenery in urban areas. Decision-makers are reevaluating their practices, realising much needs to be changed and compensated. Lorberg Nursery began its reassessments 25 years ago. Alongside architects, Beuth University, Humboldt University, and other institutes, we have been participating in research on drought-resistant trees.

We are committed to biological plant protection, resulting in a 50% reduction in pesticide use through planting selected seeds that attract beneficial insects that feed on pests. Lorberg Nursery pioneered cost-effective water use when it started implementing the drip irrigation system 30 years ago. Planners, landscape architects, and many others are increasingly involved.

The availability of trees is another issue to address in the coming period. Purchasers often believe that everything should always be available, which is not the case. Needs have changed; from 1990 to 2018, demand gradually decreased through projects. From 2004 to 2018, the number of nurseries decreased from 3,400 to 1,700 and continues to decline, affecting the market situation.

We participate in the research project „Trees4streets“, monitoring 21 clones from 8 genera (e.g., *Tilia*, *Acer*, etc.) in *in vitro* culture, further growing stress-resistant street trees in Lorberg Nursery, and monitoring them in urban locations.

Keywords: Lorberg Nursery, trees, biological protection, changes, needs, availability, vegetative „in vitro.“

ZNAČAJ I PREDNOSTI UPOTREBE GENETSKI KVALITETNOG SEMENA

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Apstrakt:

Veličina genetske dobiti izražena preko kvalitetnog semenskog materijala, a potom sadnica, zavisi od dubine poznavanja semenskih baza. S obzirom na to, da je seme nosilac naslednih osobina i da od njegovih genetskih svojstava zavisi kvalitet budućih sastojina, neophodno je da se korišćenje semena iz postojećih i potencijalnih (antropogenih šuma i intenzivnih zasada) semenskih objekata postavi na savremene osnove i na taj način obezbedi sigurnija i kvalitetnija proizvodnja.

Za unapređenje biljne proizvodnje u šumarstvu, kako u povećanju produkcije tako i poboljšanju kvaliteta, presudnu ulogu ima genetika i oplemenjivanje šumskog drveća. Polazeći od činjenica da je šumsko seme, u uslovima slobodnog oprašivanja nosilac kompleksa osobina, kako loših tako i dobrih i da od njih zavisi kvalitet budućih sastojina, u poslednjim decenijama stručnjaci šumarske struke nastoje da proizvodnju semena postave na što savremenije i racionalnije osnove. Korišćenjem stečenih znanja iz genetike, oplemenjivanja drveća i proizvodnje sadnog materijala obezbediće se pravilna i stručna proizvodnja kvalitetnog šumskog reproduktivnog materijala.

Upotreba semena visokog kvaliteta, i genetskog i fiziološkog, važan je faktor u poboljšanju genetičke strukture šumskih sastojina i racionalnoj upotrebi semena. Poznavanje kvaliteta semena važan je faktor za sve koji su uključeni u proces proizvodnje, trgovine, skladištenja, sertifikovanja semena, počevši od proizvođača, dorađivača, rasadničara pa do sertifikacionih službi.

Imajući na umu sve napred navedeno može se zaključiti da je u budućnosti potrebno popraviti sliku i podići kvalitet proizvodnje šumskog semena u Srbiji na viši nivo. S tim u vezi potrebno je kontinuirano vršiti edukaciju i osvežavati znanja svim učesnicima u lancu proizvodnje šumskog reproduktivnog materijala.

Ključne reči: genetika, oplemenjivanje biljaka, seme, semenski objekti.

SIGNIFICANCE AND ADVANTAGES OF USING GENETICALLY QUALITY SEEDS

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Abstract:

The level of the genetic gain expressed through quality seed material, and subsequently the seedlings, depends on the depth of knowledge on seed bases. Considering that the seed is the carrier of hereditary traits and that the quality of future stands depends on its genetic properties, it is necessary to set on a modern basis the use of seeds from existing and potential seed facilities (anthropogenic forests and intensive plantations) and thus ensure safer and better-quality production.

For plant production improvement in forestry, both in increasing production and improving quality, genetics and breeding of forest trees play a crucial role. In recent decades, forestry experts have tried to put seed production on the most modern and rational basis possible based on the fact that forest seeds, under conditions of free pollination, are the carriers of a complex of traits, both bad and sound and that the quality of future stands depends on them. The acquired knowledge in genetics, tree breeding, and planting material production will ensure proper and professional production of high-quality forest reproductive material.

The use of high genetic and physiological quality seeds is an essential factor in improving the genetic structure of forest stands and the rational use of seeds. Knowledge of seed quality is necessary for everyone involved in the production, trade, storage, and certification of seeds, starting from producers, processors, and nurseries and ending with certification services.

Considering all those mentioned above, it is necessary to improve the image and raise the quality of forest seed production in Serbia to a higher level in the future. In this regard, it is necessary to continuously educate and refresh the knowledge of all participants in producing forest reproductive material.

Keywords: genetics, plant breeding, seed, seed facilities

ŠUMSKI SADNI MATERIJAL U SRBIJI – OBIM PROIZVODNJE I KVALITET

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Apstrakt:

Prema podacima Uprave za šume (2020), šumske sadnice u Srbiji se proizvode u 87 registrovanih šumskih rasadnika od kojih se samo 32 šumska rasadnika nalaze u privatnom vlasništvu. Proizvodnja šumskih sadnica se obavlja na površini od 475,44 ha, a najveći broj proizvedenih šumskih sadnica su lišćari od kojih najviše topola, a zatim bagrem i hrastovi, dok se od četinarara proizvode crni bor i smrča. Asortiman proizvodnje šumskog sadnog materijala u Srbiji je dosta uzak, a kvalitet proizvedenog sadnog materijala upitan sa više aspekata. Kvalitet sadnica se određuje samo na osnovu morfoloških karakteristika (visina i prečnik korenovog vrata) prateći Standard o kvalitetu šumskih sadnica lišćara/četinarara (SRPS D.Z2.111:1968/SRPS D.Z2.112:1968) koji je bez izmena u upotrebi duže od 50 godina. U Srbiji se godišnje proizvede oko 3 miliona šumskih sadnica što nije zadovoljavajući obim proizvodnje imajući u vidu površine koje su opredeljene i registrovane u ovu svrhu. Godišnje pošumljena površina ima tendenciju opadanja u poslednjih 20 godina i može se dovesti u vezu sa nedostatkom šumskih sadnica, ali se ne može smatrati jednim uzrokom ovakvog trenda. Trenutno stanje ukazuje na potrebu za proizvodnjom sadnica većeg broja vrsta šumskog drveća sa posebnim akcentom na retke i ugrožene vrste. Unapređenje tehnologije proizvodnje i bolje korišćenje postojećih kapaciteta u rasadnicima je neophodno u svrhu proizvodnje većeg broja šumskih sadnica, boljeg korišćenja površina i proizvodnje kvalitetnog sadnog materijala.

Ključne reči: šumski sadni materijal, šumski rasadnik, kvalitet sadnica

FOREST SEEDLINGS IN SERBIA – PRODUCTION AND QUALITY

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Abstract:

According to Forestry directorate (2020), forest seedlings have been produced in 87 registered forest nurseries, and 37 of them are privately owned. Total area determined for forest seedlings production is 475,44 ha, and mostly deciduous seedlings has been produced poplars, black locust and oaks (respectively), while conifers are represented as black pine and spruce seedlings. Production range of forest seedlings in Serbia is quite narrow, and the quality of the produced seedlings is questionable from several points. Seedlings quality determinates on the basis of root collar diameter and height according to Standard of forest seedlings quality (SRPS D.Z2.111:1968/SRPS D.Z2.112:1968) which has been used more than last 50 years without any change. Around 3 millions of forests seedlings has been produced per year which is not satisfactorily production according to surface determined for the purpose. Afforestation trend are negative during last 20 years and can be related with number of forests seedlings, but it can not be accepted as main one reason for this trend. The current situation indicates the need for seedlings production of a larger number of forest tree species with a special emphasis on rare and endangered species. Improvement of production technology and better use of existing capacities in nurseries is necessary for the purpose of producing a greater number of forest seedlings, better use of areas and production of quality planting material.

Keywords: forest seedlings, forest nursery, seedlings quality

DIVLJA TREŠNJA (*PRUNUS AVIUM* L.) – OD RASADNIKA DO PREDELA VELIKOG RATNOG OSTRVA

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Apstrakt:

Kao predeo izuzetnih odlika, Veliko ratno ostrvo je tačka najvećeg biodiverziteta ornitofaune na teritoriji Beograda. Odlikuje se malim brojem drvenastih vrsta, čiji genofond se, iz godine u godinu, uvećava kroz planirana pošumljavanja. Pored autohtonih vrsta, planirano je i pošumljavanje divljom trešnjom, koja je izvor hrane za ptice i svojom dekorativnošću doprinosi vizuri samog predela.

Kada je reč o ovakvim pošumljavanjima, posebnu pažnju treba posvetiti poreklu sadnog materijala. U tom kontekstu, obavljena je analiza gen-ekološkog potencijala različitih linija polusrodnika divlje trešnje u rasadničkom testu i na prostoru Velikog ratnog ostrva, na kome je osnovan terenski ogled.

Semenski materijal sakupljen je sa 14 materinskih stabala sa područja planina Kosmaj – KO (3), Bešnjaja – BE (10) i Jastrebac – JA (1), u julu 2018. godine. Rasadnički test je osnovan u septembru iste godine, u rasadniku Šumarskog fakulteta. Tokom dve godine istraživanja, u rasadničkom testu su praćeni: dinamika klijanja, parametri rasta (visine i prečnici) i mortalitet na kraju svake vegetacije.

Klijanje je bilo neujednačeno i trajalo je do kraja maja 2019. godine. Prosečna vrednost prečnika na kraju prve vegetacije iznosi 2,91 mm, a na kraju druge 8,52 mm, sa visokim koeficijentom varijacije (CV1p=31,80%, CV2p=26,60%, respektivno). Prosečna vrednost za visine na kraju prve vegetacije je 17,13 cm, a na kraju druge 64,87 cm, takođe, sa visokim koeficijentom varijacije (CV1h=46,08%, CV2h=38,92%, respektivno). Svi mereni parametri pokazuju statistički značajne razlike za obe godine merenja ($P \leq 0,05$), što ukazuje na snažan efekat genetičke kontrole. Prosečan godišnji debljinski prirast iznosi 5,50 mm, a visinski 45,70 mm. U rasadničkom testu procenat preživelih biljaka je 29%, pri čemu je najveći procenat preživljavanja evidentiran za sadnice linije BE03 (56%), a najmanji za BE07 (7%). Najveći mortalitet zabeležen je u drugoj vegetaciji (57%).

Sadnja na Velikom ratnom ostrvu izvršena je novembra 2020. godine. Na kraju 2022. godine 35% sadnica je preživelo. Linija sa najvećim procentom preživljavanja je KO03 (69%), dok je linija BE09 sa najmanjim (20%). Prosečan prirast prečnika u nivou zemlje na terenu iznosio je 14,61 mm, a visina 147,08 cm. Linija sa najvećim vrednostima prečnika i visina je BE01 (24,33 mm, 220,0 cm, respektivno), dok su najmanje vrednosti prosečnog prečnika zabeležene za liniju BE09 (13,13 mm, a visina za BE02 (128,0 mm).

Unošenjem proizvedenih sadnica divlje trešnje obogaćen je biodiverzitet i unapređen predeo Velikog ratnog ostrva, a dobijeni rezultati tokom ovih istraživanja poslužiće kao osnova za dalju, namensku, proizvodnju sadnog materijala divlje trešnje za pošumljavanje ovakvih i sličnih predela.

Ključne reči: sadnice, parametri rasta, preživljavanje, rasadnički test, poljski ogled

WILD CHERRY (*PRUNUS AVIUM* L.) – FROM THE NURSERY TO THE LANDSCAPE OF GREAT WAR ISLAND

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Abstract:

As a Landscape of Extraordinary Characteristics, Veliko Ratno Ostrvo (Great War Island) is the focal point of the highest biodiversity of avifauna in the Belgrade area. It is characterized by a small number of woody species, whose gene pool is increasing every year due to the planned afforestation. In addition to indigenous species, afforestation with wild cherry is planned, as it serves as a food source for birds and contributes to the landscape's aesthetics.

When it comes to such afforestation, particular attention should be paid to the origin of planting material. In this context, an analysis of the genetic-ecological potential of different lines of wild cherry half-siblings was conducted in the nursery test and in the Veliko Ratno Ostrvo area where the field trial was established. Seed material was collected in July 2018 from 14 mother trees in the areas of mountains Kosmaj – KO (3), Bešnjaja – BE (10), and Javor – JA (1). The nursery trial was established in September of the same year in the nursery of the Faculty of Forestry. Over two years, germination dynamics, growth parameters (height, diameter), and mortality at the end of each vegetation period, were monitored in the nursery trial.

Germination was uneven and lasted until the end of May 2019. The average diameter at the end of the first vegetation period was 2.91 mm, and 8.52 mm at the end of the second, with a high coefficient of variation (CV1p=31.80%, CV2p=26.60%, respectively). The average height at the end of the first vegetation period was 17.13 cm, and 64.87 cm at the end of the second, also with a high coefficient of variation (CV1h=46.08%, CV2h=38.92%, respectively). All measured parameters show statistically significant differences for both years of measurement ($P \leq 0.05$), indicating a strong effect of genetic control. The average annual diameter increment was 5.50 mm, while the average annual height increment was 45.70 mm. In the nursery test, the percentage of surviving plants is 29%, with the highest survival rate recorded in seedlings of half-sib line BE03 (56%), and the lowest in the seedlings of line BE07 (7%). The highest mortality was recorded in the second vegetation period (57%).

Planting in the Veliko Ratno Ostrvo area was carried out in November 2020. At the end of 2022, 35% of the seedlings had survived. The line with the highest survival rate is KO03 (69%), while BE09 is the line with the lowest (20%). The average ground-level diameter increment in the field was 14.61 mm, and the height was 147.08 cm. The line with the highest values for diameter and height is BE01 (24.33 mm, 220.0 cm, respectively), while the lowest average diameter values were recorded for BE09 (13.13 mm), and height for BE02 (128.0 mm). The introduction of the produced wild cherry seedlings has enriched the biodiversity and enhanced the landscape of Veliko Ratno Ostrvo. The results obtained during this research will serve as a basis for further, specialized, production of wild cherry planting material for afforestation in similar landscapes.

Key words: seedlings, growth parameters, survival, nursery trial, field trial

ZAŠTITA BILJAKA I ARBORIKULTURA

ZDRAVSTVENO STANJE DRVOREDA I DRVOREDNIH STABALA U CRNOJ GORI

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Apstrakt:

Drvoređi predstavljaju nezaobilazne i važne elemente zelene infrastrukture. Drvoredna stabla izložena su brojnim negativnim uticajima životne sredine. Održavanje postojećih, kao i podizanja novih drvoreda pitanja su koja neprestano zaokupljaju pažnju stručnjaka, i kojima se iznova vraćamo.

Cilj rada je da skrene pažnju na zdravstveno stanje starih i novoformiranih drvoreda, zastupljenih u primorskim i kontinentalnim gradovima u Crnoj Gori. U zavisnosti od zastupljenih vrsta drveća, od vrste patogenih organizama, uslova sredine u kojima se razvijaju, kao i od stepena oštećenja, stara i obolela drvoredna stabla nose različiti stepen rizika po bezbednost ljudi i materijalnih dobara u gradovima, što će biti pokazano na primerima.

Problemi se takođe javljaju u podizanju novih drvoreda u naseljima ili duž saobraćajnica. Ovakve aktivnosti su u dugom nizu godina izostajale i sada predstavljaju pozitivnu promenu. Izbor vrsta drveća, dostupnost sadnog materijala, održavanje zasada, kao i patogeni, realno prisutni i potencijalni, stoje kao prepreka na putu od sadnog materijala do predela, ili zelenih gradskih koridora. Nedostatak standarda iz oblasti kvaliteta sadnog materijala, kao i mali broj stručnjaka iz oblasti rasadničke proizvodnje dendrološkog sadnog materijala takođe se javljaju kao problem, koji je potrebno brzo rešavati.

Ključne reči: drvoređi, zdravstveno stanje drveća, urbana zelena infrastruktura, standard

THE HEALTH CONDITION OF TREE ROWS IN MONTENEGRO

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Abstract:

Tree rows are the indispensable and important elements of green infrastructure. In tree lines, trees are exposed to intensive environmental pressure. Maintenance of existing, as well as raising new rows of trees, are questions that constantly occupy the attention of experts, and to which we return again and again.

The aim of the work is to draw attention to the health condition of old and newly formed tree rows in coastal and continental cities in Montenegro. Depending on the types of trees represented, type of pathogenic organisms, environmental conditions in which they develop, as well as on the degree of damage, old and diseased trees carry a different degree of risk for the safety of people and material goods in cities, which will be shown on examples.

Problems also arises in the construction of new tree rows in settlements or along roads. Such activities have been absent for many years and now represent a positive change. The choice of tree species, the availability of planting material, the maintenance of plantations, as well as pathogens, both real and potential, stand as the obstacles on the way from planting material to landscapes, or green city corridors. The lack of standards in the field of quality of planting material, as well as a small number of experts in the field of nursery production of dendrological planting material, also appear as the problems that need to be solved quickly.

Key words: tree rows, tree health, urban green infrastructure, standards

SUŠENJE BOROVA U PARKOVIMA UŠĆE I KALEMEGDAN U BEOGRADU

IZAZVANO KOMPLEKSOM PATOGENA I INSEKATA

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Apstrakt:

Borovi (*Pinus* spp.) su vrste sa vrlo širokom ekološkom i geografskom amplitudom. Zastupljeni su u Srbiji u prirodnim ili veštački podignutim šumama i u urbanim sredinama gde imaju značajnu estetsku funkciju. Poslednjih decenija zbog izmenjenih ekoloških uslova ove vrste su postale podložne različitim uzročnicima bolesti i novim štetčinama, koje se javljaju u povećanoj brojnosti. Prisustvo aerozagađenja u gradovima utiče na njihovo zdravstveno stanje.

Podizanje zelenih površina u Novom Beogradu počinje 1947. godine, kada je na levoj obali reke Save posađena grupacija borova koja je bila predmet istraživanja, kao i stabla u blizini Palate Srbije. Istraživanja zdravstvenog stanja borova obavljena su i u parku Kalemegdan od maja do septembra 2023. godine vizuelnim metodom i gajenjem uzoraka u laboratoriji. Metodom feromonskih klopki se prate populacije insekata od 2019. godine na navedenim lokalitetima.

Na svim lokalitetima evidentirano je prisustvo potpuno suvih stabala i mnogobrojnih simptomi koji ukazuju na ugroženo zdravstveno stanje preostalih stabala (redukovana krošnja, polomljene grane, grane sa kojih su četine potpuno opale ili su promenile boju, potištena iskrivljena stabla). Analizom sakupljenih četina i grana na svim lokalitetima evidentirano je prisustvo parazitskih i saprofitskih gljiva. Najčešće su parazitske gljive *Mycosphaerella pini* Rostrup apud Munk. (Syn. *Scirrhia pini* Funk et Parker) (n.f. *Dothistroma pini* Hulbary) koja izaziva bolest crvena prstenasta pegavost borovih četina, *Sphaeropsis sapinea* (Fr.) Dyko & Sutton i *Lophodermium pinastri* (Schrad.) Chev koja izaziva crvenilo i osipanje četina iz prethodne vegetacije. Od insekata zabeležene su sledeće vrste: *Acanthocinus aedilis* (L.), *Arhopalus rusticus* (L.), *Spondylis buprestoides* (L.) i *Monochamus galloprovincialis* (Olivier) (Coleoptera: Cerambycidae), *Phaenops cyanea* (F.), *Chrysobothris* sp. (Coleoptera: Buprestidae), *Ips sexdentatus* (Boern.), *Tomicus minor* Hartig (Coleoptera: Curculionidae: Scolytinae). Od prirodnih neprijatelja ksilofagnih insekata, najčešći su: *Temnoscheila caerulea* (Olivier) (Coleoptera: Trogossitidae) i *Thanasimus formicarius* (L.) (Coleoptera: Cleridae) i Ichneumonidae (Insecta: Hymenoptera).

Zabeležena su i mnogobrojna oštećenja nastala pod uticajem antropogenog faktora. Analizirana stabla nalaze se na lokalitetima koji su vrlo atraktivni i značajni za stanovnike Beograda i posetioce parkova. Neophodno je sprovesti redovan monitoring svih stabala kako bi se pravovremeno primenjivale integralne mere zaštite u kritičnom periodu za konstatovane infekcije i štetočine a u skladu sa klimatskim uslovima. Potrebno je sprovoditi mere zaštite prirodnih neprijatelja.

Ključne reči: bor, *Pinus* spp., parazitske gljive, ksilofagni insekti, prirodni neprijatelji, zelene površine

DYING OF PINE TREES IN UŠĆE AND KALEMEGDAN PARKS IN BELGRADE DUE TO THE COMPLEX OF PATHOGENS AND INSECTS

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Abstract:

Pines (*Pinus* spp.) are species with a broad ecological and geographical range. In Serbia, they are found in natural or artificially established forests and urban environments, where they serve a significant aesthetic function. In recent decades, due to altered environmental conditions, these species have become susceptible to various pathogens and emerging pests. The presence of air pollution in cities affects their health condition.

Green area development in New Belgrade began in 1947 when a group of pines was planted on the left bank of the Sava River. Investigations on the health condition of pines in Ušće Park started in 2019, while in Kalemegdan Park, it began in 2021. Investigations based on visual inspections along with sample cultivation in the laboratory were conducted from May to September 2023. On all sites, the presence of dead trees and numerous symptoms indicating the compromised health condition of remaining trees (such as reduced canopy, broken branches, branches with fallen or discoloured needles and suppressed and twisted trunks) was documented. Analysis of collected needles and branches on all sites revealed the presence of parasitic and saprophytic fungi. The most common parasitic fungi were *Mycosphaerella pini* Rostrup apud Munk. (Syn. *Scirrhia pini* Funk et Parker) (n.f. *Dothistroma pini* Hulbary), causing red band pine needle blight, *Sphaeropsis sapinea* (Fr.) Dyko & Sutton and *Lophodermium pinastri* (Schrad.) Chev, causing redness and shedding of the previous year's needles. Among insects, the following species were recorded: *Acanthocinus aedilis*, *Arhopalus rusticus*, *Spondylis buprestoides* and *Monochamus galloprovincialis* (Coleoptera: Cerambycidae), *Phaenops cyanea*, *Chrysobothris* sp. (Coleoptera: Buprestidae), *Ips sexdentatus*, *Tomicus minor* (Coleoptera: Curculionidae: Scolytinae). The most common natural enemies of xylophagous insects were *Temnoscheila caerulea* (Coleoptera: Trogossitidae), *Thanasimus formicarius* (Coleoptera: Cleridae) and Ichneumonidae (Insecta: Hymenoptera). Damage caused by human activity was also noted. Analysed trees grow in areas highly attractive and significant for Belgrade residents and park visitors. Regular monitoring of all trees is necessary to apply integrated protection measures timely during critical periods for identified infections and pests, in line with climate conditions. Protection measures to preserve natural enemies should also be implemented.

Keywords: pine, *Pinus* spp., parasitic fungi, xylophagous insects, natural enemies, green areas

NOVE ŠTETOČINE U SRBIJI INTRODUKOVANE SA SADNIM MATERIJALOM UKRASNIH BILJAKA

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Apstrakt:

Podizanje zelenih površina je često povezano sa uvozom sadnica drvenastih biljaka. Uvoz ukrasnih biljaka je jedan od najvažnijih puteva za unošenje stranih i invazivnih vrsta i nativnih štetočina koje mogu da predstavljaju pretnju za lokalnu proizvodnju ukrasnih biljaka. Pregledom biljaka u vrtnim centrima i rasadnicima koji se bave uvozom ukrasnih biljaka, utvrđene su sledeće vrste: *Stigmaeopsis nanjingensis* (Ma et Yuan), *Eurytetranychus latus* (Canestrini & Fanzago), (Acari Tetranychidae), *Ctenarytaina eucalypti* (Maskell) (Hemiptera: Aphalaridae), *Aphis gossypii* Glover, *Cinara cedri* Mimeur, *C. tujaefilina* (del Guercio), *Illinoia liriodendri* (Monell), *Takecallis arundinariae* (Essig) (Hemiptera: Aphididae), *Ceroplastes japonicus* Green, *C. ceriferus* (F.) (Hemiptera: Coccidae), *Planococcus vovae* (Nasonov) (Hemiptera: Pseudococcidae), *Lamprodila festiva* (L.), *Callidiellum rufipenne* (Motschulsky) (Coleoptera: Cerambycidae), *Phloeosinus aubei* (Perris), *P. thujae* (Perris) (Coleoptera: Curculionidae: Scolytinae), *Phytomyza agromyzina* Meigen, *Phytomyza jucunda* Frost & Sasakawa (Diptera: Agromyzidae), *Cydalima perspectalis* (Walker) (Lepidoptera: Crambidae). Sadni materijal iz uvoza je najčešće infestiran stranim vrstama i one čine 55,56% determinisanih vrsta. Ukrasne biljke iz uvoza prate mediteranske vrste i to 16,67%, dok je novih štetočina koje se javljaju u povećanoj brojnosti kao odgovor na klimatske promene, zabeleženo 27,78%. Vrste reda Hemiptera preovlađuju sa 50% konstatovanih vrsta, Coleoptera obuhvataju 22,22%, muve mineri (Diptera: Agromyzidae) 11,11% i leptiri (Lepidoptera) 5,56%. Bambusi (*Phyllostachis* spp., *Pseudosasa* spp.) se sve češće uvoze i sa sadnicama su uvezene dve invazivne vrste: grinja paučinar *S. nanjingensis* poreklom iz Kine i biljna vaš *T. arundinariae* iz jugoistočne Azije. Zabeleženo je još sedam stranih i invazivnih vrsta. Na sadnicama *Eucalyptus gunni* 'Azora' evidentirana je mala populacija lisne buve *C. eucalypti*, koja potiče iz Australije i sklona je prenamnoženjima. Ovo je prvi nalaz u Srbiji. Biljna vaš *A. gossypii* je široka polifaga i aklimatizovana je u Srbiji. Na tulipanovcu je zabeležena biljna vaš monofaga *I. liriodendri*. Štitaši *C. japonicus* i *C. ceriferus* su ustanovljeni na sadnicama *Acer palmatum*, *Ilex aquifolium* i *Laurus nobilis*. Sadnice šimšira su bile infestirane invazivnom vrstom *C. perspectalis*. Nativne vrste koje su konstatovane u vrtnom centru su: šimširov paučinar (*E. latus*), biljna vaš (*C. tujaefilina*), vunasta vaš (*P. vovae*) i potkornjak četinar (P. *thujae*). Vrste koje potiču iz mediteranskog područja *C. cedri*, *L. festiva* i *P. aubei* razvijaju velike populacije i mogu da izazovu ekonomske štete.

Ključne reči: sadni materijal drvenastih biljaka, invazivne strane vrste, Tetranychidae, štetni insekti, ukrasne biljke, vrtni centar

NEW PESTS INTRODUCED TO SERBIA THROUGH ORNAMENTAL PLANT NURSERY STOCK

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Abstract:

The establishment of green areas is often associated with the import of nursery stock of woody plants. The import of ornamental plants represents one of the crucial pathways for introducing alien and invasive species and pests of native range that may pose a threat to local production of ornamental plants. A survey conducted in garden centers and nurseries involved in the import of ornamental plants identified the following species: *Stigmaeopsis nanjingensis* (Ma et Yuan), *Eurytetranychus latus* (Canestrini & Fanzago), (Acari Tetranychidae), *Ctenarytaina eucalypti* (Maskell) (Hemiptera: Aphalaridae), *Aphis gossypii* Glover, *Cinara cedri* Mimeur, *C. tujaefilina* (del Guercio), *Illinoia liriodendri* (Monell), *Takecallis arundinariae* (Essig) (Hemiptera: Aphididae), *Ceroplastes japonicus* Green, *C. ceriferus* (F.) (Hemiptera: Coccidae), *Planococcus vovae* (Nasonov) (Hemiptera: Pseudococcidae), *Lamprodila festiva* (L.), *Callidiellum rufipenne* (Motschulsky) (Coleoptera: Cerambycidae), *Phloeosinus aubei* (Perris), *P. thujae* (Perris) (Coleoptera: Curculionidae: Scolytinae), *Phytomyza agromyzina* Meigen, *Phytomyza jucunda* Frost & Sasakawa (Diptera: Agromyzidae) and *Cydalima perspectalis* (Walker) (Lepidoptera: Crambidae). Imported nursery stock is most commonly infested with alien species constituting 55.56% of identified species. Imported ornamental plants also bring Mediterranean species at 16.67%, while new pests emerging in increased numbers due to climate change account for 27.78%. Hemiptera species predominate with 50% of recorded species. Coleoptera include 22.22%, leaf-miner flies (Diptera: Agromyzidae) 11.11% and butterflies and moths (Lepidoptera) 5.56%. Bamboos (*Phyllostachis* spp., *Pseudosasa* spp.) are increasingly imported, introducing two invasive species with the nursery stock: the spider mite *S. nanjingensis* from China and the black-spotted bamboo aphid *T. arundinariae* from Southeast Asia. Another seven alien and invasive species were recorded. A small population of blue gum psyllid *C. eucalypti*, originating from Australia and prone to outbreaks, was recorded on *Eucalyptus gunni* 'Azora' nursery stock. This is the first report in Serbia. The cotton aphid *A. gossypii* is a broad polyphagous pest and it has acclimatised in Serbia. Tulip-trees were infested with the monophagous tulip-tree aphid *I. liriodendri*. The Japanese wax scale *C. japonicus* and Indian wax scale (*C. ceriferus*) were identified on the nursery stock of *Acer palmatum*, *Ilex aquifolium* and *Laurus nobilis*. Boxwood seedlings were infested with the invasive species *C. perspectalis*. Native species observed in garden centers included the boxwood spider mite (*E. latus*), the aphid (*C. tujaefilina*), Nasonov's mealybug (*P. vovae*) and the conifer bark beetle (*P. thujae*). Species originating from the Mediterranean region, such as *C. cedri*, *L. festiva* and *P. aubei* develop large populations and cause economic damage.

Keywords: woody plant nursery stock, invasive alien species, Tetranychidae, harmful insects, ornamental plants, garden center

ZNAČAJ PREVENTIVNIH MERA U SUZBIJANJU BOLESTI SEZONSKOG CVEĆA I RUŽA

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Apstrakt:

Proizvodnja sezonskog cveća kao i ruža, kako proizvodnja sadnica tako i rezanog cveta, postaje sve intenzivnija i značajnija poljoprivredna grana, u Srbiji i svetu. Površine na kojima se proizvode sezonsko cveće i ruže u zatvorenom i na otvorenom prostoru imaju konstantan uzlazni trend. Postoji imperativ da se proizvode inovativne sorte, hibridi i genotipovi i u količinama prema zahtevima tržišta. Ovakav sortiment je najčešće posebno osetljiv na razvoj različitih bolesti, biotičkog i abiotičkog porekla, koje su uvek prisutne u proizvodnji i često mogu predstavljati ograničavajući faktor. To predstavlja izazov za obezbeđivanje održive proizvodnje kvalitetnih i zdravih biljaka. Bolesti koje se razvijaju u proizvodnji sezonskog cveća i ruža mogu biti abiotičke prirode i prouzrokovani su nepovoljnim proizvodnim uslovima: neadekvatan kvalitet, sastav, vodno-vazdušni režim, pH vrednost i sadržaj hranljivih elemenata supstrata ili zemljišta, nepravilan način sadnje, postavke banka ili pogrešan izbor saksije, uticaj nepovoljne temperature i vlažnosti vazduha u proizvodnim objektima, neadekvatna i najčešće prekomerna upotrebom đubriva, i izostajanje indukcije imuniteta biljaka. Bolesti koje su značajnije za proizvodnju cveća zbog kompleksnijih mera suzbijanja jesu biotičke bolesti, prouzrokovane biotičkim činiocima, uglavnom gljivama, bakterijama i virusima. Najznačajniji predstavnici su *Botrytis cinerea*, *Fusarium* spp., *Xanthomonas campestris* pv. *pelargonii*, i mnogi virusi kao što je *Impatiens Necrotic Spot Virus* (INSV). Posebni izazovi u suzbijanju ovih patogena proističu iz činjenice da je literatura na ovu temu često veoma oskudna, naročito u Srbiji, a sami proizvođači često nedovoljno iskusni, te je prognoza pojave i dijagnoza ovih bolesti otežana i usporena. Takođe, upotreba pesticida je ograničena zbog nepostojanja većeg broja adekvatnih pesticida za upotrebu u proizvodnji cveća. Iz ovog razloga, ali i načela očuvanja životne sredine, održive i racionalne upotrebe pesticida, neophodno je primenjivati preventivne mere suzbijanja biljnih bolesti. Najznačajnije su: upotreba zdravog, sertifikovanog sadnog i setvenog materijala kao i dodatne mere dezinfekcije pre sadnje ili setve, upotreba supstrata adekvatnih karakteristika i bez prisustva inokuluma patogena, dezinfekcija alata, kontejnera i saksija za proizvodnju, sistema za navodnjavanje, uništavanje korova oko proizvodnih parcela ili proizvodnih objekata, obezbeđivanje optimalnog temperaturnog režima i vlažnosti vazduha kako bi se izbegli uslovi sredine koji pogoduju razvoju prouzrokovaca bolesti, minimalno mehaničko i fizičko povređivanje biljaka, optimalna upotreba đubriva, pridržavanje optimalnog biljnog sklopa, rotacije vrsta, perioda sadnje ili setve, uklanjanje zaraženih biljnih delova. Posebnom preventivnom merom u borbi protiv biljnih bolesti smatra se i indukcija i jačanje imuniteta same biljke upotrebom organskih i mikrobioloških biostimulatora i drugih metoda.

Ključne reči: sezonsko cveće, ruže, abiotičke bolesti, biotičke bolesti, preventivne mere

IMPORTANCE OF PREVENTIVE MEASURES IN DISEASES CONTROL OF SEASONAL FLOWERS AND ROSES

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Abstrakt:

The production of seasonal flowers and roses, for seedlings and cut flowers, is becoming an increasingly intensive and significant branch of agriculture in Serbia and the world. Areas where seasonal flowers and roses are produced indoors and outdoors have a constant upward trend. There is an imperative to produce innovative varieties, hybrids and genotypes and in quantities according to market demands. This assortment is usually especially sensitive to the development of various diseases, biotic and abiotic, which are always present in production and can often be a limiting factor. It is a challenge to ensure the sustainable production of quality and healthy plants. Diseases that develop in the production of seasonal flowers and roses can be abiotic and are caused by unfavorable production conditions: inadequate quality, composition, water-air regime, pH value and nutrient content of the substrate or soil, improper planting method, bank settings or wrong choice of pot, the influence of unfavorable temperature and air humidity in production facilities, inadequate and often excessive use of fertilizers, and the absence of induction of plant immunity. Diseases that are more important for flower production due to more complex control measures are biotic diseases, caused by biotic agents, mainly fungi, bacteria and viruses. The most important representatives are *Botrytis cinerea*, *Fusarium* spp., *Xanthomonas campestris* pv. *pelargonii*, and many viruses such as *Impatiens Necrotic Spot Virus* (INSV). Special challenges in controlling these pathogens come due to the fact that the literature on this topic is often very scarce, especially in Serbia, and the producers themselves are often insufficiently experienced, so the prognosis of the occurrence and diagnosis of these diseases is difficult and slow. Also, the use of pesticides is limited due to the lack of a large number of adequate pesticides for use in flower production. For this reason, as well as the principles of environmental protection, sustainable and rational use of pesticides, it is necessary to apply preventive measures to control plant diseases. The most important are: the use of healthy, certified planting and sowing material as well as additional disinfection measures before planting or sowing, the use of a substrate with adequate characteristics and without the presence of pathogen inoculum, disinfection of tools, containers and pots for production, irrigation systems, destruction of weeds around the production plots or production facilities, ensuring an optimal temperature regime and air humidity in order to avoid environmental conditions that favor the development of disease-causing agents, minimal mechanical and physical damage to plants, optimal use of fertilizers, adherence to the optimal plant composition, species rotation, planting or sowing period, removal of infected plants parts. A special preventive measure in the fight against plant diseases is the induction and strengthening of the immunity of the plant itself using organic and microbiological biostimulators and other methods.

Key words: seasonal flowers, roses, abiotic diseases, biotic diseases, preventive measures

PODZEMNO NAVODNJAVANJE BILJAKA KAO ODGOVOR NA KLIMATSKE PROMENE

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Apstrakt:

Usled klimatskih promena, sve manje kiše i sve veće toplote, biljke pate jednako kao i ljudi. Često skupo zasađeno drveće, travnjaci i biljke umiru. Loše za životnu sredinu, skupo za izvodjače. Kod konvencionalnog nadzemnog navodnjavanja kao što je navodnjavanje raspršivačima, mnogo vode se gubi, isparava sa površine ili prolazi kroz zemlju i ne stiže tamo gde je biljkama zaista potrebna: do korena!

Rešenje za ove probleme je podzemno navodnjavanje: Lite-Soil proizvodi izuzetno štedljive, biorazgradive i održive, posebno dizajnirane netkane proizvode u vidu mreže (LITE.NET) i trakaste forme (LITE-STRIPS) koji se ugrađuju duboko u zemlju i mogu uštedeti do 70% vode koja se koristi za navodnjavanje biljaka. 1 kg materijala čuva 10 litara vode. Voda se skladišti u materijalu a koren je izvlači u momentu kada je to biljci potrebno. Proizvodi takođe vrše aeraciju, što znači da su idealni za zemljište bez treseta.

Još jedna inovacija je, BLUELITE-NET sistem, mreža iznad koje se postavljaju podzemne kap po kap cevi za navodnjavanje obložene omotačem od netkanog materijala, ovim se postiže trajno i ravnomerno, podzemno navodnjavanje. Omotač od netkanog materijala štiti kapaljke, kontakt vode sa tlom uvećava se hiljadu puta, mreža ravnomerno raspoređuje vodu po velikoj površini u veoma malom vremenskom periodu omogućavajući korenu da se razvija i raste kroz nju.

Proizvodi su takođe izuzetno lagani, što ih čini idealnim za mnoge primene kao što su zeleni krovovi, travnjaci, drveće, nasipi, žardinjere, saksije, padine i još mnogo toga.

LITE-SOIL konstantno radi na razvoju novih proizvoda. Na primer, postoje mreže za vegetaciju (LITE-NET TREE) specijalno dizajnirane za drveće sa standardnom veličinom busena, obmotaju se oko busena i ravnomerno distribuiraju vodu. Koren može neometano da raste kroz mrežu, ima pristup vodi i vazduhu, što je izuzetno važno, posebno u fazi vegetacije, ovim pomaže da drvo raste održivo i postane veliko. Tek tada drveće daje senku i vezuje CO₂.

Velike štete na drveću nastaju na gradilištima. Posledična šteta je ogromna i može dovesti do odumiranja ili čak pada drveta. Sa inovativnim zavojima za zaštitu korena (LITE-ROOTPROTECT), otkriveno korenje drveća štitimo od sunca i oštećenja, a ujedno ih održavamo trajno važnim. Zavoj čuva vodu mnogo puta bolje od konvencionalnog filca ili prostirki od jute.

LITE-ROOTPROTECT je 100% biorazgradiv, po završetku radova jednostavno se zatrpaju.

Ključne reči: travnjaci, drveće, padine, urbano ozelenjavanje, biljke, podzemno navodnjavanje, skladištenje vode.

UNDERGROUND IRRIGATION FOR PLANTS IN RESPONSE TO CLIMATE CHANGE

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Abstract:

Due to climate change, less and less rain and increasing heat, plants are suffering as well as people. Often expensively planted trees, lawns and plants are dying. Bad for the environment, expensive for the operators. With conventional above-ground irrigation such as spray irrigation, a lot of water is wasted, it evaporates on the surface or seeps away somewhere in the soil and does not get to where the plants really need it: to the roots!

The solution to these problems is therefore underground irrigation: Lite-Soil produces extremely water-saving, biodegradable and sustainable, specially designed nonwovens in net (LITE.NET) and strip form (LITE-STRIPS) that are embedded root-deep in the substrate and can save up to 70% of the water used to irrigate plants. 1 kg of the material stores 10 liters of water. The water is stored in the material and the roots draw out the water they need when required. The products also aerate, which means they are ideal for peat-free soil.

Another innovation, the BLUELITE-NET, a net with a nonwoven-covered drip irrigation tube mounted on top, achieves permanent, underground irrigation. The nonwoven covering protects the drippers, the water contact between tube and soil is multiplied a thousand-fold and the net distributes the water over a large area in the soil, allowing the roots to grow through the net and develop.

The products are also extremely lightweight, making them ideal for many applications such as green roofs, lawns, trees, embankments, raised planting beds, pots, slopes and much more.

LITE-SOIL is constantly developing new innovations especially also for trees. For example, there are vegetation nets (LITE-NET TREE) specially designed for the typical root ball size of trees, which are wrapped around the root ball and the water is distributed directly to the roots of the tree. The roots can grow through the net and have access to water and air, which is extremely important, especially in the vegetation phase, to help the tree grow sustainably and become large. Only then do trees provide shade and bind CO₂.

Most damage to trees occurs on construction sites. The consequential damage is enormous and can lead to the tree dying or even falling over. With the innovative root protection bandage (LITE-ROOTPROTECT), exposed tree roots on construction sites are not only protected from the sun and damage, but are also kept permanently moist. The bandage stores water many times better than conventional construction site fleeces or jute mats.

As the LITE-ROOTPROTECT is 100% biodegradable, it can simply be poured over at the end of the construction site.

Key words: lawns, trees, slopes, urban greening, plants, underground irrigation, water storage

EDUKACIJA I SERTIFIKACIJA IZ OBLASTI ARBORIKULTURE U REPUBLICI ČEŠKOJ

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Apstrakt:

Arborikultura u České Republice je doživila značajnu evoluciju od 1989. godine. Obeležena je osnivanjem prvih arborikulturnih preduzeća 1991. godine i stalnom posvećenošću kvalitetnoj nezi drveća. Početni napor u obuci bili su fokusirani na metode orezivanja drveća, oslanjajući se na radove A. Shigo-a i D. Dujesiefken-a, a kasnije su prošireni na tehnike procene stabala koje su razvili L. Vessolly i C. Matheck, uključujući usvajanje metoda za testiranje stabilnosti drveća, pomoću uređaja. 2006. godine, Češka unija za zaštitu prirode pokrenula je program sertifikacije "Češki Sertifikovani Arborista" (ČSA), koji je razvijen u saradnji sa profesionalnim arboristima i akademikima. Zatim je 2017. godine, Fakultet za Nauku o Životnoj Sredini, Českog Univerziteta Prirodnih Nauka u Pragu, postao novi akademski garant. Kancelarija programa, pod nazivom „Češka unija za očuvanje prirode – Arboristička Akademie“ (AA), postala je odgovorna za kompletnu administraciju ČSA programa, uključujući i ponovnu sertifikaciju. Štaviše, između 2011. i 2020. godine, dva češka univerziteta su počela da nude diplome iz oblasti arborikulture, pri čemu je Češki Univerzitet Prirodnih Nauka u Pragu bio ključni partner u profesionalnom obrazovanju. Između 2012. i 2016. godine razvijen je kompletan set nacionalnih arborikulturnih standarda, a 2019. godine pokrenuta je slična inicijativa na evropskom nivou, što je dovelo do najuspešnijeg projekta u savremenoj arborikulturi – Evropskih Standarda za Arborikulturu. Ovi standardi imaju za cilj da harmonizuju formalne i neformalne nacionalne norme i standarde, uključujući aktuelna znanja i iskustva u arborističkoj zajednici. Proces razvoja uključivao je diskusije radnih grupa sa stručnjacima iz 11 evropskih zemalja, javne konsultacije i integraciju povratnih informacija pre objavljivanja. Evropski Standardi za Arborikulturu imaju za cilj da pruže transparentne i usklađene opise dobre prakse u arborikulturi, imajući u vidu fragmentisanu i lokalizovanu prirodu postojećih normi i standarda. Partnerstvo uključuje 12 organizacija iz cele Evrope, uključujući privatne kompanije, centre za obuku i sertifikaciju, udruženja arborista i istraživačke centre. Kroz aktivnosti širenja informacija, koje sprovodi Evropski savet za arborikulturu (jedan od partnera), sugestije i povratne informacije iz 22 evropske zemlje su integrisane, i prosleđene profesionalcima i arborističkim udruženjima, kao i izvođačima, centrima za obuku i sertifikaciju, proizvođačima opreme (kablovskih sistema) i rasadničarima.

Ključne reči: arborikultura, Republika Česka, sertifikacija, obrazovanje, Evropski Standardi za Arborikulturu

EDUCATION AND CERTIFICATION OF ARBORISTS IN THE CZECH REPUBLIC

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Abstract:

Arboriculture in the Czech Republic has experienced significant evolution since the 1989, marked by the establishment of the first arboricultural companies in 1991 and an ongoing commitment to quality tree care. Initial training efforts focused on tree pruning methods, drawing on the works of A. Shigo and D. Dujesiefken, and later expanded to tree assessment techniques developed by L. Wessolly and C. Matheck, including the adoption of device-supported methods for tree stability testing. In 2006, the Czech Union for Nature Conservation initiated the Czech Certified Arborist (ČCA) certification program, developed collaboratively with professional arborists and academics. In 2017, the Faculty of Environmental Sciences at the Czech University of Life Sciences Prague became the new academic guarantor. The program's office, named "Czech Union for Nature Conservation - Arboricultural Academy" (AA), is responsible for the complete administration of the ČCA program, including recertifications.

Furthermore, between 2011 and 2020, two Czech universities began offering bachelor's degrees in arboriculture, with the Czech University of Life Sciences Prague being a key partner in professional education. Between 2012 and 2016, a complete set of national arboricultural standards was developed, and in 2019, a similar initiative was launched at the European level, leading to the most successful project in contemporary arboriculture - the European Arboricultural Standards. These standards aim to harmonize formal and informal national norms and standards, incorporating current knowledge and experience in the arboricultural community. The development process involves working group discussions with experts from 11 European countries, public consultations, and feedback integration before publishing.

The European Arboricultural Standards aim to provide transparent and harmonized descriptions of good practice in arboriculture, addressing the fragmented and localized nature of existing norms and standards. The partnership includes 12 organizations from across Europe, encompassing private companies, training and certification centers, arborist associations, and research centers. Through the dissemination activities of the European Arboricultural Council, one of the partners, input and feedback from 22 European countries were integrated, targeting arboricultural professionals and associations, as well as contracting organizations, training and certification centers, cabling systems manufacturers, and tree nursery managers.

Keywords: arboriculture, Czech Republic, certification, education, European Arboricultural Standards, ecosystem services.

URBANA SADNJA ŠIROKIH RAZMERA – EKOLOŠKA REVOLUCIJA ILI VANDALIZAM

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Apstrakt:

Sadnja drveća širom Evrope se naširoko smatra ključnom strategijom za ublažavanje efekata klimatskih promena, posebno za smanjenje nivoa CO₂ u atmosferi. Strategija EU o biodiverzitetu ima za cilj da se zasadi 3 milijarde stabala, uglavnom kao šumske plantaže, ali ne isključivo, do 2030. godine kako bi se podstaknula obnova ekosistema i poboljšao biodiverzitet. Potrebna površina zemljišta na kojoj bi bila posađena ova nova stabla, procenjuje se na 0,81 do 1,37 miliona hektara (prosečno 1,02 miliona ha). Ovaj cilj, iako deluje ambiciozno, znatno je niži od istorijskih stopa pošumljavanja u EU, i predstavlja samo 40% prošlih trendova.

U Češkoj Republici, ovaj plan je izazvao značajno interesovanje, što je dovelo do velikih ulaganja u sadnju drveća iz državnog i privatnog sektora. Na primer, posvećenost Praga da zasadi milion stabala mogla bi skoro udvostručiti sadašnju populaciju drveća. Međutim, praktična implementacija ovih planova otkriva značajne nedostatke. Metode procene životnog ciklusa (Life Cycle Assessment - LCA) za ispitivanje ugljeničnog otiska urbanog drveća od nicanja do seče, osporavaju ideju da je nova sadnja drveća efikasan odgovor na klimatske promene. Rezultati pokazuju da promene u praksi nege drveća, kao što su ciklusi orezivanja, mogu značajno uticati na vreme potrebno da drvo pređe sa “emitera ugljenika” na “ugljenično neutralno” stablo.

Sadnje širokih razmera dovele su do smanjenja kvaliteta samog procesa sadnje, nedostatka kvalitetnog rasadničkog fonda i pogrešne alokacije resursa za nepovezane aktivnosti, kao i do “greenwashing-a”. Ekolog Tomas Krauter, čije je istraživanje u početku podstaklo globalne kampanje sadnje drveća, sada se zalaže protiv masovnih plantaža kao ekološkog rešenja, naglašavajući njihov ograničen uticaj na sekvencijalnu ugljeniku i potencijalnu štetu po biodiverzitet. Krauter se zalaže za nijansirani pristup, dajući prioritet očuvanju postojećeg drveća i šuma i distribuciji novčanih sredstava društvima koja žive sa biodiverzitetom.

Pozitivno zaključujemo da je sadnja drveća i dalje ključna, ali bi trebalo da bude integrisana sa negom posle sadnje i usklađena sa Evropskim Standardima za Arborikulturu, kako bi se obezbedio kvalitet i efikasnost. Ako bismo taj proces preimenovali u ‘uspostavljanje drveća’, moglo bi se sveobuhvatnije pristupiti sadnji drveća sa stanovišta urbanog šumarstvu i arborikulture.

Ključne reči: urbana sadnja drveća, ublažavanje klimatskih promena, Strategija EU za biodiverzitet, Procena životnog ciklusa, urbano šumarstvo, Evropski Standardi za Arborikulturu

LARGE-SCALE URBAN PLANTING - ECOLOGICAL REVOLUTION OR VANDALISM

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Abstract:

Tree planting across Europe is widely regarded as a key strategy for mitigating climate change effects, particularly for reducing atmospheric CO₂ levels. The EU Biodiversity Strategy aims to plant 3 billion trees mostly as forest plantations, but not only, by 2030 to enhance ecosystem restoration and biodiversity. The required land area to support these new trees is estimated to 0.81 to 1.37 million hectares (average 1.02 Mha). This target, while appearing ambitious, is substantially lower than the historical afforestation rates within the EU, representing only 40% of past trends.

In the Czech Republic, this plan has sparked significant interest, leading to large investments in tree planting from both government and private sectors. For instance, Prague's commitment to planting 1 million trees could nearly double its current tree population. However, the practical implementation of these plans reveals considerable flaws. Life Cycle Assessment (LCA) methods to examine the carbon footprint of urban trees from propagation to disposal, challenges the notion that new tree planting is an effective response to climate change. Results indicate that alterations in tree care practices, such as pruning cycles, can significantly influence the time taken for a tree to transition from a carbon emitter to being carbon neutral.

Large-scale plantings have led to a decrease in the quality of planting work, a scarcity of quality nursery stock, and misallocation of resources for unrelated activities and greenwashing. Ecologist Thomas Crowther, whose research initially spurred global tree-planting campaigns, now argues against mass plantations as an environmental solution, emphasizing their limited impact on carbon sequestration and potential harm to biodiversity. Crowther advocates for a more nuanced approach, prioritizing the preservation of existing trees and forests and distributing wealth to communities living with biodiversity.

Concluding positively, tree planting remains crucial, but it should be integrated with post-planting care and aligned with European Arboricultural Standards to ensure quality and efficacy. Renaming the process as ‘tree establishment’ could reflect a more comprehensive approach to tree plantings in urban forestry and arboriculture.

Keywords: urban tree planting, climate change mitigation, EU Biodiversity Strategy, Life Cycle Assessment, urban forestry, European Arboricultural Standards.

PUBLIKACIJE

PRAKTIKUM IZ OSNOVA EKOLOGIJE I ZAŠTITE ŽIVOTNE SREDINE

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Apstrakt:

Predmet Osnove ekologije i zaštite životne sredine se realizuje na osnovnim studijama, u prvom semestru studijskog programa Pejzažna arhitektura Šumarskog fakulteta u Beogradu. Predmet je osmišljen da upozna studente sa osnovnim ekološkim pojmovima, procesima i odnosima u ekosistemu i osnovnim principima i konceptima zaštite životne sredine i pruži im osnovno znanje iz ovih oblasti, koje će kroz kasnije faze studiranja i druge nastavne predmete biti prošireno, a sve sa ciljem da buduće pejzažne arhitekthe raspolažu multidisciplinarnim znanjem sa kojim će biti konkurentni na tržištu rada.

Praktikum iz Osnova ekologije i zaštite životne sredine je nastao kao težnja autora da spoji teorijski i praktični aspekt ekologije i zaštite životne sredine. Strukturni sadržaj Praktikuma je određen tako da prati predavanja na predmetu Osnove ekologije i zaštite životne sredine. Organizovan je u 12 nastavnih tema, koncizno obrađenih, iza kojih slede Pitanja i zadaci. Autor je težio da izneseno gradivo bude jasno i primenljivo. Pitanja i zadaci su pripremljeni sa ciljem da studenti prodube znanje na zadatu temu, ali i da provere razumevanje glavnih pojmova. Pored toga, ovaj deo svake nastavne teme treba da podstakne studenta na kritičko, logičko i kreativno mišljenje.

Ključne reči: ekologija, zaštita životne sredine, pejzažna arhitektura, praktikum

FUNDAMENTALS OF ECOLOGY AND ENVIRONMENTAL PROTECTION WORKBOOK

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Abstract:

The course Fundamentals of Ecology and Environmental Protection is part of the undergraduate studies in the first semester of the Landscape Architecture study at the Faculty of Forestry in Belgrade. The course is designed to familiarize students with basic ecological concepts, processes, and relationships in ecosystems, as well as fundamental principles and concepts of environmental protection. It provides students with basic knowledge in these areas, which will be further expanded through later stages of study and other courses, aiming to equip future landscape architects with multidisciplinary knowledge that will make them competitive in the job market.

The Fundamentals of Ecology and Environmental Protection Workbook emerged from the author's desire to integrate the theoretical and practical aspects of ecology and environmental protection. The content of the Workbook follows the lectures in the Fundamentals of Ecology and Environmental Protection course. It is organized into 12 topics, concisely elaborated, followed by Questions and Tasks. The author aimed to present the material clearly and applicably. The Questions and Tasks are designed to help students deepen their knowledge of the given topic and to assess their understanding of key concepts. Furthermore, this section of each lesson aims to encourage the student to think critically, logically, and creatively.

Keywords: ecology, environmental protection, landscape architecture, practical course, workbook

PRIMENA QR KODOVA U ŠUMARSTVU NA PRIMERU ARBORETUMA ŠUMARSKJE ŠKOLE

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Apstrakt:

Šumarska škola pokušava u svojim aktivnostima da primeni savremene trendove u obrazovanju. Jedan od prioriteta razvoja obrazovanja, a i drugih sfera života je primena digitalizacije. Sve je češća upotreba QR kodova u turizmu, ugostiteljstvu, trgovini, bankarstvu. Naša ideja je da QR kodove primenimo u šumarstvu i hortikulturi! Obeležavanjem drvenastih vrsta u Arboretumu Šumarske škole QR kodovima, činimo informacije dostupnim, a istovremeno promoviramo šumarstvo, hortikulturu, savremene tehnologije. Postavljanjem digitalnog priručnika povezanog sa QR kodovima na sajt škole omogućavamo da svi zainteresovani brzo i lako dođu do informacija o arealu, poreklu, izgledu, staništu, značaju određene drvenaste vrste. Na sličan način se mogu obeležiti i determinisati vrste u rasadnicima ili na zelenim površinama svih namena.

Ključne reči: QR kodovi, digitalizacija, informisanje

APPLICATION OF QR CODES IN FORESTRY – EXAMPLE OF THE ARBORETUM OF KRALJEVO FORESTRY SCHOOL

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Abstract:

The Forestry school tries to apply modern trends in education in its activities. One of the priorities for the development of education and other spheres of life is the application of digitization. QR codes are increasingly being used in tourism, hospitality, commerce, and banking. Our idea is to apply QR codes in forestry and horticulture as well! By marking woody species in the Arboretum of the Forestry School with QR codes, we make information available and at the same time promote forestry, horticulture, and modern technologies. By placing a digital handbook connected with QR codes on the school's website, we enable all interested parties to quickly and easily access information about the range, origin, appearance, habitat, and importance of a particular woody species. In a similar way, species can be marked and determined in nurseries or on green areas of all purposes.

Keywords: QR codes, digitization, information

ATLAS MEDONOSNIH BILJAKA CRNE GORE

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Apstrakt:

Publikacija „Atlas Medonosnih biljaka Crne Gore“ je nastala kao rezultat trogodišnjeg istraživanja koje je sprovedeno u okviru projekta „Izrada atlasa medonosnih biljaka sa katastrom pčelinjaka“ koji je finansiran od Svetske banke, kao drugi projekat institucionalnog razvoja i jačanja poljoprivrede Crne Gore (MIDAS 2).

Atlas ima za cilj da pruži podršku u stvaranju uslova za održivi razvoj pčelarstva, ekološki i ekonomski optimalno korišćenje pčelinje paše u Crnoj Gori, a realizovan je inicijativu Saveza pčelarskih organizacija Crne Gore. Publikacija je usklađena sa smernicama i ciljevima postavljenim Pravilnikom o bližoj sadržini, načinu utvrđivanja i vođenja katastra pčelinje paše i pčelarskog pašnog reda („Službeni list CG“, br. 72/10 i 48/15) kojim se definiše sadržina i način vođenja katastra pčelinje paše i način utvrđivanja pčelarskog pašnog reda.

Izazov u prikupljanju i obradi podataka o medonosnim vrstama Crne Gore predstavljao je izučavanje bogatog prirodnog fonda biljnih vrsta na području koji se sastoji od mozaika različitih staništa i geografskih karakteristika. Rad na ovoj publikaciji je podrazumevao prikupljanje podataka o biološkim i ekološkim karakteristikama vrsta značajnih za pčelinju pašu, uključujući podatke o fenologiji cvetanja biljaka, abundanci i distribuciji medonosnih biljaka.

Na osnovu dosadašnjih istraživanja evidentirano je više od 550 vrsta na teritoriji Crne Gore, koje domaća pčela (*Apis mellifera*) rado posećuje. Više od 130 vrsta i rodova je izdvojeno kao posebno značajno i opisano u publikaciji. Familije sa najvećim brojem medonosnih biljnih vrsta u Crnoj Gori, koje odlikuje najveće obilje nektara i polena su: Rhamnaceae, Asteraceae, Fabaceae, Lamiaceae, Rosaceae, Boraginaceae i dr., čiji su predstavnici zeljaste i drvenaste vrste. Vrste značajne sa aspekta produkcije medne rose pripadaju familijama Pinaceae, Salicaceae, Fagaceae i Betulaceae.

Od posebnog značaja je endemska vrsta *Moltkia petraea*, sa najvećim prisustvom u opštinama Bar, Cetinje, Kolašin, Kotor, Plužine, Podgorica, Tuzi. Ova vrsta, kao endemit Balkanskog poluostrva, sa najvećim prisustvom u Crnoj Gori i Hrvatskoj, zaslužuje posebnu pažnju u budućim istraživanjima, naročito za potrebe brendiranja i zaštite geografskog porekla medova sa područja Crne Gore i zapadnog Balkana.

Sastavni deo publikacije je Šveska polena najznačajnijih medonosnih biljaka Crne Gore, koja pruža osnovu i potrebne podatke za melisopalinološke analize, za potrebe utvrđivanja prisustva biljnih vrsta u medu.

Atlas sadrži skup naučno proverenih informacija i dokaza neophodnih u postupku zaštite autentičnosti ili geografskog porekla crnogorskog meda, koji su od posebnog značaja za izradu specifikacije u postupku zaštite. Uz ovu publikaciju izrađena je geoprostorna baza podataka o prisustvu i rasprostranjenju medonosnih vrsta Crne Gore – Katastar medonosnih biljaka Crne Gore.

Ključne reči: medonosne biljke, pčelinja paša, pčelarstvo, Crna Gora, atlas, polinatori, pčela

ATLAS OF HONEY PLANTS OF MONTENEGRO

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Abstract:

The publication “Atlas of Honey Plants of Montenegro” was created as a result of a three-year research that was carried out as part of the project “Development of Atlas of honey plants with apiary cadastre” financed by the World Bank, as the second project of institutional development and strengthening of agriculture in Montenegro (MIDAS 2).

Atlas aims to provide support sustainable development of beekeeping, ecologically and economically optimal use of honeybee pasture in Montenegro, that is realised on the initiative of the Union of Beekeeping Organizations of Montenegro. The publication is aligned with the guidelines and goals set by the Regulation on the content and manner of keeping the cadastre of bee pastures (“Official Gazette of the Republic of Montenegro”, no. 72/10 and 48/15) which defines the content and manner of maintaining the bee pasture cadastre and implementation of beekeeping grazing order on the territory of one or more local self-government units.

The challenge in collecting and processing data on the honey plant species of Montenegro consists of studying a floristically rich area made up of a mosaic of different habitats and geographical characteristics. The work on this publication involved the collection of data on biological and ecological characteristics of species important for bee pasture, including data on plant flowering phenology, abundance, and distribution of honey plants.

Based on our research, more than 550 species have been recorded on the territory of Montenegro, which the honeybee (*Apis mellifera*) visits. More than 130 plant species and genera have been singled out as particularly important and described in this publication. The families with the largest number of honey plant species in Montenegro are: Rhamnaceae, Asteraceae, Fabaceae, Lamiaceae, Rosaceae, Boraginaceae, etc., whose representatives are herbaceous and woody species. Species important from the aspect of honeydew production belong to the families Pinaceae, Salicaceae, Fagaceae and Betulaceae.

Of special importance for Montenegrin honeys is the endemic species *Moltkia petraea* (Tratt.) Griseb., with the largest presence in the municipalities of Bar, Cetinje, Kolašin, Kotor, Plužine, Podgorica, and Tuzi. This species, as an endemic of the Balkan Peninsula, deserves special attention in future research, especially for the purposes of branding and protecting the geographical origin of honeys from the area of Montenegro and the Western Balkans.

An integral part of the publication is the Pollen Book of the most important honey plants of Montenegro, which provides the basis and necessary data for melissopalynological analyses, for the purposes of determining the presence of plant species in honey.

The Atlas contains a set of scientifically verified information and evidence necessary in the process of protecting the authenticity or geographical origin of Montenegrin honey. Along with this publication, a geospatial database - Cadastre of honey plants of Montenegro - was created.

Keywords: honey plants, bee pasture, beekeeping, Montenegro, atlas, pollinators, honeybee

POSTERI*

* po abecednom redu prezimena prvog autora

ODABIR BILJNIH VRSTA PREMA ZONAMA OTPORNOSTI NA NISKE TEMPERATURE

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Apstrakt:

U hortikulturi, odavno je prepoznata važnost preciznog predviđanja zimskih povreda kao ključne komponente efikasnog gajenja drvenastih i zeljastih višegodišnjih biljaka u različitim klimatskim uslovima. Relativno jednostavan metod koji se koristi za vizuelizaciju geografskih obrazaca, koji prikazuju jačinu povreda biljaka na niskim temperaturama, je mapiranje klimatološke varijable koja je blisko povezana sa obrascima preživljavanja biljaka. Dakle, zona otpornosti na niske temperature predstavlja geografsko područje definisano određenom srednjom godišnjom minimalnom temperaturom, faktorom koji je relevantan za opstanak mnogih biljaka. Originalni i najčešće korišćeni sistem, koji je razvilo Ministarstvo poljoprivrede Sjedinjenih Država (U.S. DEPARTMENT OF AGRICULTURE - USDA) kao grubi vodič, definiše 13 zona prema prosečnim godišnjim ekstremnim minimalnim temperaturama. Široko je prihvaćen sistem, a prilagođen je i od strane drugih zemalja (kao što je Kanada) u različitim oblicima. USDA mapa zona otpornosti biljaka na niske temperature, je standard po kome svako može da odredi koje će višegodišnje biljke najverovatnije uspevati na datoj lokaciji. Mapa zona otpornosti na niske temperature u ovom istraživanju je zasnovana na 30-godišnjoj prosečnoj godišnjoj minimalnoj temperaturi. Za našu analizu koristili smo najnoviji dostupni vremenski okvir: 1991-2020, za trenutnu mapu, i 2091-2120 za projektovanu kartu. Prema klimatskim podacima dobijenim preko Digitalnog atlasa klime Srbije, u Srbiji trenutno postoje 4 zone otpornosti (podeljene na 6 podzona): 5b do 8a, što znači da biljke u (različitim delovima) Srbije mogu da prežive minimalne zimske temperature od -23,4 °C do -11,8 °C. Prema projekcijama RCP 4.5 i RCP 8.5, minimalne temperature će znatno porasti, pa ćemo imati zone 6b do 9a (min. zimske temperature od -18,45 °C do -2,73 °C) ili zone 7a do 9b (min. zima). temperature od -16,81 °C do -1,9 °C) respektivno. Biljne vrste koje su aklimatizovane na određenu zonu otpornosti treba koristiti na odgovarajući način. Takođe, potrebno je obratiti pažnju na tržište biljnog materijala, na način da se biljne vrste proizvedene u jednoj zoni otpornosti na niske temperature prodaju i koriste u odgovarajućim zonama. Pripremili smo izbor najčešćih vrsta drveća, žbunja i višegodišnjih biljaka u Srbiji, prema zonama otpornosti na niske temperature, i dali predloge pogodnih područja na kojima je sadnja najpogodnija. Odnosno koja su to područja u Evropi odakle je najpogodnije nabaviti sadni materijal.

Ključne reči: USDA, zone otpornosti biljaka na niske temperature, klimatske promene, biljni materijal

SELECTION OF PLANT SPECIES ACCORDING TO THE HARDINESS ZONES

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Abstract:

Horticulturists have long recognized the importance of the accurate prediction of winter injury as a key component of the effective cultivation of long-lived woody and herbaceous perennial plants in many different climates.

A relatively simple method used to visualize geographic patterns of the severity of the plant injuries from low-temperature events, is to map a climatological variable that closely correlates with patterns of plant survival. Therefore, hardiness zone represents a geographic area defined by a certain average annual minimum temperature, a factor that is relevant for the survival of many plants. The original and most widely used system, developed by the United States Department of Agriculture (USDA) as a rough guide, defines 13 zones by long-term average annual extreme minimum temperatures. It has been widely accepted, and adapted by other countries (such as Canada) in various forms. The USDA Plant Hardiness Zone Map is the standard by which anyone can determine which perennial plants are most likely to thrive based on a given location.

The hardiness zone map in this research is based on the 30-year average annual minimum winter temperature. For our analysis, we used most recent available time window: 1991-2020, for the current map, and 2091-2120 for the projected map. According to the climate data, obtained via Digital Climate Atlas of Serbia, there are currently 4 hardiness zones (divided into 6 sub-zones) in Serbia: 5b to 8a, meaning that plants in (different parts of) Serbia can survive minimum winter temperatures from -23.4 °C to -11.8 °C. According to the projections, RCP 4.5 and RCP 8.5, minimum temperatures will rise considerably, so we will have zones 6b to 9a (min. winter temperatures from -18.45 °C to -2.73 °C) or zones 7a to 9b (min. winter temperatures from -16.81 °C to -1.9 °C) respectively.

Plant species that are acclimatized to certain hardiness zone should be used appropriately. Attention should be made in market of the plant material, in a way that plant species produced in one hardiness zone should be sold in appropriate zone.

We've prepared a selection of the most common species of trees, shrubs and perennials in Serbia, according to their hardiness zones, and made suggestions of the most suitable areas for the planting. That is, the most suitable areas in Europe from where the plant material should be purchased.

Keywords: USDA hardiness zones, climate change, plant material

BOTANIČKO NASLEĐE KAO INSPIRACIJA ZA BIODIZAJN

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Apstrakt:

Predmet ovog istraživanja predstavlja izučavanje botaničkog nasleđa i njihovih formi kao inspiracije za biodizajnerski postupak, a u cilju kreiranja konceptualnih rešenja kao sredstva za podizanje svesti o samom botaničkom nasleđu određenog mesta. Spoj botaničkog nasleđa (bio-kulturno-istorijskog nasleđa) i koncepta održivosti, jeste deo nove dizajnerske agende koja nastoji da spoji lepotu, održivost i inkluzivnost u jedno: New European Bauhaus. Cilj ovog rada jeste prikaz odabranih botaničkih vrsta od značaja za odabrane lokacije i potencijala koji mogu da imaju u oblasti biodizajna, kao održiva rešenja koja dolaze iz prirode. Odabrane su dve lokacije: gradovi Beograd (Srbija) i Najrobi (Kenija). U ovom radu predstavljena su dva biodizajnerska konceptualna rešenja. Za prvo rešenje, inspiracija za bio-dizajn bila je vrsta *Spathodea campanulata* P. Beauv. iz Kenije, poznato i kao afričko plameno drvo. „Afričko drvo plamena“ (čije je uobičajeno ime Nandi Flame u Keniji) prepoznato je kao simbol borbe za životnu sredinu. Inspiracija za drugo biodizajnersko konceptualno rešenje jeste zaštićeno stablo platana u Topčiderkom parku *Platanus x acerifolia* (Aiton) Willd. Zaštićeno stablo platana u Topčiderkom parku koje predstavlja botaničko kulturno istorijsko nasleđe, ne samo grada Beograda, već i Srbije. Kao spomenik prirode botaničkog karaktera, ovaj platan približne je starosti oko 200 godina. Na prikazanim biodizajnerskim konceptima je primenjen isti istraživački okvir koji je obuhvatao terensko istraživanje, identifikaciju poželjnih morfoloških karakteristika i digitalno modelovanje (u odgovarajućim softverima) na bazi odabranih morfoloških formi radi izrade biodizajnerskih konceptualnih rešenja prikazanih u ovom radu.

Ključne reči: botaničko nasleđe, biodizajn, Srbija, Kenija

BOTANICAL HERITAGE AS INSPIRATION FOR BIODESIGN

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Abstract:

This paper research was the study of botanical heritage and their forms as an inspiration for the bio-design process, with the aim of creating urban solutions as a means of raising awareness of the botanical heritage of a particular place. The combination of botanical heritage (bio-cultural-historical heritage) and the concept of sustainability is part of a new design agenda that seeks to combine beauty, sustainability and inclusiveness into one: New European Bauhaus. The aim of this work was to present selected botanical species of importance for selected locations and the potential they could have in the field of bio-design, as sustainable solutions that come from nature. Two locations were chosen: the cities of Belgrade (Serbia) and Nairobi (Kenya). In this paper, two bio-design conceptual solutions were presented. For the first solution, the inspiration for bio-design was the species *Spathodea campanulata* P. Beauv. from Kenya, also known as the African flame tree. The “African flame tree” (whose common name is Nandi Flame in Kenya) is recognized as a symbol of the fight for the environment. The inspiration for another bio-design conceptual solution is protected plane tree in Topčider park - *Platanus x acerifolia* (Aiton) Willd. Protected plane tree represents the botanical cultural historical heritage, not only of the city of Belgrade, but also for Serbia. As a natural monument of botanical character, this plane tree is approximately 200 years old. The same research framework, is applied to both biodesigned concepts, that included field research, identification of desirable morphological characteristics and digital modelling (using appropriate software and methodology) based on selected morphological forms in order to create bio-design conceptual solutions presented as results of this paper.

Keywords: botanical heritage, bio-design, Serbia, Kenya

BIODIZAJN KANDELABRA INSPIRISAN VRSTAMA RODA

PELARGONIUM SP.

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Apstrakt:

Biodizajn je savremena disciplina koja inspiraciju pronalazi u prirodnim oblicima i procesima, primenjujući ih u stvaranju funkcionalnih, održivih i vizuelno privlačnih rešenja. U ovom radu fokus je na istraživanju domena biodizajna kroz kreiranje kandelabra inspirisanog vrstama iz roda *Pelargonium* sp. (muškatlama). Muškatla je izuzetno rasprostranjena višegodišnja biljna vrsta, bogate istorije, koja je prisutna u mnogim vrtovima i pejzažima zbog svoje jedinstvenosti i otpornosti na različite klimatske uslove. Analizirajući ključne karakteristike predstavljene cvetne vrste i roda kome pripada, istražuje se estetika i funkcionalnost koje biodizajn može da pruži u stvaranju inovativnih rešenja. Softveri Blender 3.3.1. i Lumion 12 poslužili su kao alat za digitalnu vizuelizaciju čiji je rezultat konceptualno kreiranje kandelabra inspirisano cvetom muškatele u svojoj početnoj razvojnoj fazi pupoljka. Prikazana je procedura modelovanja do finalnog ambijentalnog 3D prikaza. Finalni koncept interaktivnog kandelabra predstavlja funkcionalno i estetski prihvatljivo inovativno biodizajnersko rešenje koje je i samoodrživo jer je predviđeno solarno napajanje dinamičnih delova koji se otvaraju kao latice i uključuju i isključuju u skladu sa prelaskom iz dana u noć. Predstavljeno biodizajnersko interaktivno rešenje predstavlja primer primene principa biomimikrije u domenu biodizajnerske digitalne kreacije inspirisano cvetom roda *Pelargonium* sp.

Ključne reči: biodizajn, 3D model interaktivnog kandelabra, *Pelargonium* sp, softver Blender

BIODESIGN OF STREET LIGHT INSPIRED BY SPECIES OF GENUS *PELARGONIUM SP.*

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Abstract:

Biodesign is a contemporary discipline that finds inspiration in natural forms and processes, applying them to create functional, sustainable and visually appealing solutions. In this study, the focus is on researching the domain of biodesign through the creation of a street light inspired by species from the genus *Pelargonium* sp. *Pelargonium* is an extremely widespread perennial plant, rich in history, which is present in many gardens and landscapes due to its uniqueness and resistance to different climatic conditions. Analyzing the key characteristics of the presented flower species and the genus to which it belongs, explored is the aesthetics and functionality that biodesign can provide in creating innovative solutions. Software Blender 3.3.1. and Lumion 12 were used as digital visualization tools to conceptually create a interactive street light inspired by the *Pelargonium* sp. flower in its early bud stage. Process of modeling, up to the final 3D ambient display is presented. The final design of the interactive street light represents a functional and aesthetically pleasing innovative biodesign solution. It is also self-sustainable, utilizing solar power for dynamic components that open like petals and activate or deactivate in sync with the shift from day to night. The showcased interactive biodesign solution serves as an illustration of applying the biomimicry principles within the realm of digital creation in biodesign inspired by *Pelargonium* sp. flower.

Keywords: biodesign, 3D model of interactive street light, *Pelargonium* sp, Blender software

DIGITALNO PEJZAŽNO ARHITEKTONSKO MODELOVANJE INSPIRISANO FRAKTALNOM GEOMETRIJOM CVETA BILJNE VRSTE *HELIANTHUS ANNUUS* L.

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Apstrakt:

Fraktal je beskonačno kompleksan ponavljajući matematički obrazac, čiji je svaki deo, koliko god bio uvećan ili umanjen, približno identičan prikaz celine. Fraktali čine čudesni sakriveni mikro i makro svet oko nas, ali i deo su nas samih. Pahulje, led, obale mora, paukova mreža, krošnja drveća, a satelitski snimci pokazuju da je čak i čitava galaksija jedan fraktal. Život se odvija u svetu punom fraktala na bezbroj različitih načina. Neke osnovne karakteristike fraktala su sledeće: Fraktali imaju finu strukturu, odnosno detalji su veoma malih dimenzija; Fraktali poseduju svojstvo samosličnosti, odnosno delovi fraktalnog objekta slični su fraktalu u celini, apsolutno ili približno; Fraktalne forme su isuviše nepravilne da bi mogle da se opišu uobičajnom euklidskom geometrijom.

Mandelbrotove studije o fraktalima promenile su brojne naučne i kreativne domene i doprinele novom razumevanju geometrije prirode. Inspirisana fraktalnim obrascima koji se svuda nalaze, od grana drveća do oblika oblaka, fraktalna arhitektura crpi inspiraciju iz prirodnog sveta.

Jedna od ključnih prednosti fraktalne arhitekture jeste da se, kroz kreiranje prostora koji poštuju zakone fraktalne geometrije, vizuelno stimulativno i prijatno utiče na ljude. Istraživanja su pokazala da izloženost fraktalnim obrascima može smanjiti nivo stresa, poboljšati raspoloženje i povećati kognitivne funkcije. Jedinstveni oblik fraktala je jedan od izvora inspiracije za različite domene dizajna. Koncept fraktalne geometrije je temelj velikog broja poduhvata i prostornih dizajnerskih rešenja širom sveta. Koriste se kompjuterski softveri kao alat za istraživanje oblasti biodizajna i digitalnog modelovanja.

U ovom radu prikazani su kreirani projekti fraktalne geometrije, kao i digitalni konceptualni pejzažnoarhitektonski 3D modeli inspirisani fraktalnim obrascima prisutnim u cvetu biljne vrste *Helianthus annuus* L. – suncokret, koja dobro uspeva kako u Keniji, tako i u Slovačkoj i Srbiji.

Ključne reči: fraktalna geometrija, biodizajn, digitalno modelovanje, pejzažna arhitektura, *Helianthus annuus* L.

DIGITAL LANDSCAPE ARCHITECTURAL MODELING INSPIRED BY THE FRACTAL GEOMETRY OF THE FLOWER OF THE PLANT SPECIES *HELIANTHUS ANNUUS* L.

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Abstract:

A fractal is an infinitely complex repeating mathematical pattern, each part of which, no matter how large or small, is an approximately identical representation of the whole. Fractals make up the wonderful hidden micro and macro world around us, but they are also a part of us. Snowflakes, ice, sea shores, spider webs, treetops, satellite images show that even the entire galaxy is a single fractal. Life unfolds in a world full of fractals in countless different ways. Some basic characteristics of fractals are as follows: Fractals have fine structure, that is detail on arbitrary small scales; Fractals possess the property of self-similarity, i.e. the parts of the fractal object are similar to the fractal as a whole, absolutely or approximately; Fractal forms are too irregular to be described by ordinary Euclidean geometry.

Mandelbrot's studies on fractals changed numerous scientific and creative domains and contributed to a new understanding of nature's geometry. Inspired by fractal patterns found in anything from tree branches to cloud forms, fractal architecture draws inspiration from the natural world. Creating environments that adhere to the principles of fractal geometry has a visually fascinating and pleasant influence on humans, which is one of the main benefits of fractal architecture. Research have indicated that fractal pattern exposure can enhance mood, lower stress levels, and boost cognitive performance. The unique shape of fractals is one of the sources of inspiration for different domains of design. The concept of fractal geometry is the foundation of a great deal of undertakings and spatial design solutions worldwide. Computer software are employed in the field of biodesign research and digital modeling.

This paper show created fractal geometry conceptual biodesign projects as well as a digital landscape architectural 3D models that was inspired by the fractal patterns in the sunflower (*Helianthus annuus* L.), a plant that thrives well in Serbia, Slovakia and Kenya.

Keywords: Fractal geometry, Biodesign, Digital modelling, Landscape Architecture, *Helianthus annuus* L.

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BIODIZAJN: PROSTORNA STRUKTURA - INSTALACIJA INSPIRISANA VRSTOM AMANITA MUSCARIA (LINN. EX FR.) HOOKER

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Apstrakt:

Savremene tehnologije, prvenstveno u vidu različitih raspoloživih softvera, omogućavaju efikasnu analizu prirodnih formi što biomimetičkom stvaralaštvu pruža nepresušan izvor inspiracija. Biomimetika, bionika ili biomimikrija su relativno mlade naučne discipline koje daju odgovore na aktuelne probleme po uzoru na modele iz prirode. Ovaj rad inspirisan je jednom od najpoznatijih vrsta gljiva *Amanita muscaria* (Linn. ex Fr.) Hooker – muhara, čiji specifičan izgled je čini veoma upečatljivom i širom sveta lako prepoznatljivom. Upravo zbog njenog karakterističnog crvenog mesnatog šešira pokrivenog sitnim, belim ostacima omotača, ova vrsta čest je motiv pri grafičkim vizuelizacijama. Muhara je od davnina poznata u različitim mitologijama, ritualima i verovanjima. Karakteristična forma i tekstura ove vrste gljive poslužila je kao polazna osnova za kreiranje prostorne konceptualne instalacije koja predstavlja rezultat ovog rada. Počevši od prikupljanja fotografija ove inspirativne vrste, zatim izrade slobodoručnih skica, proces geometrijskog 3D modelovanja izveden je primenom metode Voronojevog dijagrama i Delunijeve triangulacije. Digitalni model kreiran je u softveru SketchUp Pro 2023 uz korišćenje i softvera Lumion 12.5, koji je korišćen za dobijanje realističnog 3D modela i ambijentalnog prikaza finalnog rešenja. Kao krajnji rezultat procesa digitalnog modelovanja, nastala je konceptualna instalacija namenjena otvorenim prostorima, koja je svojim koloritom, dizajnom i teksturom povezana sa izvorom inspiracije. Konstrukcija je bele boje, dok su prozirni delovi modelovane strukture crveni. Oni tokom dana formiraju senke i time doprinose ambijentalnom doživljaju prostora, dok tokom noći emituju svetlo, prethodno sakupljeno putem solarnih panela i time doprinose samoodrživosti. Sklop izabranih boja u kombinaciji sa okolnim pejzažom odaje utisak skladnog uklapanja predstavljenog rešenja u predeo, odnosno pejzažnoarhitektonsku scenografiju.

Ključne reči: biodizajnan, muhara (*Amanita muscaria* (Linn. ex Fr.) Hooker), konceptualna prostorna instalacija

BIODESIGN: SPATIAL STRUCTURE - INSTALLATION INSPIRED BY SPECIES AMANITA MUSCARIA (LINN. EX FR.) HOOKER

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Abstract:

Contemporary technologies, primarily in the form of various available software, enable efficient analysis of natural forms, which provides biomimetic creativity with an limitless source of inspiration. Biomimetics, bionics or biomimicry are relatively young scientific disciplines that provide answers to current problems based on models from nature. This research is inspired by one of the most famous type of fungi, *Amanita muscaria* (Linn. ex Fr.) Hooker – Fly agaric, whose specific appearance is very striking and easily recognizable all over the world. Precisely because of its characteristic red fleshy cap covered with small, white remnants of the shell, this species is a frequent motif in graphic visualizations. The Fly agaric has been known since ancient times in various mythologies, rituals and beliefs. The characteristic form and texture of this type of mushroom served as a starting point for the creation of a spatial conceptual installation that represents the result of this work. Starting with collecting photographs of this inspiring species, then the creation of freehand sketches, the process of geometric 3D modeling was carried out using the method of Voronoi diagram and Delaunay triangulation. The digital model was created in SketchUp Pro 2023 software, alongside Lumion 12.5 software, which was used to obtain a realistic 3D model and an ambient rendering of the final solution. As the final result of the digital modeling process, a conceptual installation planned for open spaces was created, which is connected to the source of inspiration by its color, design and texture. The structure is white, while the transparent parts of the modeled structure are red. During the day, they form shadows and contribute to the ambient experience of the space, while during the night they emit light, previously collected through solar panels, thus contributing to self-sustainability. The set of selected colors in combination with the surrounding landscape gives the impression of the created installation is being harmoniously integrated into the landscape, i.e. the landscape-architectural scenography.

Keywords: biodesign, Fly agaric (*Amanita muscaria* (Linn. ex Fr.) Hooker), conceptual spatial installation

BIODIZAJN: PROSTORNA STRUKTURA – INSTALACIJA INSPIRISANA JELENKOM (*LUCANUS CERVUS* L.)

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Apstrakt:

Korišćenjem bioničkih obrazaca pri parametarskom modelovanju, ovaj rad je usmeren na analizu forme gornjih vilica (mandibulae) insekta jelenka (*Lucanus cervus* L.) (Coleoptera: Lucanidae). Jelenak je u Srbiji, shodno Pravilniku o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva, strogo zaštićena vrsta. Prema Direktivi o očuvanju prirodnih staništa i divljih biljnih i životinjskih vrsta (Council Directive 92/43/EEC) *L. cervus* je vrsta od zajedničkog interesa, čije očuvanje zahteva proglašenje posebno zaštićenih područja. Naseljava terestrične ekosisteme: prirodne šume, plantaže i elemente zelene infrastrukture. Larve žive u pridanku trulog debla, panjevima i podzemnim delovima hrasta, vrbe, lipe, pitomog kestena i drugih lišćara. Kao deo usnog aparata, mandibule mužjaka su posebno razvijene, mogu da dostignu dužinu od 30mm i služe za borbu mužjaka oko ženke. Mandibule jelenka su inspiracija za biodizajn izrađenog konceptualnog rešenja prikazane prostorne strukture – instalacije - koja je rezultat rada. Procedura za dobijanje finalnog rešenja započela je izradom slobodnoručnih skica, stilizovanjem forme mandibula jelenka, zatim je kreirana prostorna struktura – instalacija kroz proces digitalnog modelovanja finalnog biodizajnerskog konceptualnog rešenja. U ovom radu su korišćeni softveri: AutoCad 2023, SketchUp Pro 2023 i Lumion 12.5. Pri geometrijskom modelovanju je primenjena metoda Voroni dijagram / Delunijeva triangulacija. Rezultat je monumentalna, dinamična prostorna struktura, namenjena otvorenim prostorima, u obliku gornjih vilica jelenka. Različite visine zidova kreirane prostorne strukture asociraju na debljinu samih vilica jelenka, gde je gornja vilica najdeblja na proksimalnom kraju, odnosno na mestu gde se spaja sa glavom, a najtanja distalno, na vrhu. Upravo, na opisani način, modelovana konturna forma konceptualne prostorne instalacije pruža mogućnost, kako samog prolaska kroz prostornu strukturu, tako i zbog predviđenih različitih visinskih nivoa omogućava različite načine upotrebe izrađenog projekta od strane korisnika. Finalno rešenje 3D modela ima za cilj stavljanje akcenta na značaj insekata kao saprofagnih organizama koji predstavljaju ključnu kariku u razlaganju organske materije i održavanju stabilnosti gotovo svakog ekosistema bez kojih bi se čitav lanac ishrane prekinuo i život na ovoj planeti drastično promenio.

Ključne reči: *Lucanus cervus* L., jelenak, mandibule, digitalno modelovanje, biodizajn, prostorna struktura – instalacija

BIODESIGN: SPATIAL STRUCTURE – AN INSTALLATION INSPIRED BY THE STAG BEETLE (*LUCANUS CERVUS* L.)

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Abstract:

By using bionic patterns in parametric modeling, this paper is focused on the analysis of the upper jaws (mandibulae) form of the European stag beetle insect (*Lucanus cervus* L.) (Coleoptera: Lucanidae). In Serbia, according to the Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and mushrooms, the stag beetle is a strictly protected species. According to the Directive on the conservation of natural habitats and wild plant and animal species (Council Directive 92/43/EEC) *L. cervus* is a species of common interest, whose conservation requires the declaration of specially protected areas. It inhabits terrestrial ecosystems: natural forests, plantations, and elements of green infrastructure. Larvae live in the appendages of rotten trunks, stumps and underground parts of oak, willow, linden, chestnut, and other deciduous trees. As part of the mouth apparatus, the upper jaws (mandibulae) of the male are specially developed, they can reach a length of 30 mm and are used for the male's fight over the female. The mandibles of the European stag beetle are the inspiration for the biodesign of the created conceptual solution of the displayed spatial structure - the installation - which is the result of this project. The procedure for obtaining the final solution began with the creation of freehand sketches, stylization of the form of the stag beetle's mandible, then the spatial structure - installation was created through the process of digital modeling of the final biodesign conceptual solution. The following software were used in this biodesign: AutoCad 2023, SketchUp Pro 2023 and Lumion 12.5. The Voroni diagram / Delaunay triangulation method was used for geometric modeling. The result is a monumental, dynamic outdoor spatial structure in the shape of European stag beetle upper jaws. The different heights of the walls of the created spatial structure are associated with the thickness of the stag beetle jaws themselves, where the upper jaw is thickest at the proximal end, i.e. at the point where it joins the head, and the thinnest distally, at the top. Modeled in the previously described manner, the contour form of the conceptual spatial installation provides the possibility of both passing through and, due to the different height levels, enables different ways of interactions by the users of the created project. The final solution of the 3D model aims to emphasize the importance of insects as saprophagous organisms that represent the key link in the decomposition of organic matter and the maintenance of the stability of almost any ecosystem, without which the entire food chain would collapse and life on this planet would drastically change.

Keywords: *Lucanus cervus* L., stag beetle, mandibles, digital modeling, biodesign, spatial structure – installation

PODRŠKA RANOM JAVLJANJU O POJAVI INVAZIVNIH STRANIH INSEKATA I NOVIH ŠTETOČINA UKRASNIH BILJAKA

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Apstrakt:

Invazivne strane vrste su poznate po štetnim posledicama koje izazivaju u ekološkom, ekonomskom i socijalnom smislu. U ovom radu su prikazane najčešće strane i invazivne vrste i nove štetočine koje su poznate kao važne štetočine drveća u šumama i na elementima zelene infrastrukture u Srbiji: *Leptoglossus occidentalis* Heidemann (Hemiptera: Coreidae), *Halyomorpha halys* Stål (Hemiptera: Pentatomidae), *Corythucha arcuata* (Say) (Hemiptera: Tingidae), *Metcalfa pruinosa* (Say) (Hemiptera: Flatidae), *Acizzia jamatonica* (Kuwayama) (Hemiptera: Psyllidae), *Aphis gossypii* Glover, *Cinara* (*Cupressobium*) *tujafilina* (Del Guercio), *Illinoia liriodendri* (Monell), *Wahlgreniella nervata* (Gillette), *Takecallis arundicolens* (Clarke), *Tinocallis takachihoensis* Higuchi, *Myzocallis* (*Lineomyzocallis*) *walshii* (Monell) (Hemiptera: Aphididae) *Agrilus sinuatus* (Olivier), *Agrilus* sp., *Lamprodila* (*Palmar*) *festiva* (L.), *Ovalisia rutilans* (F.), *Phenops cyanaea* (F.) (Coleoptera: Buprestidae), *Callidiellum rufipenne* (Motschulsky), *Neoclytus acuminatus* (F.) (Coleoptera: Cerambycidae), *Phloeosinus aubei* Perris, *P. thuje* Perris, (Coleoptera: Curculionidae: Scolytinae), *Cydalima perspectalis* (Walker), (Lepidoptera: Crambidae), *Cameraria ohridella* Deschka & Dimić, *Phyllonorycter issikii* (Kumata), *P. populifoliella* (Treitschke) (Lepidoptera: Gracillariidae), *Choreutes nemorana* (Hübner) (Lepidoptera: Choreutidae), *Chrysodeixis chalcites* (Esper) (Lepidoptera: Noctuidae), *Aproceros leucopoda* Takeuchi, (Hymenoptera: Argidae). Unošenje stranih invazivnih vrsta je povezano sa aktivnostima čoveka poput trgovine, transporta i turizma. Spontanom letom ili vetrom mogu da šire svoj areal i aklimatizuju se u novoj sredini. Širenjem trofičkog spektra domaćina i prilagođavanjem novim biljkama hraniteljima, neke vrste postaju uspešnije u invaziji. Najbolji primer je zeleni klekin krasac (*L. festiva*), koji se od mediteranske vrste i sekundarne štetočina na klemama u makiji, prilagodio ishrani na tujama, a zatim i na biljkama iz rodova *Callitris*, *Chamaecyparis*, *Cupressus*, *Platycladus*, *Tetraclinis*, da bi nedavno bilo utvrđeno da je u botaničkoj bašti na Krimu infestirana sekvoja (*Sequoia sempervirens* (D. Don) Endl.) i time je stekao status značajne štetočine u kontinentalnom delu Evrope. Većinom je trgovina ukrasnim biljkama put za unošenje stranih i invazivnih insekata na druge kontinente i velika rastojanja. Klimatski uslovi pogoduju migracijama mediteranskih vrsta prema kontinentu. Neke autohtone i retke vrste se pojavljuju kao nove štetočine jer stupaju u gradacije zbog povoljnijih vremenskih uslova. Zato je važno da se upoznaju rani simptomi infestacija: defolijacija, promena boje asimilacionih organa, odumiranje pojedinih grana, smolotok ili curenje biljnih sokova na mestu ubušivanja ksilofaga, crvotočina, gale, odlubljivanje kore, larveni hodnici, izletni otvori na kori i slično. Determinacija invazivnih vrsta i novih štetočina, poznavanje simptoma oštećenja i životnog ciklusa su važni za zaustavljanje njihovog širenja, pa je osnovni cilj ovog rada da se pruže informacije za ranu detekciju štetočina.

Ključne reči: invazivne strane vrste, nove štetočine, insekti, ukrasne biljke, rana detekcija

CONTRIBUTION TO EARLY WARNING ON INVASIVE ALIEN INSECTS AND EMERGING PESTS OF ORNAMENTAL PLANTS

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Abstract:

Invasive alien species are known for the harmful consequences they inflict in ecological, economic, and social contexts. This paper highlights the most common alien and invasive species, as well as emerging pests known as significant threats to forest trees and elements of green infrastructure in Serbia. They include *Leptoglossus occidentalis* Heidemann (Hemiptera: Coreidae), *Halyomorpha halys* Stål (Hemiptera: Pentatomidae), *Corythucha arcuata* (Say) (Hemiptera: Tingidae), *Metcalfa pruinosa* (Say) (Hemiptera: Flatidae), *Acizzia jamatonica* (Kuwayama) (Hemiptera: Psyllidae), *Aphis gossypii* Glover, *Cinara* (*Cupressobium*) *tujafilina* (Del Guercio), *Illinoia liriodendri* (Monell), *Wahlgreniella nervata* (Gillette), *Takecallis arundicolens* (Clarke), *Tinocallis takachihoensis* Higuchi, *Myzocallis* (*Lineomyzocallis*) *walshii* (Monell) (Hemiptera: Aphididae) *Agrilus sinuatus* (Olivier), *Agrilus* sp., *Lamprodila* (*Palmar*) *festiva* (L.), *Ovalisia rutilans* (F.), *Phenops cyanaea* (F.) (Coleoptera: Buprestidae), *Callidiellum rufipenne* (Motschulsky), *Neoclytus acuminatus* (F.) (Coleoptera: Cerambycidae), *Phloeosinus aubei* Perris, *P. thuje* Perris, (Coleoptera: Curculionidae: Scolytinae), *Cydalima perspectalis* (Walker), (Lepidoptera: Crambidae), *Cameraria ohridella* Deschka & Dimić, *Phyllonorycter issikii* (Kumata), *P. populifoliella* (Treitschke) (Lepidoptera: Gracillariidae), *Choreutes nemorana* (Hübner) (Lepidoptera: Choreutidae), *Chrysodeixis chalcites* (Esper) (Lepidoptera: Noctuidae), *Aproceros leucopoda* Takeuchi, (Hymenoptera: Argidae). The introduction of alien invasive species is linked to human activities such as trade, transport, and tourism. Through spontaneous flight or wind dispersal, they can expand their range and acclimatise to new environments. By broadening their trophic spectrum of hosts and adapting to new host plants, some species become more successful in invasion. A prime example is the jewel beetle (*L. festiva*), which as a primarily Mediterranean species and secondary pest on junipers in macchias, has adapted its feeding to tujas, and later to plants from the genera *Callitris*, *Chamaecyparis*, *Cupressus*, *Platycladus*, and *Tetraclinis*. Recently, it has been discovered infesting sequoias (*Sequoia sempervirens* (D. Don) Endl.) in a botanical garden in Crimea, thus earning the status of a significant pest in continental Europe. The trade of ornamental plants serves as the most common pathway for introducing alien and invasive insects to other continents and over long distances. Climate conditions favour the migration of Mediterranean species inland. Some native and rare species emerge as new pests due to population outbreaks caused by favourable weather conditions. Hence, it is crucial to recognise early symptoms of infestations: defoliation, leaf colour change, die-back of individual branches, resin flow or leaking sap at the site of boring holes caused by xylophagous insects, wormholes, galls, bark peeling, larval tunnels, exit holes on the bark, etc. The determination of invasive species and emerging pests and the knowledge of damage symptoms and life cycle are essential for halting their spread. Thus, the primary goal of this paper is to provide information related to the early detection of pests.

Keywords: invasive alien species, emerging pests, insects, ornamental plants, early detection

ODRŽIVO UPRAVLJANJE ZAŠTIĆENOG PRIRODNOG DOBRA BOJČINSKE ŠUME

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Apstrakt:

Urbane i suburbane šume imaju veliki značaj u gradskoj sredini. Koristi koje one pružaju su očuvanje biodiverziteta, zaštita od zagađenja i poboljšanje kvaliteta vazduha i vode. Zatim, pružaju prostor za rekreaciju i povoljno utiču na mentalno zdravlje ljudi i estetsku vrednost prostora. S obzirom na to da je stabilnost šumskih ekosistema ugrožena usled različitih faktora kao što su klimatske promene i različite antropogene aktivnosti, potrebno je angažovanje eksperata koji će različitim metodama ublažiti negativne uticaje kojima su permanentno izložene.

Predmet istraživanja u ovom radu je zaštićeno prirodno dobro Bojčinska šuma. Pripada III kategoriji zaštite na osnovu Zakona o zaštiti prirode, dok je prema klasifikaciji IUCN-a svrstana u V kategoriju. Valorizovano je kao međunarodno područje za ptice IBA i takođe je prepoznato kao potencijalno područje međunarodne ekološke mreže Natura 2000. Neophodno je napomenuti da najvećim delom pripada opštini Surčin i da se nalazi u blizini gradskog tkiva, što predstavlja preduslov za mnoge ugrožavajuće faktore.

Cilj rada je da se jasno definišu problemi prilikom upravljanja ovim područjem i daju adekvatni predlozi bazirani na održivom upravljanju. Prilikom istraživanja korišćeno je nekoliko metoda. Prvenstveno, izvršena je analiza plana upravljanja, gde su izdvojena staništa prioriteta za zaštitu, zatim i analiza invazivnih biljnih vrsta, ali i glavne misije i vizije upravljača JP „Srbijašume“. Takođe, izvršena su i terenska istraživanja, što je obuhvatalo metodu ankete korisnika, gde su ispitani stavovi korisnika i lokalnog stanovništva o načinu korišćenja i značaju ovog zaštićenog prirodnog dobra. Obavljen je i intervju sa ekspertima koji upravljaju zaštićenim prirodnim dobrom, gde su izdvojeni problemi sa kojima se susreću prilikom upravljanja. Na osnovu dobijenih rezultata pregledom planskog dokumenta i terenskim istraživanjem, izvršena je SWOT metoda gde su jasno definisane snage, slabosti, mogućnosti i pretnje ovog zaštićenog prirodnog dobra. Takođe, primenjena je i metoda pet kapitala.

Pomoću navedenih metoda izdvojene su brojne preporuke u vidu aktivnosti i sadržaja gde će upravljač moći da generiše sredstva za potrebe zaštićenog prirodnog dobra - Bojčinska šuma. Sve preporuke bazirane su na održivim i ekološkim principima, kako bi upravljač mogao da zaštiti i unapredi vrednosti ovog šumskog ekosistema.

Ključne reči: Održivo upravljanje, zaštićeno prirodno dobro, invazivne biljne vrste, SWOT, metoda pet kapitala, anketa, preporuke.

SUSTAINABLE MANAGEMENT OF THE PROTECTED NATURAL WEALTH OF BOJČINA FOREST

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Abstract:

Urban and suburban forests are of great importance in the urban environment. The benefits they provide are preservation of biodiversity, protection from pollution and improvement of air and water quality. In addition, they provide space for recreation and have a favorable effect on people's mental health and the aesthetic value of the space. Given that the stability of forest ecosystems is threatened by various factors such as climate change and various anthropogenic activities, it is necessary to engage experts who will mitigate the negative impacts that ecosystems are permanently exposed to by using various methods.

The subject of research in this work is the protected natural asset Bojčinska šuma. It belongs to the III category of protection based on the Law on Nature Protection of Serbia, while according to the IUCN classification it is classified in the V category. It has been valorized as an international IBA bird area and is also recognized as a potential area of the international ecological network Natura 2000. It is necessary to note that most of it belongs to the municipality of Surčin and that it is located near the urban fabric, which is a prerequisite for many threatening factors.

The goal of the work is to clearly define the problems in the management of this area and provide adequate proposals based on sustainable management. During the research, several methods were used. Primarily, an analysis of the management plan was carried out, where priority habitats were selected for protection, then an analysis of invasive plant species, but also the main mission and vision of the management of public company "Srbijašume". Also, field research was carried out, which included the user survey method, where the views of users and local residents were examined on the way of use and the importance of this protected natural asset. An interview was also conducted with experts who manage the protected natural resource, where the problems they face during management were highlighted. Based on the results obtained from the review of the planning document and field research, the SWOT method was carried out, where the strengths, weaknesses, opportunities and threats of this protected natural asset were clearly defined. Also, the five capital method was applied.

Using the mentioned methods, numerous recommendations were identified in the form of activities and content where the manager will be able to generate funds for the needs of the protected natural asset - Bojčinska šuma. All recommendations are based on sustainable and ecological principles, so that management can protect and improve the values of this forest ecosystem.

Key words: Sustainable management, protected natural resource, invasive plant species, SWOT, five capital method, survey, recommendations.

RAZVOJ VEGETACIJSKOG SISTEMA ZA POBOLJŠANJE KVALITETA VAZDUHA I VREDNOSTI AMBIJENTA UNUTRAŠNJEG PROSTORA

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Apstrakt:

Vertikalno zelenilo je specifičan vid ozelenjavanja i spada u zelene površine specijalne namene. Dugotrajan boravak u zatvorenim prostorima može izložiti korisnike prostora različitim štetnim supstancama poput volatilnih organskih jedinjenja (VOC) koja sadrže kancerogeni formaldehid, benzen, ksilen, tulen i dr. Zeleni zidovi u enterijeru imaju višestruki značaj, koji podrazumeva estetski, ekološki, ekonomski i zdravstveni aspekt. Funkcionalne osobine biljaka, kao što su transpiracija, emisija fitoncida, apsorpcija i degradacija štetnih supstanci, razmena gasova u procesu fotosinteze, proizvodnja biomase i dr. doprinose poboljšanju kvaliteta vazduha.

U radu je istraživana značaj zelenih zidova u enterijeru i njihov doprinos kvalitetu vazduha i energetske efikasnosti prostora. Cilj ovog inovativnog pristupa je efikasno smanjenje prisustva zagađivača u zatvorenom prostoru, kao i unapređenje estetike i doživljaja prostora, stvarajući prijatno okruženje za njegove korisnike. Zeleni panel je mobilnog tipa, dizajniran za unutrašnje prostore, sa vegetacijskim sistemom, sa namenom pružanja nove dimenzije prostora, poboljšanja higijensko – sanitarnih uslova, snižavanja temperature i drugih pozitivnih efekata u enterijeru. Kreirana je eksperimentalna konstrukcijska podrška vegetacijskom sistemu sa ciljem ispitivanja interakcije između različitih vrsta biljaka, supstrata i sistema za navodnjavanje, sa naglaskom na analizu parametara relevantnih za kvalitet vazduha. Konstrukcija je izrađena od metala obloženog drvenim materijalom. Podloga za biljke obuhvata 30 pregrada za sadnju biljaka i napravljena je od geotekstila koji pruža stabilnost i filtraciju supstrata.

Pažljivo izabrani supstrat sačinjen od perlita, vermikulita i treseta pruža optimalne uslove za rast biljaka, ima malu masu i ne opterećuje konstrukciju. Primenjeni supstrat biljnim vrstama omogućava i adekvatnu drenažu, povećan kapacitet za razmenu nutrijenata, aeraciju supstrata, odnosno povoljan vodno-vazdušni režim. Sistem za zalivanje je implementiran u cilju pravilnog održavanja zelenog zida, ravnomernog zalivanja biljaka, očuvanja vlažnosti supstrata, kao i sprečavanja propadanja biljaka. Sastoji se iz rezervoara, potapajuće pumpe i cevi za vodu sa ubodnim kapljačima.

Ključnu ulogu u pružanju maksimalnog potencijala zelenog zida ima adekvatan odabir biljnih vrsta. Biljne vrste za zeleni zid poput *Epipremnum aureum*, *Hedera helix*, *Nephrolepis* sp., *Philodendron scandens*, *Spathiphyllum* sp., *Chlorophytum comosum*, *Aglaonema modestum*, *Tradescantia purpurea*, *Sansevieria trifasciata*, pažljivo su odabrane zbog svoje izuzetne prilagodljivosti i sposobnosti da uspevaju u unutrašnjem prostoru i testirane su u navedenoj konstrukciji. Najbolju prilagodljivost pokazale su sledeće vrste: *Epipremnum aureum*, *Aglaonema modestum*, *Hedera helix*, *Chlorophytum comosum*.

Dalja istraživanja mogu obuhvatiti različite aspekte uticaja zelenih zidova na enterijer, uključujući boje, teksture biljnih vrsta, adaptacije neprimenjenih biljaka, najefikasnijih i najodrživijih materijala za izgradnju zelenih zidova, ekonomsku isplativost, kao i uticaj na produktivnost, koncentraciju i smanjenje stresa.

Ključne reči: vegetacijski sistem u enterijeru, vertikalno zelenilo, kvalitet vazduha, izbor biljnih vrsta, supstrati

DEVELOPMENT OF A SMALL-SCALE VEGETATION SYSTEM FOR IMPROVING AIR QUALITY AND AMBIENT VALUE OF INDOOR SPACE

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Abstract:

Vertical greenery is a specific type of greening and belongs to green areas of special purpose. Long-term stay in indoor spaces can expose the users of the space to various harmful substances like volatile organic compounds (VOCs) containing carcinogenic formaldehyde, benzene, xylene, toluene, etc. Interior green walls have multiple significances, encompassing aesthetic, ecological, economic, and health aspects. Functional properties of plants such as transpiration, emission of phytoncides, absorption and degradation of harmful substances, gas exchange in the process of photosynthesis, biomass production, etc., contribute to air quality improvement.

This study explores the significance of green walls in indoor spaces and their contributions to air quality and energy efficiency in the spaces. The innovative approach aims to efficiently reduce indoor pollutant levels, enhance aesthetics, and create a pleasant environment for users. The green panel is a mobile type, designed for indoor spaces, with a vegetation system to provide new dimensions of the space, improve hygienic and sanitary conditions, lowering the temperature and other positive effects in the indoor spaces. An experimental construction supports the vegetation system, examining the interaction between different plant species, substrate, and irrigation systems, with an emphasis on the analysis of parameters relevant to air quality. The construction is made of metal covered with wooden material. The plant mat includes 30 pockets for planting plants and is made of geotextile that provides substrate stability and filtration.

The carefully selected substrate made of perlite, vermiculite, and peat provides optimal conditions for plant growth, has a low mass and does not burden the structure. The applied substrate provides plant species with adequate drainage, increased capacity for nutrient exchange, aeration of the substrate, i.e. a favorable water-air regime. The irrigation system was implemented in order to properly maintain the green wall, uniform plant watering, substrate moisture preservation, and prevention of plant decay. It consists of a tank, a submersible pump and a water pipe with stab drippers.

Adequate selection of plant species plays a key role in providing the maximum potential of a green wall. Green wall plant species such as *Epipremnum aureum*, *Hedera helix*, *Nephrolepis* sp., *Philodendron scandens*, *Spathiphyllum* sp., *Chlorophytum comosum*, *Aglaonema modestum*, *Tradescantia purpurea*, *Sansevieria trifasciata*, have been carefully selected for their exceptional adaptability and ability to thrive indoors and were tested in the specified construction. The following species showed the best adaptability: *Epipremnum aureum*, *Aglaonema modestum*, *Hedera helix* and *Chlorophytum comosum*.

Future research could cover various aspects of the impact of green walls on indoor spaces, including the colors and textures of plant species, adaptations of unused plants, the most efficient and sustainable materials for green wall construction, economic profitability, and effects on productivity, concentration, and stress reduction.

Keywords: vegetation system in the indoor space, vertical greenery, air quality, selection of plant species, substrates

JAČANJE SVESTI JAVNOSTI O RIZIKU OD UNOŠENJA MUŠKATLINOG PLAVCA (*CACYREUS MARSHALLI* BUTLER) (LEPIDOPTERA: LYCAENIDAE)

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Apstrakt:

Jačanje svesti javnosti o značaju zaštite zdravlja biljaka i njihovog učešća u ranom javljanju o pojavi karantinskih ili novih štetnih organizama je veoma važno za razumevanje i prihvatanje preventivnih mera i mera direktne zaštite. Masovne pojave karantinskih vrsta *Anoplophora* spp., *Aromia bungii*, *Dryocosmus kuriphilus*, *Phytophthora ramorum* su prvo zapazili građani a posle su njihovu pojavu prijavile zvanične službe. Ako je dobro razvijena svest javnosti može da dovede do uključivanja tzv. "građanske nauke", odnosno članova društva koji su zainteresovani za zaštitu bilja i spremni da istražuju, tako da je veća verovatnoća da će oni da zapaze u ranoj fazi masovne pojave insekata pre nego inspektori za vreme posebnog nadzora. Za društvo je prednost kada ima dobro obaveštene članove koji znaju koje karantinske vrste ili nove štetočine treba da traže, kako izgledaju, kako da ih razlikuju od drugih insekata i ako ih nađu, kome i kako da jave. Evropska i mediteranska organizacija za zaštitu bilja (EPPO) je objavila standard za Fitosanitarne postupke PM3/86 (1) *Raising public awareness of Quarantine and Emerging Pests*. U radu će biti prikazan primer muškatlinog plavca (*Cacyreus marshalli* Butler) (Lepidoptera: Lycaenidae) koji je na A2 listi karantinskih organizama u Evropi i A1 u Turskoj. Prirodni areal je južna Afrika, gde je i areal muškati (Pelargonium spp.). Prvi put je unet u Evropu krajem 20. veka, gde se brzo proširio u mnoga južna i istočna područja gde je postao štetočina gajenih *Pelargonium* i *Geranium* vrsta i kultivara. Rasprostranjen je u susednim zemljama: Bosni i Hercegovini, Crnoj Gori, Makedoniji i Bugarskoj. U Srbiji je prvi put konstatovan početkom oktobra 2020. godine u Nišu. Ženke imaju raspon krila od 18-27 mm, dok je kod mužjaka od 15-23 mm. Krila su smeđa, sa belom ivicom. Njihova donja strana je sivo-smeđa sa tamnim pojasevima, koji su ispresecani belom jedinstvenom šarom. Larve prvog stupnja miniraju list, hrane se cvetovima i zatim ubušuju u stabljike. Mogu potpuno da unište biljke i izazovu ekomomske štete. Modelovanjem za period od 2061. do 2080. godine, očekuje se da će u Srbiji vladati uslovi klime koji omogućavaju da se ova vrsta aklimatizuje. Ovim posterom će se pokazati alati za edukaciju u cilju jačanja svesti javnosti o riziku od širenja *C. marshalli* u Srbiji.

Ključne reči: razvijanje svesti javnosti, *Cacyreus marshalli*, *Pelargonium* spp., *Geranium* spp., muškatla

RAISING PUBLIC AWARENESS OF GERANIUM BRONZE (*CACYREUS MARSHALLI* BUTLER) (LEPIDOPTERA: LYCAENIDAE)

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Abstract:

Raising public awareness about the importance of plant health protection and their involvement in the early detection of quarantine or emerging harmful organisms is crucial for understanding and accepting preventive and direct protection measures. Mass occurrences of quarantine species such as *Anoplophora* spp., *Aromia bungii*, *Dryocosmus kuriphilus* and *Phytophthora ramorum* were initially noticed by citizens and later reported by official services. A heightened public awareness can increase the engagement of so-called "citizen science," i.e. individuals interested in plant protection willing to investigate. These individuals are more likely to notice an outbreak of insects at an early stage before inspectors during special surveillance inspections. For society, it is an advantage to have well-informed members who know which quarantine species or emerging pests to look for, what they look like, how to distinguish them from other insects, and if found, whom and how to report to. The European and Mediterranean Plant Protection Organization (EPPO) has published the standard for Phytosanitary Procedures PM3/86 (1) – "Raising public awareness of Quarantine and Emerging Pests." The paper will present the example of the Geranium Bronze (*Cacyreus marshalli* Butler) (Lepidoptera: Lycaenidae), listed as an A2 quarantine organism in Europe and A1 in Turkey. Its natural range is South Africa, where geraniums (*Pelargonium* spp.) are also native. It was first introduced to Europe in the late 20th century, quickly spreading to many southern and eastern areas, where it became a pest of cultivated *Pelargonium* and *Geranium* species and cultivars. It is widespread in neighbouring countries: Bosnia and Herzegovina, Montenegro, North Macedonia, and Bulgaria. In Serbia, it was first recorded in Niš in early October 2020. Females have a wingspan of 18-27 mm, while males range from 15-23 mm. The wings are brown, with a white border. Their underside is greyish brown with dark bands, intersected by a unique white pattern. First-instar larvae mine leaves, feed on flowers and then bore into stems. They can utterly destroy plants and cause economic damage. Modelling for the period from 2061 to 2080 suggests that climate conditions in Serbia will allow this species to acclimatise. This poster showcases educational tools aimed at raising public awareness of the risk of *C. marshalli* spreading in Serbia.

Keywords: public awareness raising, *Cacyreus marshalli*, *Pelargonium* spp., *Geranium* spp.

