UNIVERZITET U BEOGRADU
POLJOPRIVREDNI FAKULTET
Institut za hortikulturu

NAUČNO VOĆARSKO DRUŠTVO SRBIJE
ČAČAK

17.
KONGRES VOĆARA I VINOGRADARA SRBIJE
SA MEĐUNARODNIM UČEŠĆEM

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WITH INTERNATIONAL PARTICIPATION

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Reč urednika

17. Kongres voćara i vinogradara Srbije sa međunarodnim učešćem organizuje se u Vršcu od 16. do 18. oktobra 2024. godine. Organizatori Kongresa su Institut za hortikulturu Poljoprivrednog fakulteta Univerziteta u Beogradu i Naučno voćarsko društvo Srbije, Čačak. Sagledavajući trenutno stanje u voćarsko-vinogradarskoj proizvodnji Srbije, mišljenja smo da je održavanje ovakvog skupa od posebnog značaja za razmenu novostečenih naučnih i stručnih saznanja.

Programski odbor Kongresa opredelio se za dva uvodna predavanja, jedno iz oblasti voćarstva, a drugo iz oblasti vinogradarstva u kojima se obrađuju trenutno stanje i perspektive razvoja ove dve grane poljoprivrede.

U radu Kongresa učestvuju naučnici iz zemlje i inostranstva sa ukupno 106 prijavljenih radova koji se predstavljaju po odgovarajućim sekcijama u usmenoj formi ili u formi postera.

- Oplemenjivanje voćaka i vinove loze, sorte i podloge (1 predavanje po pozivu, 7 usmenih radova i 19 postera)
- Ekologija i fiziologija voćaka i vinove loze, uticaj klimatskih promena i mere adaptacije (3 predavanja po pozivu, 4 usmena rada i 18 postera)
- Tehnologija gajenja voćaka i vinove loze (4 predavanja po pozivu, 11 usmenih radova i 20 postera)
- Berba, čuvanje, tehnologija prerade i ekonomika proizvodnje voća i grožđa (8 usmenih radova i 11 postera)

Svi radovi u Zborniku su recenzirani i na odgovarajući način korigovani od strane recenzenata. Radovi sa Kongresa izloženi u formi apstrakta mogu se publikovati u časopisima „Voćarstvo“ i „Journal of Agricultural Sciences“.

Pored naučnih radnika na Kongresu prisustvuje veliki broj poljoprivrednih proizvođača, savetodavaca i svih onih koji učestvuju u proizvodnji voća i grožđa ili njihovih prerađevina.

U okviru Kongresa organizuje se Skupština Naučnog voćarskog društva Srbije, panel iz oblasti klimatskih promena, kao i stručna ekskurzija na području opštine Vršac.

Zahvaljujemo svim autorima, recenzentima, moderatorima sekcija i kolegama na pomoći u uređivanju zbornika.

Beograd, 01. oktobar, 2024.

Urednik

Prof. dr Dejan Đurović

Sadržaj/*Content*

Uvodna predavanja

Introductory lectures

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STANJE I PERSPEKTIVA RAZVOJA VOĆARSTVA U REPUBLICI SRBIJI

Dejan Đurović[1], Jasminka Milivojević[1], Boban Đorđević[1], Dragan Milatović[1], Dragan Radivojević[1], Čedo Oparnica[1], Gordan Zec[1], Dragan Nikolić[1], Milica FotirićAkšić[1], Zoran Keserović[2] Nenad Magazin[2], Sandra Bijelić[2], Mirjana Ljubojević[2], Marijana Pešaković[3], Tanja Vujović[3], Slađana Marić[3], Ivana Glišić[3], Sanja Radičević[3]

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U Srbiji se komercijalno gaji 14 vrsta voćaka: jabuka, kruška, dunja, šljiva, breskva i nektarina, kajsija, trešnja, višnja, orah, lešnik, jagoda, malina, kupina i borovnica. Ostale voćne vrste su manje zastupljene i nemaju veći ekonomski značaj. Prema popisu poljoprivrede iz 2023. godine, ukupne površine pod zasadima voćaka u Srbiji, sa izuzetkom jagode, iznose 196.129 ha.

Najveće površine pod voćnjacima u Srbiji se nalaze u Zlatiborskom (24.300 ha), Moravičkom (15.500 ha), Grad Beograd (14.000 ha), Šumadijskom i Mačvanskom okrugu (po 13.100 ha). Preko 10.000 ha pod voćnjacima se nalazi još i u Topličkom, Kolubarskom i Rasinskom okrugu. Ako se posmatra gustina voćnjaka, izražena preko odnosa broja hektara i km^2 površine okruga, voćarstvo je najviše zastupljeno u Podunavskom (6,14 ha/km^2), Topličkom (5,71 ha/km^2), Šumadijskom (5,49 ha/km^2) i Moravičkom okrugu (5,16 ha/km^2). Manje od jednog ha voćnjaka po km^2 imaju Južnobanatski, Severnobanatski, Pirotski, Borski i Srednjebanatski okrug. Opština sa najvećim površinama pod voćnjacima je Grocka (6.600 ha). Preko 5.000 ha pod zasadima imaju i opštine Prokuplje, Smederevo i Valjevo.

U poslednje tri godine proizvodnja voća u Republici Srbiji se kretala od 1.263,692 t 2023. godine do 1.546.903 t 2022. godine. Veliko variranje prinosa posledica je izraženih klimatskih promena, pri čemu najveći uticaj ispoljava pojava prolećnih mrazeva, jaka suša i izražen rast temperature, učestala pojava grada, poplave i sl. U Srbiji postoji veliki broj zasada koji su podignuti u neodgovarajućim lokalitetima i na zemljištima sa nepovoljnim fizičkim ili hemijskim karakteristikama. U takvim zasadima prinos i kvalitet plodova je na veoma niskom nivou, uprkos primeni savremene tehnologije gajenja.

Jabuka je najzastupljenija jabučasta vrsta voćaka, koja se gaji na površini od 26.000 ha (popis poljoprivrede iz 2023. godine). Najviše zasada ima u Podunavskom, Moravičkom, Šumadijskom i Severnobačkom okrugu. Uočava se velika oscilacija u visini ostvarenih ukupnih prinosa između godina. Tako je u 2021. godini proizvodnja jabuke bila 513.238 t, a u 2023. godini samo 379.690 t, iako su površine pod zasadima jabuke ostale skoro iste. U sortimentu jabuke dominaraju sorte Zlatni delišes, Greni Smit i Gala. Pored ove tri sorte, dosta se gaji i Ajdared (u starijim zasadima), kao i Crveni delišes. S obzirom na to da se poslednjih godina sve teže kod obojenih sorti razvija dopunska boja, zasnivaju se novi zasadi ili prekalemljuju postojeći sa bolje obojenim klonovima istih sorti. M9 je dominatna podloga, dok se M26 i MM 106 primenjuju samo pri kalemljenju slabo bujnih „spur“ sorti ili na peskovitim zemljištima. Primećuje se trend

povećanja gustine sadnje, pa se sa nekadašnjih 3.000-4.000 stabala po hektaru, prelazi na 5.000 i više. Iako većina proizvođača primenjuje hemijsko proređivanje plodova, javljaju se teškoće u regulisanju rodnosti, iz čega proizilazi neujednačen kvalitet plodova i variranje u prinosima po godinama. Veći proizvođači uglavnom imaju rešen problem skladištenja jabuke u hladnjačama, koje su uglavnom opremljene ULO sistemom uz korišćenje MCP-a (1-Methylcyclopropene). Manji proizvođači često plodove čuvaju u skladištima, u kojima se uglavnom reguliše samo temperatura i važnost vazduha. Poslednjih godina, jabuka se uglavnom izvozi na tržište zemalja Arabijskog poluostrva, Velike Britanije, nekih zemljalja Evropske Unije i tržište Ruske Federacije.

Površine pod zasadima kruške su se u poslednjih deset godina smanjile sa 7.300 ha na 6.100 ha. U 2023. godini, proizvodnja kruške je iznosila 48.028 t. Uglavnom dominiraju sorte kruške letnjeg vremena zrenja, kao što su Karmen i Vilijamovka. Pored ove dve sorte, u zasadima kruške se sporadično javljaju i sorte Santa Marija, Abate Fetel i Kiferov sejanac. S obzirom da dominiraju sorte ranog vremena zrenja, nedostatak zimskih sorti na tržištu se nadoknađuje uvozom svežih plodova iz inostranstva. Dunje MA i BA29 su dominatne podloge u intenzivnim zasadima. Problemi u proizvodnji kruške su pre svega nedefinisana tehnologija gajenja i učestala pojava kruškine buve i bakteriozne plamenjače u zasadima, što rezultira niskim prinosima, koji uz visoke troškove proizvodnje čine gajenje kruške nerentabilnim.

U proizvodnji dunje, površine pod zasadima su se u poslednjih 10 godina udvostručile i trenutno iznose 3.100 ha. Pored Leskovačke dunje, u novijim zasadima zastupljene su sorte: Trijumf, Asenica i Hemus. Plodovi su uglavnom namenjeni za preradu. I dalje je najveći problem pojava plamenjače, koju izaziva bakterija *Erwinia amylovora* (Burr).

Šljiva je i dalje najdominantnija voćna vrsta u Srbiji, u pogledu površina na kojima se gaji, sa preko 75.500 ha. Glavni okruzi gajenja šljive su Kolubarski, Toplički i Šumadijski. U sortimentu šljive dominiraju tri sorte: Stenli, Čačanska lepotica i Čačanska rodna. Pored navedenih sorti, dosta se gaji i Čačanska rana, koja je prvenstveno namenjena potrošnji u svežem stanju. Dominatna podloga na kojoj se gaji šljiva je i dalje džanarika, a uzgojni oblici kotlasta kruna i vretenast žbun. U cilju proizvodnje vrhunske rakije, poslednjih godina se javlja velika potražnja za plodovima starih sorti Crvene ranke i Požegače. Iz tog razloga se površine pod sortom Crvena ranka poslednjih godina povećavaju. Osim prerade u alkoholne destilate, povećava se udeo plodova namenjen proizvodnji sušene šljive (naročito u Topličkom okrugu).

Kod breskve i nektarine se zapaža najveće smanjenje površina tako da je proizvodnja sa 8.000 ha u 2012. godini smanjena (ili pala) na 5.700 ha u 2022. godini. Glavni okruzi gajenja breskve su Podunavski i Grad Beograd gde se nalazi skoro 70% proizvodnje. U sortimentu breskve najviše se gaje dobro obojene sorte kao što su Rojal glori, Rojal džem, i Svit skarlet. U novije vreme se šire sorte iz grupe Ikstrim i to najviše 486 (Extreme 486). Od sorti nektarine su zastupljene Caldezi 2000 (smanjuju se površine pod ovom sortom), Amiga, Orion, a u novijim zasadima sorte Big beng i Svit lejdi. Najznačajnija podloga je i dalje vinogradarska breskva, mada se sve više podižu zasadi i na podlozi GF677.

Kajsija se gaji na površini od 6.500 ha sa godišnom proizvodnjom koja varira od 29.087 tona u 2023. godini do 44.386 tona u 2022. godini. Tri najvažnija okruga za gajenje kajsije su Beogradski, Podunavski i Moravički gde je koncentrisano skoro 70% proizvodnje. Najvažnije sorte su Ruža, Novosadska rodna, NS-4 i NS-5, sorte koje se odlikuju krupnim plodom čija je pretežna namena za potrošnju u svežem stanju.

UV/1

Trešnja se u Srbiji gaji na oko 4.800 ha i to najviše u Gradu Beogradu i Podunavskom okrugu. U starijim zasadima preovladavaju sorte Burlat, Sanberst i Germersdorfska, a u novijim Karmen, Grejs star, Ferovija, Kordija i Regina. Magriva je dominatna podloga na kojoj se gaji trešnja, a manje se koriste Kolt i divlja trešnja (vrapčara). U novijim zasadima sa protivgradnim mrežama i sistemom za zalivanje se kao podloge koriste Gizela 5 i Gizela 6.

Višnja je u Srbiji veoma značajna vrsta, proizvodi se na površini od oko 20.000 ha i sa prosečnom godišnjom proizvodnjom od 150.000 t, što je svrstava na treće mesto, iza jabuke i šljive. Površine pod višnjom su se u poslednjih deset godina uvećale za 6.000 ha. Glavni okruzi gajenja višnje su Toplički i Podunavski. Najviše se gaji Oblačinska višnja. Dodatno, u Podunavskom okrugu se dosta gaji i sorta Šumadinka. Sve više se primenjuje mehanizovana berba Oblačinske višnje, čiji se plodovi zamrzavaju. Sorta Šumadinka je namenjena stonoj potrošnji, ali se poslednjih godina javljaju veliki problemi u plasmanu njenih plodova, naročito na rusko tržište koje je ranije bilo dominatno.

Ukupne površine pod orahom u Srbiji iznose 3.500 ha, sa godišnjom proizvodnjom od oko 10.000 t. Poslednjih godina se dosta uvozi sadni materijal iz Turske sa sortama Čendler i Franket, koje se odlikuju lateralnim tipom rađanja i podižu se novi zasadi sa većom gustinom sadnje.

Leska u Republici Srbiji doživljava drugu ekspanziju proširenja proizvodnje nakon perioda od 2000. do 2007. godine, što se ogleda u značajnom povećanju proizvodnih površina koje su se kretale od 2.200 ha (2012. godina) do 9.000 ha (2023. godina). Najviše zasada ima u Bačkoj i Sremu. U novijim zasadima dominiraju sorte Tonda đentile romana, Tonda di đifoni, Tonda đentile dela lange i Noćione. Sorte se pretežno gaje na sopstvenom korenu, a dominatan uzgojni oblik je žbun.

Jagoda se gaji na površini od oko 7.000 ha, sa proizvodnjom koja je oscilirala između 23.704 t (2023. godina) i 32.943 t (2022. godina). Glavni centri gajenja jagode su Mačva, Pocerina, Podunavlje i Rasinski okrug. Najzastupljenije su sorte Aprika, Kleri, Džoli, Alba, Roksana. U zasadima preovladava gajenje na otvorenom polju na gredicama u jednorednom ili dvorednom sistemu sa zastiranjem polietilenskom folijom. Ovakvom tehnologijom se zasadi održavaju tri kalendarske godine i ostvaruju dva plodonošenja. U manjem obimu se jagoda gaji kao jednogodišnja kultura, sa ciljem obezbeđivanja visokih, konstantnih prinosa odličnog kvaliteta plodova. Na godišnjem nivou se svega oko 200 ha novih zasada jagode podigne sa bezvirusnim frigo sadnim materijalom iz uvoza, dok se najveći deo novih zasada podiže sa sadnim materijalom proizvedenim u rodnim zasadima. Gajenje jagode u zaštićenom prostoru (staklenici, plastenici, tuneli) pokazuje trend širenja sa fokusom na vansezonsko plodonošenje i zaštitu od nepovoljnog uticaja klimatskih faktora.

Malina se gaji na površini od 18.600 ha sa godišnjom proizvodnjom od 98.674 t u 2023. godini. Najviše proizvodnih zasada se nalazi u Moravičkom i Zlatiborskom okrugu. Najzastupljenija sorta u malinjacima Srbije je Vilamet sa preko 90% učešća. U zavisnosti od intenzivnosti primenjene tehnologije gajenja, kao i štetnog uticaja padavina (kiše, grada, prolećnog snega) i suše tokom letnjeg perioda, prinosi kod jednorodnih sorti variraju od 8 do 20 t/ha. U poslednje vreme se šire i remontantne sorte čiji su plodovi namenjeni plasmanu u svežem stanju, kao što su Enrosadira, Kvanza, Kveli i dr. Novi trendovi u proizvodnji se odnose na gajenje konzumnih sorti u supstratu ili na bankovima u zaštićenom prostoru (protivgradne mreže, „rain cap" sistemi i plastenici).

UV/1

Proizvodnja kupine u 2023. godini bila je oko 30.000 ta sa površine od 5.000 ha. Najviše kupine se proizvede u Kolubarskom, Mačvanskom i Rasinskom okrugu. Sorta Čačanska bestrna je i dalje dominantno zastupljena u proizvodnim zasadima sa namenom zamrzavanja plodova, dok sorta Loh Nes ostaje najznačajnija sorta za plasman u svežem stanju. Poslednjih godina se širi i sorta Čester Tornles zahvaljujući visokoj rodnosti i odličnom kvalitetu plodova za svežu potrošnju i zamrzavanje.

Najveće povećanje površina u poslednjih deset godina zabeleženo je kod borovnice, koja se najviše gaji u Zlatiborskom, Moravičkom i Mačvanskom okrugu. Sa 250 ha u 2012. godini površine su povećane na oko 3.000 ha u 2023. godini. Ukupni prinosi borovnice ne prate trend povećanja proizvodnih površina zbog lošeg stanja u zasadima koje je uslovljeno nepravilnim izborom terena za zasnivanje zasada, štetnim dejstvom klimatskih faktora i zemljišnih štetočina, lošim kvalitetom sadnog materijala, neizbalansiranom i prekomernom primenom đubriva, nestručnom rezidbom i neblagovremenom zaštitom. Inovacije u tehnologiji gajenja bazirane su na uvođenju kontejnerskog gajenja (saksije/vreće), sa povećanjem gustine sadnje do 5.500 biljaka po ha. Dominatno mesto u plantažama zauzima sorta Djuk.

Generalno, voćarstvo u Srbiji još uvek ima uzlazni trend koji je započeo početkom novog mileniuma, najviše zahvaljujući jeftinoj proizvodnji voća (niska cena zemljišta, jeftina radna snaga), brzom prilagođavanju novim tehnološkim postupcima i sortimentu, kao i pristupu velikom tržištu (Ruska Federacija). Međutim, poslednjih nekoliko godina se situacija menja. Troškovi proizvodnje voća su značajno porasli, a plasman na inostrano tržište je otežan. U takvim uslovima mogu da opstanu samo proizvođači koji postižu visoke prinose uz očuvanje visokog kvaliteta plodova. Podizanje novih zasada, kao i krčenje starih se izvodi stihijski, bez ozbiljnog plana i strategije. To za posledicu može imati hiperprodukciju ili nedostatak nekog voća na tržištu. Sve to utiče na plasman voća i njegovu cenu, koja u najvećem broju slučajeva nije realna. U cilju postizanja sigurnosti u plasmanu voća, potrebno je da se više radi na strategiji razvoja voćarstva. Potrebno je uraditi preciznu analizu trenutnog stanja voćarstva u Srbiji, sa poznavanjem starosne strukture zasada i sortimenta, površina i količine proizvodnje. Na osnovu tih podataka, zajedno sa detaljnijom analizom i primenom rejonizacije po okruzima, zadržavanjem postojećih i osvajanjem novih tržišta za plasman voća, treba težiti davanju stručne podrške proizvođačima u pogledu pravilnog izbora vrste, sorte i tehnologije gajenja.

Ključne reči: voćarstvo, proizvodnja, površine, sortiment, tehnologija gajenja

UV/1

SITUATION AND PROSPECTS FOR THE DEVELOPMENT OF FRUIT GROWING IN THE REPUBLIC OF SERBIA

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In Serbia, 14 types of fruit trees are grown commercially: apple, pear, quince, plum, peach and nectarine, apricot, cherry, sour cherry, walnut, hazelnut, strawberry, raspberry, blackberry and blueberry. Other types of fruit are less common and are not of major economic importance. According to the 2023 agricultural census, the total area under fruit trees in Serbia, with the exception of strawberries, is 196,129 ha.

The largest fruit-growing areas in Serbia are located in the districts of Zlatibor (24,300 ha), Moravica (15,500 ha), City of Belgrade (14,000 ha), Sumadija and Macva (13,100 ha each). The districts of Toplica, Kolubara and Rasina also have over 10,000 ha under orchards. Looking at the density of orchards, expressed by the ratio of the number of hectares to the km^2 area of the district, fruit growing is most widespread in the districts of Podunavlje (6.14 ha/km^2), Toplica (5.71 ha/km^2), Sumadija (5.49 ha/km^2) and Moravica (5.16 ha/km^2). The districts of South Banat, North Banat, Pirot, Bor and Middle Banat have less than one hectare of orchards per km^2. The municipality with the largest fruit-growing area is Grocka (6,600 ha). The municipalities of Prokuplje, Smederevo and Valjevo also have over 5,000 hectares under cultivation.

In the last three years, fruit production in the Republic of Serbia has fluctuated between 1,263,692 tons in 2023 and 1,546,903 tons in 2022. Large fluctuations in yields are the result of pronounced climatic changes, with the greatest impact being the occurrence of spring frosts, severe drought and a significant increase in temperature, frequent occurrence of hail, flooding, etc. In Serbia, there are a large number of plantations grown in unsuitable locations and on soils with unfavorable physical or chemical properties. In such plantations, the yield and quality of the fruit are very low, despite the use of modern cultivation techniques.

The apple is the most widespread fruit tree species, cultivated on an area of 26,000 ha (agricultural census of 2023). Most plantations are located in the districts of Podunavlje, Moravica, Sumadija and North Backa. The total yield varies greatly from year to year. For example, apple production amounted to 513,238 tons in 2021 and only 379,690 tons in 2023, although the area under apples has remained almost the same. The apple assortment is dominated by the Golden Delicious, Granny Smith and Gala varieties. In addition to these three varieties, Idared (in older plantations) and Delicious are also grown on a large scale. As it has become increasingly difficult in recent years for colored varieties to develop additional color, new plantings are established or

existing ones are grafted with better colored clones of the same varieties. M9 is the predominant rootstock, while M26 and MM 106 are only used for grafting low-vigorous "spur" varieties or on sandy soils. There is a tendency to increase planting density from the previous 3,000-4,000 trees per hectare to 5,000 or more. Although most growers chemically thin the fruit, there are difficulties in regulating cropping, resulting in uneven fruit quality and varying yields per year. Larger growers have largely solved the problem of storing apples in cold stores, which are usually equipped with the ULO system using MCP (1-methylcyclopropene). Smaller growers often store the fruit in warehouses where only the temperature and the humidity of air are regulated. In recent years, apples have been exported mainly to the markets of the Arabian Peninsula, Great Britain, some European Union countries and the Russian Federation.

The area under pear cultivation has decreased from 7,300 ha to 6,100 ha in the last ten years. In 2023, pear production amounted to 48,028 tons. Summer-ripening pear varieties such as Carmen and Williams are predominant. In addition to these two varieties, Santa Maria, Abate Fetel and Kieffer seedling can be found rarely in the pear orchards. As early ripening varieties dominate, the lack of winter varieties on the market is compensated for by importing fresh fruit from abroad. Quinces MA and BA29 are the predominant rootstock in intensive plantations. The problems in pear production are mainly the undefined cultivation technology and the frequent occurrence of pear psylla and bacterial fire blight in the plantations, which leads to low yields that, together with the high production costs, make pear cultivation unprofitable.

The area under quince production has doubled in the last 10 years and currently stands at 3,100 hectares. In addition to the Leskovac quince, the following varieties are represented in the newer plantations: Triumf, Asenica and Hemus. The fruits are mainly intended for processing. The biggest problem is still the occurrence of fire blight, which is caused by the bacterium *Erwinia amylovora* (Burr).

With over 75,500 ha, plums are still the dominant fruit crop in Serbia in terms of acreage. The most important plum-growing areas are Kolubara, Toplica and Sumadija. The assortment of plums is dominated by the three varieties: Stanley, Cacanska lepotica and Cacanska rodna. In addition to the above-mentioned varieties, Čačanska rana is also grown, which fruits are mainly intended for fresh consumption. The predominant rootstock on which plums are grafted is still *Prunus cerasifera*, and the growth forms are the open crown (vase) and the spindle-shaped bush. In recent years, there has been a great demand for the fruit of the old Crvena ranka and Pozegaca varieties for the production of high-quality brandy. For this reason, the area under cultivation of the Crvena ranka variety has increased in recent years. In addition to processing into alcoholic distillates, the proportion of fruit destined for the production of dried plums is increasing (especially in the Toplica district).

Peaches and nectarines have seen the largest decline in acreage, with production falling from 8,000 ha in 2012 to 5,700 ha in 2022. The most important districts for peach cultivation are Podunavski and the city of Belgrade, where almost 70% of production is located. In the peach assortment, mainly well-coloured varieties such as Royal Glory, Royal Gem and Sweet Scarlet are grown. Recently, varieties from the Extreme group have also become widespread, especially 486 (Extreme 486). Among the nectarine varieties there are Caldezi 2000 (the acreage of this variety is declining), Amiga and Orion, and more recently, the varieties Big Beng and Sweet Lady. The most

important rootstock is still the vineyard peach seedling, although more and more plantings are being made on the GF677 rootstock.

Apricots are grown on an area of 6,500 ha. Annual production varies between 29,087 tons in 2023 and 44,386 tons in 2022. The three main apricot growing areas are Belgrade, Danube and Moravica districts, where almost 70% of production is concentrated. The most important varieties are Ruža, Novosadska rodna, NS-4 and NS-5, varieties characterized by large fruit intended mainly for fresh consumption.

Sweet cherries are grown on around 4,800 hectares in Serbia, mainly in the Belgrade and Danube districts. The older plantations are dominated by the Burlat, Sunburst and Germersdorfer varieties, while the newer ones are dominated by the Carmen, Ferrovia, Kordia, Grace Star and Regina varieties. *Prunus mahaleb* seedling is the predominant rootstock on which cherry is grown, and Colt and *Prunus avium* sedling occur rarely. In newer plantations with hail protection nets and an irrigation system, Gisela 5 and Gisela 6 are used as rootstocks.

Sour cherry is a very important species in Serbia, cultivated on an area of about 20,000 ha and with an average annual production of 150,000 tons. The area under sour cherry trees has increased by 6,000 ha in the last ten years. The main sour cherry-growing areas are Toplica andDanube districts. Oblačinska is the most widely cultivated variety. In addition, the Šumadinka variety is grown on a large scale in the Danube region. The mechanized harvesting of Oblačinska višnja, whose fruits are frozen, is increasingly being used. The Šumadinka variety is intended for fresh consumption, but in recent years there have been major problems in marketing its fruit, especially on the Russian market, which has been dominant previously.

The total area under walnut cultivation in Serbia is 3,500 ha with an annual production of about 10,000 tons. In recent years, a lot of planting material has been imported from Turkey, namely the Chandler and Franket varieties, which are characterized by the lateral type of cropping, and new orchards are establish with a higher planting density.

Hazelnut in the Republic of Serbia is experiencing the second expansion of production after the period from 2000 to 2007, which is reflected in a significant increase in the area under cultivation, which ranged from 2,200 ha (2012) to 9,000 ha (2023). Most of the plantations are in Bačka and Srem. The newer plantations are dominated by the varieties Tonda Gentile Romana, Tonda di Giffoni, Tonda Gentile delle Langhe and Nocchione. The varieties are grown mostly on their own roots and the predominant form of cultivation is the bush.

Strawberries are grown on an area of around 7,000 ha, with production fluctuating between 23,704 t (2023) and 32,943 t (2022). The main centers of strawberry cultivation are Mačva, Pocerina, Podunavlje and the Rasina district. The most common varieties are Aprica, Clery, Joly, Alba and Roxana. In the plantations, cultivation is predominantly in the open on beds in a single or double-row system covered with polyethylene film. With this technique, the plantations are cultivated for three calendar years and produce two crops. On a smaller scale, strawberries are grown as an annual crop to ensure high, consistent yields of excellent fruit quality. Each year, only around 200 hectares of new strawberry plantations are planted with virus-free frigo planting material from imports, while the majority of new plantations are planted with planting material from local plantations. The cultivation of strawberries in a protected area (greenhouses, plastic greenhouses, tunnels) shows a tendency to expand, focusing on the off-season fruiting period and protection from the unfavourable effects of climatic factors.

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Raspberries are grown on an area of 18,600 ha with an annual production of 98,674 tonnes in 2023. Most of the production plantations are located in the Moravica and Zlatibor districts. The most common variety of Serbian raspberries is Willamette with a share of over 90%. Depending on the intensity of the cultivation technique used and the damaging effects of precipitation (rain, hail, snow in spring) and drought during the summer period, yields of floricane fruiting varieties vary between 8 and 20 t/ha. Recently, primocane fruiting varieties whose fruits are intended for fresh marketing, such as Enrosadira, Kwanza, Kweli, etc., have spread. New trends in production concern the cultivation of varieties for fresh consumption in the substrate or on embankments in a protected area (hail protection nets, "rain hat" systems and greenhouses).

Blackberry production in 2023 amounted to around 30,000 t on an area of 5,000 ha. Most blackberries are produced in the Kolubara, Mačva and Rasina districts. The Čačanska bestrna variety is still dominant in production plantations with the purpose of freezing the fruit, while the Loch Ness variety remains the most important variety for fresh consumption. In recent years, the Chester Thornless variety has become widespread thanks to its high yield and excellent fruit quality for fresh consumption and freezing.

The largest increase in production area in the last ten years has been in blueberries, which are mainly grown in the Zlatibor, Moravica and Mačva districts. The area has increased from 250 ha in 2012 to around 3,000 ha in 2023. The overall yields of blueberries are not following the trend of growing production areas. The reason for this is the poor condition of plantations caused by improper selection of soil for planting, harmful effects of climatic factors and soil pests, poor quality of planting material, unbalanced and excessive fertilization, unprofessional pruning and untimely protection. Innovations in cultivation technology are based on the introduction of container cultivation (pots/bags), with an increase in planting density up to 5,500 plants per ha. The dominant place in the plantations is occupied by the Duke variety.

In general, fruit growing in Serbia is still in an upward trend, which started at the beginning of the new millennium, mainly thanks to cheap fruit production (low land costs, cheap labor), quick adaptation to new technological processes and assortments, as well as access to a large market (the Russian Federation). In recent years, however, the situation has changed. The costs of fruit production have risen considerably and it is difficult to place fruit on the foreign market. Under these conditions, only producers who achieve high yields and at the same time obtain high-quality fruit can survive. The planting of new orchards and the removing of old ones is spontaneous, without a serious plan or strategy. This can lead to overproduction or a shortage of certain fruit on the market. All this affects the placement of the fruit and its price, which in most cases is not realistic. In order to achieve a safe placement of the fruit, it is necessary to work more on the strategy for the development of fruit cultivation. It is necessary to conduct a detailed analysis of the current state of fruit growing in Serbia, with knowledge of the age structure of plantations and assortment, areas and production volumes. Based on these data, together with a more accurate analysis and application of district rezoning, preservation of existing and conquest of new markets for fruit placement, we should strive to provide professional support to producers in the right choice of species, varieties and cultivation technologies.

Keywords: fruit growing, production, areas, assortment, cultivation technology

UV/2

STANjE I PERSPEKTIVE PRIZVODNjE GROŽĐA I VINA - NOVA ERA I IZAZOVI U SRPSKOM VINOGRADARSTVU

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Dvadeset prvi vek je doneo velike promene u vekovnoj istoriji srpskog vinogradarstva i vinarstva u mirnodopskim uslovima. Kako pozitivne, još više negativne.

Ovo je period u kome se završava jedan višedecenijski proces tranzicije i restrukturiranja srpskog vinogradarstva, koji je u završnici dobio i u intenzitetu i obimu - ubrzani i bespovratni nestanak onoga što je bila vekovna baza ove veoma značajne privredne grane, a to su seoska gazdinstva i mali vinogradi, a time i ne tako male površine pod vinovom lozom. Osim toga, obeležje ovog perioda je i nestanak velikih društvenih kombinata i propadanje i devastacija velikih kompleksa pod vinovom lozom. Razlozi propadanja su socio-ekonomske prirode. Na prvom mestu, kroz nekoliko proteklih decenija evidentan je nezaustavni proces starenja srpskog sela, ali i gašenja. Zatim nesavesno poslovanje i prenamena za neku drugu vrstu delatnosti, su takođe, doveli do drastičnog smanjenja vinogradrskih površina.

Prema podacima Republičkog zavoda za statistiku Republike Srbije (2023), površine pod vinogradima su se u prethodnom periodu permanentno smanjivale i kretale su se u intervalu od 25.676 ha 2005. godine, do 18.349 ha, 2023. godine. U ukupnom sortimentu strukturno dominiraju vinske sorte, dok je učešće stonog sortimenta u mnogo manjoj površini, tako da jedva zadovoljava potrebe srpskog tržišta. Nažalost, i pored pokušaja države da kroz različite programe podsticaja promeni negativan tok u vinogradarstvu, zanavljanje vinogradarskih površina nije uzelo zamaha i dalje ima negativan predznak.

Prema podacima RZS, proizvodnjom grožđa u 2012. godini se bavilo 80.341 poljoprivredno gazdinstvo, što je bilo 12,7% od ukupnog broja gazdinstava. Poljoprivredna gazdinstva, koje su se bavila proizvodnjom grožđa, u proseku su imala 0,28 ha pod vinovom lozom, što opet govori o velikom broju veoma usitnjenih proizvođača. U 2023. godini popisano je 52,6 hiljada gazdinstava koja imaju vinograde, što u odnosu na 2012. godinu predstavlja smanjenje od 34,6%. Ranijih godina, najveći broj gazdinstava koja su se bavila proizvodnjom grožđa, raspolagala su sa površinom manjom od 0,5 ha. Ova gazdinstva su 2012, činila čak 91,9% ukupnog broja gazdinstava koja se bave proizvodnjom grožđa, da bi se njihovo učešće 2023. godine svelo na svega 1,8%. Ako se posmatraju površine pod vinogradima, ova kategorija gazdinstava je 2012. godine učestvovala sa 44% u ukupnoj površini pod vinogradima, dok je njihovo učešće 2023. godine smanjeno na tek 0,5% ukupnih površina pod vinogradima. Istovremeno, 2012, godine, kategorije

gazdinstava sa površinom pod vinogradima od 0,5 ha do 20 ha su činile svega 8% ukupnog broja gazdinstava koja se bave proizvodnjom grožđa, dok su 2023, ove kategorije gazdinstava činile 95,3% ukupnog broja gazdinstava.

U veoma kratkom vremenskom periodu, desilo se nešto što se od pojave filoksere nije tako drastično dešavalo u srpskom selu - potpuno je promenjena struktura poljoprivrednih gazdinstava koja se bave proizvodnjom grožđa. U zemlji u kojoj je svojevremeno, u predelima u kojima su postojali povoljni agroekološki uslovi za gajenje vinove loze, gotovo svako domaćinstvo imalo mali vinograd i vino iz sopstvene proizvodnje, ta tradicija definitivno nestaje. S druge strane, pored smanjenja površina pod vinogradima i smanjenja broja gazdinstava koja se bave proizvodnjom grožđa, došlo je do ukrupnjavanja vinogradarske proizvodnje, odnosno povećan je broj gazdinstava pod vinogradima sa površinama većim od 5 hektara.

Trend smanjenja površina pod vinovom lozom svakako da je preslikan i na proizvodnju vina, pa je u prvim godinama XXI veka proizvodnja smanjena za više od 3/4. O stanju srpskog vinarstva u ovom periodu rečito govore i neadekvatni podaci o proizvodnji vina. Sve do 2009. godine Republički zavod za statistiku je registrovao samo proizvodnju industrijskih preduzeća, ali ne i privatnih preduzetnika. Tek od 2010. registruje se ukupna proizvodnja, u svim sektorima, plus zalihe i realizacija. Pri tome su za 2010. objavljeni i jedni i drugi rezultati, i uočljiva je razlika između podataka koji su se dobili koristeći dve različite metodologije. Proizvodnja vina u toj godini je, kada je dodat privatni sektor, bila veća za 43,347 hl. Prema podacima RZS, registrovana proizvodnja vina u industriji tokom 2023. godine, bila je na nivou od oko 215 000 hl, što je oko 7% manje u odnosu na 2010. Od ukupno proizvedene količine vina u 2023. godini, 11,7 miliona litara proizvedeno je od domaćeg grožđa, dok je 8,4 miliona litara proizvedeno od uvezene sirovine, pretežno iz Severne Makedonije.

U 2023. godini, u strukturi proizvodnje vina prema kategorijama kvaliteta, odnosno prema geografskom poreklu, kao i prethodnih godina, dominirla je proizvodnja vina bez geografskog porekla - „stona“ i „stona sortna“ vina, i to sa 86% učešća. Proizvodnja vina sa geografskim poreklom (G.I., K.P.K. i K.G.P.K.) u 2023. godini činila je svega 14% ukupne proizvodnje vina.

Nekada veliki proizvođač i izvoznik vina, Srbija više ne uspeva da proizvede vino ni za svoje potrebe, pa je zato orijentisana na uvoz i zahvaljujući praznini u domaćoj produkciji, uvozna vina su u jednom periodu stekla dominantnu poziciju na domaćem tržištu. Iako uvoz vina poslednjih godina opada po stopi od 12% godišnje, na srpskom vinskom tržištu uvezena vina još uvek učestvuju sa 46%. Tokom 2023. godine je, najveća količina vina uvezena je iz Severne Makedonije, oko 60% i Crne Gore, oko 17% od ukupno uvezene količine.

S druge strane, posle sunovrata u poslednjoj deceniji minulog veka i vakuuma u prvim godinama novog milenijuma, u Srbiji se ipak podižu novi vinogradi po najnovijim naučnim koncepcijama, introdukovane su nove sorte u dobroj meri praćene odgovarajućim klonskim materijalom, u preradi se koristi nova tehnologija i enološka sredstva itd. U poslednjoj dekadi, negativni priraštaj i manjak radno sposobnog stanovništva orjentisanom ka poljoprivredi i vinogradarenju, doprineo je nužnom uvođenju mehanizacije kao adekvatne zamene radu radnika. Tako, savremeni koncept vinogradarenja podrazumeva upotrebu mašina za predrezidbu, mašina za baliranje rezidbenih ostataka, lačenje, mašinsko zalamanje lastara, defolijaciju, obradu u redu, berbu itd. Dakle, težište svake od pojedinačnih ampelotehničkih operacija je svedeno na upotrebu specijalizovane vinogradarske mehanizacije.

Kada je u pitanju izbor sorti ono što je evidentno je da sve veći broj vinarija zakreće svoju proizvodnju i zasniva je dobrim delom na gajenju autohtonih sorti. Vina proizvedena od autohtonih sorti „prodornija“ su i prepoznatljivija po autentičnosti na svetskom tržištu u odnosu na veliko prisustvo već odavno standardno poznatih vina proizvednih od uglavnom standardnog francuskog sortimenta. Sve veći značaj autohtonih sorti potpomognut je i u naučnom smislu o čemu svedoči po prvi put sprovedena klonska selekcija i novopriznati klonovi sorte Prokupac (12 klonova) i Smederevka (4 klona) stvorenih na Poljoprivrednom fakultetu Univerziteta u Beogradu, koji su uključeni na sortnu listu Ministarstva poljoprivrede, šumarstva i vodoprivrede Republike Srbije. Takođe, osim pomenutih klonova na Poljoprivrednom fakultetu Univerziteta u Beogradu stvoreno je još 6 vinskih i 8 stonih sorti, a na Poljoprivrednom fakultetu Univerziteta u Novom Sadu 25 sorti. Takođe, dve sorte su proistekle iz zajedničkih oplemenjivačkih programa Poljoprivrednog fakulteta Univerziteta u Beogradu i Centra za vinogradarstvo iz Niša.

Osim konvencionalne proizvodnje, u poslednjoj dekadi se sve intenzivnije profilišu proizvođači organskog grožđa i vina. Za sada je to prilično mali broj proizvođača kojima je srpsko tržište nedovoljno razvijeno i malo, ali imajući u vidu trendove koji vladaju u vinogradarskoj struci na nivou Evrope pa i šire, svakako da se očekuje bolje i vidljivije pozicioniranje vinarija sa ovom proizvodnom orjentacijom. Srbija je za svega dvadesetak godina doživela veliku transformaciju i po kvalitetu proizvedenog vina, od proizvodnje stonih vina do vrhunskih vina, postala je jedna od cenjenijih vinskih država u regionu. Čini se da ni jedan privredni sektor u Srbiji, u ovom periodu, nije zabeležio takav pozitivni razvoj kao vinarstvo, pre svega kada je reč o kvalitetu vina. O sve boljem kvalitetu srpskih vina i potvrdu istog govore i rezultati sa mnogobrojnih međunarodnih senzornih ocenjivanja i takmičenja, sa kojih se vinari iz Srbije poslednjih godina vraćaju sa najvišim odličjima. Danas, vinari iz Srbije učestvuju uglavnom na 7 - 8 velikih internacionalnih takmičenja, a najviše njih na Decanter World Wine Awards u Londonu, Austrian Wine Challenge - AWC u Beču i Mundus Vini u Nemačkoj, a poslednjih nekoliko godina masovno učestvuju i na regionalnom takmičenju Balkans International Wine Competition – BIWC, sa sedištem u Sofiji. Pored toga, srpski vinari učestvuju i na velikim sajmovima vina, od kojih je svakako najznačajniji ProWein u Dizeldorfu. Osim pomenutih vinskih sajmova i izložbi, organizuje se čitav niz sličnih manifestacija regionalnog i lokalnog karaktera sa istim ciljem - ocenom najboljih vina.

Jedan od ključnih faktora za ovakav preokret bila su velika privatna ulaganja, i u podizanju vinarija i novih vinograda. U stvari, preporod su izvele male i srednje privatne vinarije. Pored starih vinogradarskih i vinarskih porodica, koje su uspele da obnove vinograde i podrume, na starim, porodičnim imanjima, u ovaj proces se sve više uključuju nosioci kapitala, koji je generisan u drugim oblastima, koji daju novi kvalitet i tempo razvoju ove oblasti. Zahvaljujući svemu tome, Srbija se za kratko vreme, ponovo našla među vodećim vinskim državama u regionu.

Vino je postalo ozbiljna društvena tema. Konzumiranje i poznavanje vina postali su merila društvenog i kulturološkog statusa. Ubrzano se širi krug ljubitelja i poznavaoca vina. Širom Srbije su otvarene specijalizvane prodavnice vina – vinoteke. Došlo je do prave poplave vinskih medija i vinskih manifestacija. Ukratko, stvorena je vinska scena koja, s jedne strane, otvara sasvim nove mogućnosti za razvoj vinarstva, ali, s druge strane, podrazumeva sasvim drugačiju tržišnu utakmicu. Da bi opstale na tržištu, vinarije moraju da se uključe u borbu za kvalitet.

Na ruku srpskog vinskog preporoda išao je i svetski trend da se pije domaće vino, što je bilo posebno značajno za domaće tržište, na kome je sve do nedavno dominiralo uvozno vino. Vino

je postalo piće mlade generacije, stranci su oduševljeni domaćom ponudom i kvalitetom vina - posebno, sve prisutnijim, vinima od autohtonih i lokalnih sorti, na prvom mestu prokupca i tamjanike, čija popularnost iz godine u godinu ubrzano raste, kao i novostvorenih srpskih sorti, koje su takođe postale tipične za naše podneblje, poput morave, probusa, sile i neoplante, koje daju odlična vina. Što je posebno važno, to su specifična vina ovog podneblja.

Iza svega ovoga, prevashodno, stoje novoosnovane vinarije. Prema podacima iz Vinarskog registra u Srbiji je 2014. godine bilo registrovano 240 registrovanih proizvođača vina, da bi sredinom 2024. godine broj vinarija koje su imale proizvodnju vina namenjenog prometu bio 491, od kojih je svaka na svoj način danas respektabilna na tržištu. Ove vinarije su u 2023. godini prijavile proizvodnju od oko 20,1 miliona litara vina. Pored ovih registrovanih, u fokusu je više od 200 manjih vinarija, seoskih domaćinstava, koje proizvode manje količine vina sa kojima se pojavljuju na lokalnim i regionalnim takmičenjima i tržištima. Ove vinarije najčešće posluju i kao mala etno sela gde, pored proizvodnje grožđa i vina, poseduju najčešće restoran tradicionalne kuhinje i smeštajne kapacitete koncipirane u duhu srpskog sela. Ovakav vid „vinogradarenja“ pokazao se održivim i kao dobar i stabilan izvor prihoda za prosečnu po brojnosti srpsku porodicu.

Po nepisanom pravilu, novoformirane vinarije sa sobom donose desetine hektara novih vinograda, sa savremenim konceptom gajenja vinove loze, dobrom praksom, tržišno dobro orjentisano postavljenim ciljevima i razvijenim i prepoznatljivim brendom.

Ključne reči: grožđe, vino, proizvodnja, izazovi, Srbija

UV/2

STATE AND PERSPECTIVES OF GRAPE AND WINE PRODUCTION - NEW ERA AND CHALLENGES IN SERBIAN VITICULTURE

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The twenty-first century brought great changes in the centuries-old history of Serbian viticulture and winemaking under peacetime conditions. Sometimes positive, sometimes rather negative. It is the period in which a decades-long process of transition and restructuring of Serbian viticulture is coming to an end, which has ultimately gained in intensity and scope - the accelerated and irreversible disappearance of what for centuries was the basis of this very important branch of the economy, namely peasant farms and small vineyards, and thus not so small vineyards. Furthermore, this period is characterized by the disappearance of large social complexes and the decay and devastation of large wine-growing complexes. The reasons for this decline are of a socio-economic nature. First of all, the last decades have witnessed the inexorable aging process of the Serbian countryside, but also its extinction. In addition, unscrupulous business practices and reallocation to other activities have led to a drastic reduction of vineyard areas. According to data from the Statistical Office of the Republic of Serbia (2023), the area under vines has been in constant decline over the past period, ranging from 25,676 ha in 2005 to 18,349 ha in 2023. The overall assortment is structurally dominated by wine varieties, while the share of the table assortment is so much lower than it is needed for the Serbian market. Despite the state's attempts to change the negative trend in viticulture through various incentive programs, the renewal of wine-growing areas has unfortunately not gained momentum and still has a negative sign.

According to the Statistical Office of the Republic of Serbia, 80,341 farms were engaged in grape production in 2012, which corresponded to 12.7% of the total number of farms. The farms involved in the production of grapes had an average of 0.28 hectares of vineyards, which again indicates a large number of very fragmented and small producers. In 2023, 52.6 thousand farms with vineyards were recorded, a decrease of 34.6% compared to 2012. In previous years, most of the farms that produce grapes had an area of less than 0.5 ha. In 2012, these farms accounted for as much as 91.9% of the total number of farms producing grapes, so their participation would be reduced to just 1.8% in 2023. Looking at the area under vineyards, this category of farms participated with 44% of the total area under vineyards, while in 2023 their share will fall to just 0.5% of the total area under vineyards. At the same time, the categories of farms with a cultivated area of 0.5 ha to 20 ha accounted for only 8% of the total number of farms producing grapes in 2012, while these categories of farms account for 95.3% of the total number of farms in 2023.

Something has happened in a very short period of time, that has not been so drastic since the appearance of Phylloxera in Serbia - the structure of farms involved in the production of grapes has changed completely. In a country where in the past, in areas with favorable agro-ecological conditions for grape growing, almost every household had a small vineyard and wine from its own production, this tradition is definitely disappearing. On the other hand, in addition to the decrease in the area under vineyards and the decrease in the number of farms involved in the production of grapes, there has been a consolidation of viticultural production, i.e. the number of farms with vineyards of more than 5 hectares or more has increased.

The trend towards a reduction in vineyards is certainly reflected in wine production, with production falling by more than 3/4 in the first years of the 21 st century. The insufficient data on wine production speaks volumes about the state of Serbian viticulture in this period. Until 2009, the Statistical Office of the Republic of Serbia only registered the production of industrial companies, but not that of private entrepreneurs. Only since 2010 has total production in all sectors plus stocks and use been recorded. Both results were published for the year 2010, and the difference between the data obtained using two different methods is remarkable. Wine production in that year was 43.347 hl higher if the private sector is included. According to the Statistical Office of the Republic of Serbia, the registered wine production in the sector in 2023 was about 215.000 hl, which is about 7% less than in 2010. Of the total amount of wine produced in 2023 year 11.7 million liters were produced from domestic grapes, while 8.4 million liters were produced from imported raw materials, mainly from North Macedonia.

In 2023, as in previous years, the structure of wine production by quality category, i.e. by geographical origin, was dominated by the production of wines without geographical origin - table and table varietal wines - with a share of 86%. The production of wines with geographical origin (G.I., K.P.K. and K.G.P.K.) accounts for only 14% of total wine production in 2023.

Once a major wine producer and exporter, Serbia today does not even manage to produce wine for its own needs, so it focuses on imports, and thanks to the gap in domestic production, imported wines have in a certain time gained a dominant position on the domestic market. Although wine imports have been declining at a rate of 12% per year in recent years, imported wines still account for 46% of the Serbian wine market. In 2023, the largest amount of wine was imported from North Macedonia, about 60%, and from Montenegro, about 17% of the imported volume.

On the other hand, after the decline in the last decade of the last century and the vacuum in the first years of the new millennium, new vineyards are still being planted in Serbia according to the latest scientific concepts, new varieties have been introduced to a good extent, accompanied by suitable clonal material, new technologies are used in processing and oenological resources, etc. In the last decade, the negative growth and the lack of a working-age population dedicated to agriculture and viticulture contributed to the need to introduce mechanization as an adequate substitute for the work of laborers. Thus, the modern concept of viticulture includes the use of machines for pre-pruning, machines for pressing pruning shoots, mechanical removing of shoots, defoliation, processing in rows, harvesting, etc. The focus of the individual ampelotechnical operations is therefore reduced to the use of specialized viticultural machinery.

As far as the selection of varieties is concerned, it can be seen that more and more wineries are converting their production and largely relying on the cultivation of indigenous varieties. Wines made from autochthonous varieties are more „penetrating" and recognizably more authentic on the world market than the large presence of long-established standard wines from the mostly standard French assortment. The growing importance of autochthonous varieties is also supported in a scientific sense, as demonstrated by the clonal selection carried out for the first time and the newly clones of the Prokupac (12 clones) and Smederevka (4 clones) varieties, which were selected at the Faculty of Agriculture of the University of Belgrade and included in the list of varieties of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia. In addition to the clones mentioned, 6 wine and 8 table varieties were created at the Faculty of Agriculture of the University of Belgrade, and 25 varieties were created at the Faculty of Agriculture of the University of Novi Sad. Also, 2 varieties were results from the breeding programs of the Faculty of Agriculture of the University of Belgrade and the Center for Grape Growing from Niš.

In addition to conventional production, organic grape and wine producers have increasingly made a name for themselves over the last ten years. At the moment, it is a rather small number of producers for whom the Serbian market is underdeveloped and small, but given the trends that prevail in viticulture at the European level and beyond, it is certainly expect a better and more visible positioning of wineries with this production orientation. In just twenty years, Serbia has undergone a major transformation and has become one of the most respected wine countries in the region in terms of the quality of wine produced, from the production of table wines to premium wines. It seems that no economic sector in Serbia has experienced such a positive development in this period as viticulture, especially in terms of wine quality. The constantly improving quality of Serbian wines is confirmed by the results of numerous international sensory evaluations and competitions, from which winemakers from Serbia have returned with the highest awards in recent years. Today, winemakers from Serbia participate mainly in 7 - 8 major international competitions, most of them Decanter World Wine Awards in London, Austrian Wine Challenge - AWC in Vienna and Mundus Vini in Germany, and in recent years they also participate massively in the regional competition Balkans International Wine Competition – BIWC, in Sofia. In addition, Serbian winemakers also take part in major wine fairs, of which Pro Wein in Düsseldorf is certainly the most important. In addition to the aforementioned wine fairs and exhibitions, a whole series of similar events with a regional and local character are organized, all with the same goal – to evaluate the best wines.

One of the key factors in this turnaround was extensive private investment, both in the construction of wineries and in the planting of new vineyards. The revival was driven by small and medium-sized private wineries. In addition to the old winegrowing and winemaking families, who have succeeded in restoring vineyards and cellars on old family estates, capital owners who were active in other areas are increasingly involved in this process, giving this area a new quality and a new tempo of development. Thanks to all this, Serbia has quickly re-established itself among the leading wine countries in the region.

Wine has become a serious social issue. Wine consumption and wine knowledge have become measures of social and cultural status. The circle of wine lovers and connoisseurs is growing. Specialized wine shops have opened all over Serbia. There has been a veritable flood of

wine media and wine events. In short, a wine scene has emerged that on the one hand opens up completely new opportunities for the development of viticulture, but on the other hand also implies completely different market competition. In order to survive on the market, wineries have to take up the fight for quality.

The renaissance of Serbian wine was favored by the global trend of drinking domestic wine, which was particularly important for the domestic market, which until recently was dominated by imported wine. Wine has become the drink of the young generation, foreigners are delighted with the domestic offer and the quality of wine - especially, and this is becoming more and more present, wines from autochthonous and local varieties, above all Prokupac and Tamjanika, whose popularity is rapidly increasing year by year, as well as newly created Serbian varieties that have also become typical for our climate, such as Morava, Probus, Sila and Neoplanta, which produce excellent wines. And what is particularly important, these are the specific wines of this climate.

The newly established wineries are behind all this. According to the wine register in Serbia, there were 240 registered wine producers in 2014, and by mid-2024 the number of wineries producing wine for sale would be 491, each respectable in its own way on today's market. These wineries reported a production of around 20.1 million liters of wine for the year 2023. In addition to these registered wineries, the focus is on more than 200 smaller wineries, rural households that produce small quantities of wine with which they participate in local and regional competitions and markets. These wineries are usually set up as small ethnic villages where, in addition to the production of grapes and wine, there is also a restaurant with traditional cuisine and accommodation in the spirit of a Serbian village. This type of viticulture has proven to be sustainable and represents a good and stable source of income for an average Serbian family.

According to an unwritten rule, newly established wineries bring dozens of hectares of new vineyards with a modern concept of viticulture, good practice, well-aligned market- oriented goals and a developed and recognizable brand.

Key words: grape, wine, production, challenges, Serbia

I/PO

TRENUTNO STANJE I INOVACIJE U EVROPSKIM PROGRAMIMA OPLEMENJIVANJA JABUČASTOG VOĆA

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Globalna industrija voća se nalazi na raskrsnici, suočavajući se sa značajnim izazovima koji ugrožavaju njenu održivost i produktivnost. Najvažniji izazovi su smanjenje primene zaštitnih sredstava, klimatske promene i zahtevi potrošača koji se sve više menjaju. Ovi probelmi zahtevaju hitna i odlučna rešenja. I naučni radnici i proizvođači voća su jedinstveni na putu da proizvedu voće sa što manje primene zaštitnih sredstava, što iziskuje uptrebu otpornih sorti koje su prilagođene klimatskim promenama, a da pri tome zadovoljavaju ukuse potrošača. Kroz najsavremenija naučna istraživanja uz primenu savremene tehnologije proizvodnje i posvećenosti održivom razvoju, može se stvoriti budućnost u kojoj je proizvodnja voća produktivna i odgovorna.

Jedan od najvećih izazova u proizvodnji voća je potreba da se smanji upotreba pesticida. Iako je upotreba pesticida neophodna za zaštitu voćaka od bolesti i štetočina, njihova upotreba može imati štetne efekte na životnu sredinu, zdravlje ljudi i biodiverzitet. Povećana bezbednosna kontrola plodova od strane regulatonih tela i potrošača dovela je da postoji velika potreba da se stvaraju sorte sa poboljšanom i održivom otpornošću na bolesti i štetočine, čime se upotreba hemijskih sredstava svodi na minimum. Ova promena nije samo u skladu sa održivom poljoprivrednom praksom, već se bavi brigom potrošača o bezbednosti hrane i uticaja na životnu sredinu.

Pored izazova vezanih za upotrebu pesticida u voćarstvu, industrija voća se takođe suočava sa dubokim efektima klimatskih promena. Povećanje srednje godišnje temperature, promene obrasca padavina i sve češće vremenske nepogode, menjaju poljoprivredni pejzaž. Klimatske promene menjaju vreme cvetanja, utiču na oprašivanje voćaka, na vegetativne cikluse i dinamiku razvoja štetočina, što sve na kraju utiče na prinos i kvalitet plodova. Da bi odgovorili na prve izazove, moraju se razvijati nove otporne sorte koje se mogu prilagoditi promenjivim uslovima životne sredine. Ali, ovo je izuzetno težak zadatak, jer su efekti klimatskih promena raznovrsni, neizvesni i uključuju ogroman broj veoma složenih bioloških procesa. Pre nego što se razviju nove sorte, potrebni su preliminarni koraci koji uključuju: 1) Fiziološka i genetička ispitivanja, 2) Istražiavnja vezana za genetičku raznovrsnost, 3) Početni program oplemenjivanja. Sve ovo može trajati veoma dug period!

Pored toga, zahtevi potrošača se brzo menjaju, sa sve većim naglaskom na održivost, ukus i nutritivnu vrednost. Savremeni potrošači ne traže samo visokokvalitetno voće, već su zabrinuti i zbog uticaja njihovog izbora hrane na životnu sredinu. Ove promene u zahtevima potrošača zahtevaju preispitivanje ciljeva proizvodnje voća. Proizvođači voća treba daju prioritet osobinama koje ispunjavaju ove zahteve, kao što je poboljšan kvalitet ploda i njegova trajašnost. Ukoliko se fokusiraju na gajenje sorti koje preferiraju potrošači, voćari mogu povećati svoju tržišnost i osigurati da proizvedeno voće brže i lakše dođe do potencijalnih potrošača. Oplemenjivanje voćaka u cilju pobojšanja kvaliteta plodova je veoma složeno, subjektivno i multifaktorijalno.

I/PO

Decenijama unazad, odgovor oplemenjivača na ove izazove je bio veoma spor zbog prirode procesa selekcije, niske efikasnosti i samim tim visoke cene. Tokom poslednjih 30 godina, istraživanja u cilju oplemenjivanja voćaka su bila veoma aktivna: uspostavljene su međunarodne mreže genetičara i genomičara za razvoj genetike voćaka u cilju poboljšanja osobina kvaliteta voća, kao i otpornosti na biološke stresove. Zajednički praktični cilj ovih istraživanja je bio pronalaženje molekularnih markera povezanih sa važnim agronomskim osobinama (uglavnom otpornošću na bolesti) kako bi se pomogla i poboljšala efikasnost programa oplemenjivanja. Međutim, uprkos svim ovim naporima, do pre 15 godina, praktični uticaj ovih istraživanja u komercijanim programima proizvodnje voća je bio veoma spor. Glavni razlozi su bili 1) visoka cena, 2) nedostatak efikasnih molekularnih markera u progarmima oplenjivanja, ali i nedostatak informacija i nedovoljno korišćenje genetičkog diverziteta. Nakon što su postali svesni ovih problema, nastalo je nekoliko zajedničkih projekata koji su usmereni na korišćenje najnovih modela, tehnologija i znanja za pobojšanje efikasnosti korišćenja postojećih programa oplemenjivanja voćaka: projekat Fruitbreedomics koji finasira EU (Laurens et al, 2018) i Projekat RoseBreed koji finansira finasira SAD (Iezzoni et al., 2020). Oni su bili uspešni i uticajni, sa značajnim brojem timova za oplemenjivanje voćaka koji koriste molekularne markere u svojim trenutnim komercijalnim programima oplemenjivanja.

Glavni deo prezentacije će se fokusirati na evropske programe oplemenjivanja jabuke i kruške. Počećemo sa pregledom programa oplemenjivanja u Evropi, na osnovu nedavnih istraživanja, a zatim čemo predstaviti trenutne procese pred-oplemenjivanja i oplemenjivanja, sa posebnim naglaskom na upoterbu molekularnih markera. Takođe biće prikazane neke nove sorte voćaka. Zatim ćemo preći na deo prezentacije posvećene budućnosti, posebno na onaj deo vezan za klimatske promene i smanjenje upotrbe pesticida, a zatim, kako novi alati (NGT HD, fenotipizacija itd), pristupi i metode (genomska selekcija, fenotipska selekcija, AI) mogu uticati na buduće programe oplenjivanja voćaka.

Ključne reči: oplemenjivanje, jabuka, kruška, klimatske promene, pesticidi, molekularni markeri

I/PO

STATE OF THE ART AND INNOVATIONS IN EUROPEAN PIPFRUIT BREEDING PROGRAMS

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The global fruit tree industry is at a crossroads, facing significant challenges that threaten its sustainability and productivity. Among these challenges, the reduction of phytosanitary inputs, the impact of climate change and evolving consumer demands stand out as critical issues that require immediate attention and innovative solutions. Fruit scientists and breeders are in a unique position to lead the way in developing resilient varieties that can thrive in a changing climate, require fewer chemical inputs and meet the diverse preferences of today's consumers. Through cutting-edge research, advanced breeding techniques and a commitment to sustainability, they can create a future where fruit production is both productive and environmentally responsible. But this is a long-term process.

One of the major challenges facing the fruit tree industry is the need to reduce the use of pesticides. While these inputs are essential to protect crops from pests and diseases, their use can have adverse effects on the environment, human health and biodiversity. Increased regulatory and consumer scrutiny has led to a re-evaluation of traditional practices. As a result, there is a need for fruit breeders to develop varieties with improved and sustainable resistance to pests and diseases, thereby minimising the use of chemical treatments. This shift is not only in line with sustainable agricultural practices, but also addresses consumer concerns about food safety and environmental impact.

In addition to the challenges posed by phytosanitary inputs, the fruit tree industry is also grappling with the profound effects of climate change. Rising temperatures, changing rainfall patterns and more frequent extreme weather events are reshaping the agricultural landscape. These climatic changes can disrupt flowering times, affect pollination processes, influence vegetative cycles and alter pest dynamics, ultimately affecting fruit yield and quality. To meet these challenges, fruit breeders must develop resilient varieties that can adapt to changing environmental conditions. But this is an extremely difficult task because the effects of climate change are diverse, some are still uncertain, and they involve a huge number of complex biological processes. Before they can be addressed in practical breeding programmes, preliminary steps are required: 1) in-depth physiological and genetic studies, 2) exploration of genetic diversity, and then 3) starting to develop pre-breeding crossing programmes: this can take a long time!

In addition, consumer demands are evolving rapidly, with increasing emphasis on sustainability, taste and nutritional value. Modern consumers are not only looking for high quality fruit, but are also concerned about the environmental impact of their food choices. This shift in consumer preferences requires a rethinking of breeding objectives. Fruit breeders need to prioritise

traits that meet these demands, such as improved taste and extended shelf-life. By focusing on consumer-driven breeding programmes, the industry can improve its marketability and ensure that the fruit produced meets the expectations of today's discerning consumers. Breeding for traits related to fruit quality is complex because they are genetically complex, highly subjective and multifactorial.

For decades, the response of fruit tree breeding programmes to these challenges has been slow due to the nature of the selection process: long term, low efficiency and therefore high cost. Over the last 30 years, fruit tree research has been very active: international networks of fruit geneticists and genomicists have been established to develop fruit genetics research aimed at improving fruit quality traits as well as resistance to biotic stresses. The common practical objective of these programmes has been the release of molecular markers associated with important agronomic traits (mainly disease resistance) to help and improve the efficiency of breeding programmes. However, despite all these efforts, until 15 years ago the practical impact of this research in commercial breeding programmes was very slow; the main reasons were 1) the high cost, 2) the lack of efficiency of molecular markers in breeding programmes, but also the lack of information and use of genetic diversity. After becoming aware of these bottlenecks, a few collaborative projects aimed at using the latest methods, technologies and knowledge to improve the efficiency of current fruit breeding programmes: the EU-funded Fruitbreedomics project (Laurens et al., 2018) and the US-funded RoseBREED project (Iezzoni et al., 2020). These have been successful and impactful, with a significant number of fruit tree breeding teams now using molecular markers in their current commercial breeding programmes.

This keynote presentation will focus on European apple and pear breeding programmes. We will start with an overview of these programmes in Europe, based on the results of a recent survey, then present the current pre-breeding and breeding processes, with particular emphasis on the use of molecular markers, and illustrate some recently released varieties. We will then move on to the future, looking first at the new traits under investigation that could be included in pre-breeding and breeding programmes of the future, in particular those related to the impact of climate change and the reduction of phytosanitary inputs, and then at how new tools (NGTs, HD phenotyping, etc.), approaches and methods (genomic selection, phenomic selection, deep learning, AI) could influence future breeding programmes.

Keywords: breeding, apple, pear, climate changes, pesticides, molecular markers

I/U1

DISTRIBUCIJA BROJA, MASE I PRINOSA PLODOVA U KRUNI VISOKOG VITKOG VRETENA KOD KLUPSKIH SORTI JABUKE

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Dvogodišnje istraživanje (2019-2020. god.) izvedeno je na jednom od najznačajnijih komercijalnih zasada jabuke u Srbiji, zasnovanom 2016. god. u okviru kompanije „Delta Agrar“ u Zaječarskom okrugu. Uzgojni oblik je visoko vitko vreteno posađeno u gustoj sadnji. Ispitivanje je sprovedeno kod četiri brendirane klupske sorte: Evelina®, Pink Lady®, Modi® i Lafayette®. Kod svake sorte, visina debla je iznosila 60 cm. Kruna stabla podeljena je na tri segmenta po visini (mereno od prve donje grane): 60-120 cm, 120-180 cm i 180-240 cm. Rastojanje između biljaka u redu, dakle i širina krune je iznosila 80 cm, odnosno po 40 cm sa obe strane provodnice. Na taj način, svaki od segmenata je dalje podeljen na 4 segmenta po širini krune, odnosno na po dva segmenta sa obe strane provodnice: 0-20 i 20-40 cm. Na uzorku od 30 stabala po sorti, praćeni su broj i masa ubranih i klasiranih plodova, i izračunat je prosečan prinos ploda po stablu, po navedenim segmentima visine i širine krune. U dvogodišnjem proseku, najviše ubranih i klasiranih plodova dobijeno je na prvom (donjem) segmentu po visini krune (60-120 cm); dok je njihov najmanji broj dobijen na vršnom segmentu (180-240 cm). Najveći broj plodova dobijen je kod sorte Modi. Za razliku od prethodnog, najveća prosečna masa ploda dobijena je na vršnom segmentu i smanjivala se idući ka osnovi krune. Najveću i ujednačenu masu ploda ostvarile su sorte Evelina i Pink Lady, dok je značajno manja masa ploda dobijena kod sorti Lafayette i Modi. Najveći prosečan prinos ploda po stablu dobijen je na prvom segmentu, a opadao je idući ka vrhu krune. Kod svih segmenata, veći prinos ploda dobijen je bliže provodnici, odnosno na udaljenosti od 0-20 cm, u odnosu na 20-40 cm. U dvogodišnjem proseku, najveći prinos ploda po stablu (20,28 kg) ostvaren je kod sorte Pink Lady, dok je najmanji prinos (15,35 kg) dobijen kod sorte Lafayette.

Ključne reči: prinos jabuke, klupske sorte, vitko vreteno, masa ploda, distribucija plodova

Zahvalnica: Sredstva za realizaciju istraživanja sufinansiralo je Ministarstvo za nauku, tehnološki razvoj i inovacije Republike Srbije (Ugovor o realizaciji i finansiranju NIO u 2024. godini, br. 451-03). No. 66/2024-03/200117 od 5. februara 2024. god.).

I/U1

DISTRIBUTION OF NUMBER, MASS, AND YIELD OF FRUITS IN THE CANOPY OF HIGH SLENDER SPINDLE IN CLUB APPLE VARIETIES

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A two-year study (2019-2020) was conducted on one of the most significant commercial apple orchards in Serbia, established in 2016 by the company "Delta Agrar" in the Zaječar district. The cultivation form is a high slender spindle planted in a dense assembly. The study focused on four branded club varieties: Evelina®, Pink Lady®, Modi®, and Lafayette®. For each variety, the trunk height was 60 cm. The tree canopy was divided into three vertical segments (measured from the first lower branch): 60-120 cm, 120-180 cm, and 180-240 cm. The distance between plants in the row, and thus the canopy width, was 80 cm, i.e., 40 cm on each side of the central leader. Each vertical segment was further divided into four segments across the canopy width, i.e., two segments on each side of the central leader: 0-20 cm and 20-40 cm. For a sample of 30 trees per variety, the number and mass of harvested and classed fruits were monitored, and the average fruit yield per tree was calculated for the specified vertical and horizontal canopy segments. Over a two-year average, the highest number of harvested and classed fruits was obtained in the first (lower) canopy segment (60-120 cm), while the smallest number was in the top segment (180-240 cm). The highest number of fruits was obtained for the Modi variety. In contrast, the highest average fruit mass was obtained in the top segment and decreased towards the base of the canopy. The highest and most uniform fruit mass was achieved by the Evelina and Pink Lady varieties, while significantly lower fruit mass was recorded for Lafayette and Modi. The highest average fruit yield per tree was obtained in the first segment, decreasing towards the top of the canopy. Across all segments, higher fruit yield was closer to the central leader, i.e., at a distance of 0-20 cm, compared to 20-40 cm. Over a two-year average, the highest fruit yield per tree (20.28 kg) was achieved by the Pink Lady variety, while the lowest yield (15.35 kg) was recorded for the Lafayette variety.

Keywords: apple yield, club varieties, slender spindle, fruit mass, fruit distribution

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I/U2

UTICAJ NOVIJIH VEGETATIVNIH PODLOGA NA BIOLOŠKO-POMOLOŠKE OSOBINE SORTE ŠLJIVE 'ČAČANSKA LEPOTICA'

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U svetu se intenzivno radi na stvaranju i selekciji podloga za šljivu, kao i polivalentnih podloga koje se mogu koristiti za različite vrste iz roda *Prunus*. S obzirom na brojne izazove u savremenoj proizvodnji, selekcija podloga ide u više pravaca, jer je izuzetno teško stvoriti podlogu koja zadovoljava sve kriterijume. S tim u vezi, između ostalih, selekcionisane su podloge manje bujnosti, podloge koje pokazuju visok nivo prilagođenosti na klimatske i zemljišne uslove, kao i podloge koje su tolerantne/otporne na virus šarke šljive. U ovom radu, tokom perioda 2020–2022. godina, ispitivan je uticaj četiri novije vegetativne ('Wavit', 'Weiva', 'Docera 6' i 'Dospina 235') i jedne standardne (sejanac džanarike) podloge, na najznačajnije biološko-pomološke osobine sorte šljive 'Čačanska lepotica' kao jedne od najznačajnijih sorti u Republici Srbiji. Dobijeni rezultati su pokazali da su ispitivane osobine značajno varirale među ispitivanim podlogama, ali i tokom godina istraživanja. Značajan interakcijski efekat utvrđen kod prinosa, mase ploda i koštice, randmana mezokarpa, sadržaja ukupnih kiselina i indeksa zrenja je pokazao da su ispitivane podloge na različit način uticale na pomenute parametre tokom godina istraživanja, dok je kod ostalih ispitivanih parametara ovaj efekat izostao, ukazujući na nezavisan uticaj podloge i godine. Generalno, najveću bujnost i prinos po stablu, ali i najniži koeficijent rodnosti uzrokovao je sejanac džanarike, dok je s druge strane podloga 'Wavit' podstakla najmanju bujnost, najveći koeficijent rodnosti i neznatno manji kumulativni prinos u odnosu na sejanac džanarike. Najkrupniji plod je dobijen kada su za kalemljenje korišćene podloge 'Wavit' i 'Weiva' sa neznatnim razlikama u odnosu na sejanac džanarike, dok je najsitniji plod dobijen kada su kao podloge korišćene 'Docera 6' i 'Dospina 235'. Generalno, najviše vrednosti hemijskih parametara su utvrđene kada je kao podloga korišćen sejanac džanarike, a uglavnom najniže kada je kao podloga korišćena 'Docera 6'.

Ključne reči: šljiva, vegetativne podloge, prinos, fizičke osobine ploda, hemijske osobine ploda

Zahvalnica: Istraživanja u ovom radu su realizovana sredstvima Ministarstva nauke, tehnološkog razvoja i inovacija RS (Ugovor br. 451-03-66/2024-03/200215).

I/U2

THE INFLUENCE OF NEWER CLONAL ROOTSTOCKS ON THE BIOLOGICAL AND POMOLOGICAL TRAITS OF THE PLUM CULTIVAR 'ČAČANSKA LEPOTICA'

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Intensive efforts are being made worldwide to develop and select rootstocks for plum, as well as polyvalent rootstocks that can be used for different species within the genus *Prunus*. Given the numerous challenges in modern production, rootstock selection is moving in multiple directions. In this regard, rootstocks with lower vigour, rootstocks that show a high level of adaptability to climatic and soil conditions, as well as rootstocks that are tolerant/resistant to the Sharka virus, have been selected. This study, conducted during the period 2020–2022, examined the influence of four newer clonal rootstocks ('Wavit', 'Weiva', 'Docera 6', and 'Dospina 235') and one standard rootstock (Myrobalan seedling) on the most significant biological and pomological traits of the plum cultivar 'Čačanska Lepotica'. The results showed that the examined traits varied significantly among the tested rootstocks, as well as over the years of research. A significant interaction effect found for yield, fruit and stone weight, flesh percentage, total acid content, and ripening index indicated that the tested rootstocks affected these parameters differently over the years of study. This effect was absent for the other examined parameters, indicating an independent influence of rootstock and year. In general, the highest vigour and yield per tree, but also the lowest yield efficiency, were caused by the Myrobalan seedling. On the other hand, the 'Wavit' rootstock induced the lowest vigour, the highest yield efficiency, and a slightly lower cumulative yield compared to the Myrobalan seedling. The largest fruit size was found when the rootstocks 'Wavit' and 'Weiva' were used for grafting, with slight differences compared to the Myrobalan seedling, while the smallest fruit size was found when 'Docera 6' and 'Dospina 235' were used as rootstocks. In general, the highest values of chemical parameters were caused by the Myrobalan seedling, and the lowest mostly by 'Docera 6'.

Keywords: plum, clonal rootstocks, yield, fruit physical properties, fruit chemical properties

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I/U3

POMOLOŠKE KARAKTERISTIKE SORTI NEKTARINE RANOG I SREDNJE-RANOG VREMENA ZRENJA U SISTEMU VRLO GUSTE SADNJE

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U trogodišnjem periodu (2021–2023) na području Beograda ispitivane su fenološke karakteristike, prinos i kvalitet ploda 11 sorti nektarine rane i srednje rane epohe zrenja. Sistem gajenja u oglednom voćnjaku je koso vreteno, novi originalni sistem sa vrlo velikom gustinom sadnje (3,5 × 1 m ili 2.857 stabala po hektaru). Kao kontrola za poređenje je uzeta sorta 'Caldesi 2000'. U poređenju sa kontrolnom sortom, prosečan datum početka cvetanja kretao se od 9 dana ranije ('Early Bomba') do 2 dana kasnije ('Maria Laura'). Prosečan datum berbe kretao se od 26. juna ('Early Bomba') do 28. jula ('Maria Marta'). Najmanji prosečan prinos po stablu (4,4 kg) je ostvaren kod sorte 'Early Bomba', a najveći (10,8 kg) kod kontrolne sorte 'Caldesi 2000'. U poređenju sa kontrolnom sortom, značajno manji prinos je zabeležen kod osam sorti. Prosečna masa ploda bila je najveća kod sorte 'Big Haven' (180,1 g), a najmanja kod sorte 'Rita Star' (114,6 g). U poređenju sa kontrolnom sortom, masa ploda je bila statistički značajno manja kod sedam sorti. Sadržaj rastvorljive suve materije se kretao od 12,3% ('Rita Star') do 17,7% ('Maria Laura'), a sadržaj ukupnih kiselina je varirao od 0,59% ('Big Bang') do 1,07% ('Caldesi 2000'). Najviše ocene za izgled ploda dobile su sorte 'Big Haven', 'Big Bang' i 'Amiga', a za ukus sorte 'Big Haven' i 'Big Bang'. Na osnovu dobijenih rezultata, za gajenje u regionu Beograda mogu se preporučiti sorte 'Big Haven', 'Big Bang' i 'Amiga', zajedno sa kontrolnom sortom 'Caldesi 2000'.

Ključne reči: *Prunus persica*, cvetanje, sazrevanje, prinos, kvalitet ploda

Zahvalnica: Ovo istraživanje je realizovano u okviru ugovora o finansiranju naučnoistraživačkog rada između Univerziteta u Beogradu, Poljoprivrednog fakulteta i Ministarstva za nauku, tehnološki razvoj i inovacije Republike Srbije (br. 451-03-65/2024-03/200116).

I/U3

POMOLOGICAL CHARACTERISTICS OF EARLY AND MID-EARLY SEASON NECTARINE CULTIVARS IN A VERY HIGH-DENSITY ORCHARD

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The phenological characteristics, yield and fruit quality of 11 early and mid-early season nectarine cultivars were studied during the three-year period (2021–2023) in the Belgrade area. The training system in the experimental orchard is Sloping Leader, a new original system with a very high planting density (3.5 × 1 m or 2857 trees per hectare). The cultivar 'Caldesi 2000' was used as a control for comparison. Compared to the control cultivar, flowering started on average between 9 days earlier ('Early Bomba') and 2 days later ('Maria Laura'). The average harvest time was between June 26 ('Early Bomba') and July 28 ('Maria Marta'). The lowest average yield per tree (4.4 kg) was achieved with the cultivar 'Early Bomba', and the highest (10.8 kg) with the control cultivar, 'Caldesi 2000'. Compared to the control cultivar, a significantly lower yield was achieved with 8 cultivars. The average fruit weight was highest in the cultivar 'Big Haven' (180.1 g) and lowest in the cultivar 'Rita Star' (114.6 g). Compared to the control cultivar, the fruit weight was statistically significantly lower in 7 cultivars. The soluble solids content ranged from 12.3% ('Rita Star') to 17.7% ('Maria Laura'), and the total acid content ranged from 0.59% ('Big Bang') to 1.07% ('Caldesi 2000'). The cultivars 'Big Haven', 'Big Bang', and 'Amiga' achieved the highest scores for fruit appearance, and the cultivars 'Big Haven', and 'Big Bang' for taste. Based on the results obtained, the cultivars 'Big Haven', 'Big Bang' and 'Amiga', together with the control cultivar 'Caldesi 2000', can be recommended for cultivation in the Belgrade region.

Keywords: *Prunus persica,* flowering, maturation, yield, fruit quality

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I/U4

NOVE SORTE KAJSIJE JELENA I ZAHARIJE

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Selekcija u cilju stvaranja novih sorti kajsije iz prirodne populacije na Poljoprivrednom fakultetu u Novom Sadu započeta je još 1980. godine. Rađena je u pravcu stvaranja novih sorti kasnijeg vremena cvetanja i veće otpornosti prema niskim temperaturama i mrazevima, sa visokom rodnošću i kvalitetom plodova. Procesom selekcije, na Poljoprivrednom fakultetu Univerziteta u Novom Sadu stvorene su i priznate sorte kajsije: *novosadska rodna*, *NS-4*, *NS-6*, *novosadska kasnocvetna* i *buda*, a početkom 2024. godine priznate su još dve sorte: *jelena* i *zaharije*. Novopriznate sorte praćene su na tri lokaliteta: Rimski šančevi, Gladnoš i u Mala Remeta. Sorta *jelena* (selekcija *SK1*) odlikuje se srednje bujnim stablom sa piramidalnom krunom i rađa na svim kategorijama rodnih grančica. Srednje je osetljiva na bolesti. Spada u grupu srednje-kasnocvetnih sorti i samooplodna je sorta. Plodovi sazrevaju u prvoj dekadi jula. U zavisnosti od izbora podloge masa ploda iznosi od 60 do 85 g. Osnovna boja ploda je narandžasta, sa 30-35% dopunske crvene boje. Slatko-nakiselog je ukusa sa 12% rastvorljivih suvih materija. Masa koštice je oko 3,0 grama. Randman mesa ploda je 95%. Zbog pozitivnih karakteristika ploda pogodna je za stonu potrošnju i preradu. Sorta *zaharije* (selekcija *SK3*) odlikuje se srednje bujnim stablom sa okruglom krunom i rađa na svim kategorijama rodnih grančica. Za ovu sortu je karakteristično da na mešovitim grančicama ima tri zone porasta, tako da se cvetovi postepeno otvaraju. Srednje je osetljiva na bolesti. Spada u grupu kasnocvetnih sorti i samooplodna je. Plodovi sazrevaju u prvoj dekadi jula. U zavisnosti od izbora podloge masa ploda iznosi od 65 do 85 g. Osnovna boja ploda je narandžasta sa 35-40% dopunske crvene boje. Meso se dobro odvaja od koštice. Slatko-nakiselog je ukusa sa 13,5-14,0% rastvorljivih suvih materija. Masa koštice je oko 3,0 g. Randman mesa ploda je 95%. Imajući u vidu kasno cvetanje, dobru rodnost i odličan kvalitet plodova, sorta zaharije je pogodna za intenzivne proizvodne zasade.

Ključne reči: selekcija, masa ploda, boja, suve materije, randman

Zahvalnica: Istraživanje je finansiralo Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije, na osnovu ugovora o realizaciji i finansiranju naučno-istraživačkog rada u 2024. godini, Poljoprivredni fakultet, Univerzitet u Novom Sadu, broj 451-03-66/2024-03/200117.

I/U4

NEW APRICOT VARIETIES JELENA AND ZAHARIJE

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The selection aimed to creating the new apricot varieties from natural populations at the Faculty of Agriculture in Novi Sad began as early as 1980. It aimed at developing varieties with later blooming time, increased resistance to low temperatures and frost, high yield, and fruit quality. Through the selection process at the Faculty of Agriculture, University of Novi Sad, apricot varieties 'Novosadska Rodna', 'NS-4', 'NS-6', 'Novosadska Kasnocvetna', and 'Buda' were developed and recognized. In early 2024, two more varieties, 'Jelena' and 'Zaharije', were officially recognized. The newly recognized varieties have been investigated at three locations: Rimski šančevi, Gladnoš, and Mala Remeta. The variety 'Jelena' (selection SK1) is characterized by moderately vigorous growth with a pyramidal crown and bears fruit on all categories of fruiting branches. It is moderately susceptible to diseases. It belongs to the group of medium-late blooming varieties and is self-compatible. The fruits ripen in the first decade of July. Depending on the rootstock, the fruit weight ranges from 60 to 85 g. The ground fruit color is orange, with 30-35% additional red coloration. It has a sweet-tart taste with 12% total soluble solids. The stone weight is approximately 3.0 g. The fruit flesh ratio is 95%. Due to its positive fruit characteristics, it is suitable for fresh consumption and processing. The variety 'Zaharije' (selection SK3) is characterized by moderately vigorous growth with a rounded crown and bears fruit on all categories of fruiting branches. A notable feature of this variety is that on shoots, it has 3 growth zones, allowing flowers to open gradually. It is moderately susceptible to diseases. 'Zaharije' belongs to the group of late blooming varieties and is self-compatible. The fruits ripen in the first decade of July. Depending on the rootstock, the fruit weight ranges from 65 to 85 g. The ground fruit color is orange with 35-40% additional red coloration. The flesh separates well from the stone. It has a sweet-tart taste with 13.5-14.0% total soluble solids. The stone weight is about 3.0 g. The fruit flesh ratio is 95%. Considering its late blooming time, good yield, and excellent fruit quality, 'Zaharije' is suitable for intensive commercial orchards.

Keywords: selection, fruit weight, color, total soluble solids, fruit flesh ratio

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I/U5

POREĐENJE JESENJEG I PROLEĆNOG PLODONOŠENJA NOVOINTRODUKOVANIH REMONTANTNIH SORTI MALINE GAJENIH U SUPSTRATU

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Cilj ovog rada bio je ispitati rodni potencijal i kvalitet ploda šest remontantnih sorti maline ('Dafne', 'Primalba', 'Kokanee', 'Paris', 'Versailles' i 'Enrosadira') gajenih u saksijama u dvogodišnjem proizvodnom sistemu. Istraživanje je sprovedeno na imanju kompanije "Floriva" (Ivanjica), u kolekcionom zasadu maline zasnovanom u proleće 2022. godine, sadnjom u saksije zapremine 10 l ispunjene kokosovim supstratom. Ispitivanja su izvedena merenjem parametara rodnog potencijala, fizičkih i hemijskih osobina ploda na jednogodišnjim izdancima u jesenjoj berbi (2022) i na dvogodišnjim izdancima u prolećnoj berbi (2023). Najmanji prosečni broj plodova i prinos po izdanku registrovan je kod sorte 'Primalba' (130,2 i 691 g/izdanku, po redosledu). Najveći prosečni prinos ostvarile su sorte 'Paris' i 'Enrosadira' (1081,3 i 1116,3 g/izdanku, po redosledu), uz značajno povećanje u prolećnoj berbi, što je takođe zabeleženo kod sorti 'Dafne' i 'Versailles', dok je sorta 'Kokanee' imala dva puta veći prinos na jednogodišnjim izdancima (1384,7 g/izdanku). Najveću prosečnu masu ploda imala je sorta 'Dafne' (6,11 g), a najnižu sorta 'Kokanee' (4,14 g). Značajno povećanje mase ploda registrovano je u jesenjem plodonošenju kod četiri sorte ('Dafne', 'Primalba', 'Kokanee' i 'Versailles'), dok je sorta 'Enrosadira' povećala masu ploda u prolećnoj berbi. Sorta 'Versailles' je imala najveću prosečnu čvrstoću ploda (1,08 N), dok su sorte 'Paris' i 'Enrosadira' ispoljile najveću kohezivnost ploda (0,22 i 0,21, po redosledu). Sadržaj rastvorljive suve materije se kretao od 8,48% ('Dafne') do 10,63% ('Paris'). Sorta 'Kokanee' je imala najveći sadržaj ukupnih fenola (1,25 mg ekv. galne kis./g sv.m.pl.), a sorta 'Paris' najveći sadržaj ukupnih antocijanina u plodu (19,98 mg ekv. cy-3-gluk./100 g sv.m.pl.). Sorta 'Enrosadira'se istakla po visokom sadržaju vitamina C , koji je značajno povećan u prolećnoj berbi (34,6 mg/100 g sv.m.pl.). Većina ispitivanih sorti je ispoljila bolje proizvodne performanse u dvogodišnjem sistemu gajenja, izuzev sorte 'Kokanee', koja se jedina može preporučiti za gajenje u jednogodišnjem proizvodnom ciklusu.

Ključne reči: *Rubus idaeus* L., dvogodišnji sistem gajenja, prinos, fizičke i hemijske osobine ploda

Zahvalnica: Ova istraživanja su finansirana Ugovorom o realizaciji naučnoistraživačkog rada u 2024. godini između Ministarstva za nauku, tehnološki razvoj i inovacije Republike Srbije i Univerziteta u Beogradu, Poljoprivrednog fakulteta (Ugovor br. 451-03-65). /2024-03/200116) i Univerziteta u Beogradu, Instituta za multidisciplinarna istraživanja (Ugovor br. 451-03-66/2024-03/200053).

I/U5

COMPARISON OF PRIMOCANE AND FLORICANE CROPPING OF NEWLY-INTRODUCED REMONTANT RASPBERRY CULTIVARS GROWN IN SUBSTRATE

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This study aimed to evaluate the differences in yield potential and fruit quality between primocanes and floricanes in six remontant raspberry cultivars ('Dafne', 'Primalba', 'Kokanee', 'Paris', 'Versailles' and 'Enrosadira') grown in pots in a biennial production system. The research was carried out on the property of the company "Floriva" (Ivanjica), in a collection raspberry plantation planted in spring 2022 in 10-L pots filled with coconut substrate. The research was carried out by measuring the yield potential parameters, physical and chemical fruit traits at primocanes in autumn cropping (2022) and at floricanes in spring cropping (2023). The lowest average number of fruits and yield per cane were found in 'Primalba' (130.2 and 691 g/cane, respectively). The cultivars 'Paris' and 'Enrosadira' had the highest average yield (1081.3 and 1116.3 g/cane, respectively), with a significant increase on floricanes, also recorded with 'Dafne' and 'Versailles', while 'Kokanee' had a two-fold higher yield on primocanes (1384.7 g/cane). The cultivar 'Dafne' had the highest average fruit weight (6.11 g), while 'Kokanee' had the lowest (4.14 g). In four cultivars ('Dafne', 'Primalba', 'Kokanee' and 'Versailles') a significant increase in fruit weight was observed in the autumn harvest, while the 'Enrosadira' cultivar fruit weight increased in the spring harvest. The cultivar 'Versailles' had the highest fruit hardness (1.08 N), while 'Paris' and 'Enrosadira' showed the highest fruit cohesiveness (0.22 and 0.21, respectively). The soluble solids content ranged from 8.48 % ('Dafne') to 10.63 % ('Paris'). Concerning the total phenols content, 'Kokanee' was the leading cultivar (1.25 mg eq. GA /g FW), while 'Paris' was the predominant cultivar in terms of total anthocyanins (19.98 mg eq. cy-3-gluc./100 g FW). The 'Enrosadira' cultivar distinguished itself with a high vitamin C content, significantly increased in the spring harvest (34.6 mg/100 g FW). Most of the examined cultivars showed better production performances in the biennial production system, except for the cultivar 'Kokanee', which is the only one that can be recommended for the annual production system.

Keywords: *Rubus idaeus* L., biennial production system, yield, physical and chemical fruit traits

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I/U6

PROIZVODNE OSOBINE NEKIH OTPORNIH VINSKIH SORTI STVORENIH U SREMSKIM KARLOVCIMA

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U Sremskim Karlovcima se više od 50 godina radi na stvaranju novih sorti vinove loze tolerantnih na gljivične bolesti. Uglavnom su stvarane bele vinske sorte tolerantne na različite faktore stresa među kojima su sorte *morava* i *panonia*. U okviru ovog oplemenjivačkog programa nedavno je priznata prva crna vinska sorta – *dionis*, otporna na prouzrokovače najvažnijih gljivičnih bolesti. Sorta *dionis* dobijena je ukrštanjem sorti *kaberne fran* i *panonia*. Ogled je sproveden u Sremskim Karlovcima tokom perioda od 2021. do 2023. godine. Ogled je sproveden na sortama *dionis*, *kaberne fran*, *morava* i *panonia*. U berbi je određen prinos, prosečna masa grozda, sadržaj šećera i kiselina u širi. Kod sorti *dionis*, *morava*, i *kaberne fran* berba grožđa je obavljana krajem septembra meseca, dok je kod sorte *panonia* berba obavljana krajem avgusta meseca. Sve sorte su ostvarile zadovoljavajući prinos od 1,0 (*dionis*) do 1,5 kg/m^2 (*panonia*), posebno ako se uzme u obzir da su gajene bez primene pesticida. Najveću prosečnu masu grozda imala je sorta *panonia* (163 g). Sorte *kaberne fran* i *panonia* imale su najviši sadržaj šećera u širi. Visok sadržaj šećera u širi uočen je i kod sorte *dionis*. Sorta *morava* imala je znatno niži sadržaj šećera u širi u odnosu na ostale sorte. S obzirom da *panonia* rano sazreva i nakuplja dosta šećera u širi, može se istaći da tople godine ne idu u prilog ovoj sorti. Sa druge strane, sorte *dionis* i *morava* istakle su se zadovoljavajuće visokim prinosom i kasnijom epohom zrenja, što je važno u klimatski izmenjenim uslovima sa veoma visokim temperaturama u letnjim mesecima.

Ključne reči: *dionis*, *morava*, vinova loza, prinos

Zahvalnica: Ugovor br. 451-03-65/2024-03/200117.

I/U6

CHARACTERISTICS OF SOME FUNGUS TOLERANT GRAPEVINE CULTIVARS RELEASED IN SREMSKI KARLOVCI

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For over 50 years, breeding program has been conducted in Sremski Karlovci aimed at developing new grapevine varieties tolerant to fungal diseases. Primarily, white wine varieties tolerant to various stress factors have been released, including Morava and Panonia. Recently, within this breeding program, the first black wine variety – Dionis, resistant to the causative agents of major fungal diseases, has been recognized. Dionis variety was obtained through the crossbreeding of Cabernet Franc and Panonia varieties. The trial was conducted in Sremski Karlovci from 2021 to 2023, encompassing Dionis, Cabernet Franc, Morava, and Panonia varieties. During the harvest, yield, average cluster weight, sugar content, and acidity in the must were determined. Dionis, Morava, and Panonia varieties were harvested at the end of September, while the Panonia variety was harvested at the end of August. All varieties yielded satisfactorily, ranging from 1.0 (Dionis) to 1.5 kg/m^2 (Panonia), especially noteworthy considering the absence of pesticide application. The Panonia variety exhibited the highest average cluster weight (163 g). Cabernet Franc and Panonia varieties showed the highest sugar content in the must. Dionis also showed a high sugar content in the must. Conversely, the Morava variety exhibited significantly lower sugar content in the must compared to the other varieties. Considering Panonia's early ripening and substantial sugar accumulation in the must, it can be noted that warm years are not conducive to this variety. On the other hand, Dionis and Morava varieties demonstrated satisfactory high yields and later ripening, which is crucial in climate-changed conditions characterized by very high temperatures during the summer.

Keywords: *dionis*, *morava*, grapevine, yield

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I/U7

UPOREDNA ANALIZA AGROBIOLOŠKIH OSOBINA NOVOSTVORENIH STONIH SORTI VINOVE LOZE

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U ovom radu proučavano je pet novostvorenih sorti vinove Poljoprivrednog fakulteta, Univerziteta u Beogradu, namenjenih za svežu potrošnju ('Antonina', 'Kristina', 'Leontina', 'Simona' i 'Valentina'). Sorta 'Antonina' priznata je za novu sortu 2017. godine, sorte 'Kristina', 'Leontina' i 'Simona' 2018. godine, a sorta 'Valentina' 2019. godine. Kod svih pet sorti, kao jedan od roditeljskih partnera bila je sorta 'Muskat Hamburg'. Drugi roditelj, otporan na izazivače najvažnijih gljivičnih bolesti, kod sorti 'Antonina' i 'Kristina' bio je 'Sejanac 108', kod sorte 'Simona' bio je 'Sejanac 113', a kod sorte 'Leontina' i 'Valentina' bio je 'SV 12375'. Kao standard za poređenje korišćena je sorta 'Muskat Hamburg'. Tokom trogodišnjeg perioda ispitivanja (2021-2023) proučavane su najvažnije agrobiološke osobine. Statistički značajne razlike ispitivanih sorti u odnosu na sortu standard utvrđene su u većini, ili manjem broju slučajeva, za vreme zrenja, prinos grožđa, masu grozda, dužinu grozda, širinu grozda, dužinu bobice, širinu bobice i sadržaj šećera u širi. U proseku sorta 'Kristina', 'Leontina', 'Simona' i 'Valentina' bile su poznijeg vremena zrenja (21-26. septembar) u poređenju sa sortom standard (15. septembar), dok je vreme zrenja sorte 'Antonina' bilo 14. septembar. Značajno veći prinos grožđa utvrđen je kod sorti 'Kristina' (2,22 kg/m^2), 'Leontina' (2,28 kg/m^2) i 'Simona' (2,23 kg/m^2) u odnosu na sortu standard (1,80 kg/m^2). Masa grozda kod sorti 'Leontina' (523,6 g) i 'Valentina' (364,7 g) bila je takođe značajno veća u odnosu na sortu standard (315,4 g). Masa bobice kod ispitivanih novostvorenih sorti varirala je od 3,15 g do 3,89 g, dok je kod standardne sorte bila 3,64 g. Sve ispitivane sorte imale su veći sadržaj šećera u širi od sorte 'Muskat Hamburg' (17,3%), a on je značajno bio veći kod sorti 'Kristina' (21,9%) i 'Leontina' (19,6%). Svih pet novostvorenih sorti za razliku od sorte standard ispoljile su visoku ili veoma visoku otpornost prema izazivačima najvažnijih gljivičnih bolesti (*Plasmopara viticola*, *Uncinula necator* i *Botrytis cinerea*) što ih čini pogodnim za gajenje u organskoj proizvodnji.

Ključne reči: vinova loza, vreme zrenja, prinos, osobine grozda i bobice, otpornost

Zahvalnica: Ovaj rad je realizovan u okviru ugovora o finansiranju naučnoistraživačkog rada između Univerziteta u Beogradu, Poljoprivrednog fakulteta i Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (br. 451-03-65/2024-03/200116).

I/U7

COMPARATIVE ANALYSIS OF AGROBIOLOGICAL TRAITS NEWLY CREATED TABLE GRAPEVINE CULTIVARS

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In this paper, five newly created grapevine cultivars of the Faculty of Agriculture, University of Belgrade, intended for fresh consumption ('Antonina', 'Kristina', 'Leontina', 'Simona' and 'Valentina') were studied. The cultivar 'Antonina' was recognized as a new cultivar in 2017, the cultivars 'Kristina', 'Leontina' and 'Simona' in 2018, and the cultivar 'Valentina' in 2019. In all five cultivars, one of the parental partners was the cultivar 'Muscat Hamburg'. The second parent, resistant to the most important fungal diseases, in the cultivars 'Antonina' and 'Kristina' was 'Seedling 108', in the cultivar 'Simona' it was 'Seedling 113', and in the cultivars 'Leontina' and 'Valentina' it was 'SV 12375'. The cultivar 'Muscat Hamburg' was used as a standard for comparison. During the three-year study period (2021-2023), the most important agrobiological traits were studied. Statistically significant differences of the tested cultivars compared to the standard cultivar were found in most, or fewer cases, for ripening time, grape yield, bunch weight, bunch length, bunch width, berry length, berry width and sugar content in the must. On average, cultivars 'Kristina', 'Leontina', 'Simona' and 'Valentina' had a later ripening time (September 21-26) compared to the standard cultivar (September 15), while the ripening time of cultivar 'Antonina' was September 14. A significantly higher grape yield was found in the cultivars 'Kristina' (2.22 kg/m^2), 'Leontina' (2.28 kg/m^2) and 'Simona' (2.23 kg/m^2) compared to the standard cultivar (1.80 kg/m^2). The bunch weight in the cultivars 'Leontina' (523.6 g) and 'Valentina' (364.7 g) was also significantly higher compared to the standard cultivar (315.4 g). The berry weight in investigated newly created cultivars varied from 3.15 g to 3.89 g, while it was 3.64 g in the standard cultivar. All investigated cultivars had a higher sugar content in the must than the cultivar 'Muscat Hamburg' (17.3%), and it was significantly higher in the cultivars 'Kristina' (21.9%) and 'Leontina' (19.6%). All five newly created cultivars, unlike the standard cultivar, showed high or very high resistance to the most important fungal diseases (*Plasmopara viticola*, *Uncinula necator* and *Botrytis cinerea*), which makes them suitable for cultivation in organic production.

Keywords: grapevine, ripening time, yield, bunch and berry characteristics, resistance

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I/P1

ALELNI POLIMORFIZAM *MD-ACS1* I *MD-ACO1* GENA U NOVOPRIZNATIM SORTAMA JABUKE (*Malus* × *domestica* Borkh.)

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Stopa proizvodnje endogenog etilena igra važnu ulogu u kvalitetu ploda jabuke, posebno u čvrstoći i njenom održavanju tokom i nakon skladištenja. Preterano omekšavanje ploda jabuke je nepoželjno jer rezultira kratkim rokom trajanja i nižim kvalitetom, uključujući izgled, boju, teksturu i ukus. Proizvodnju etilena i omekšavanje ploda određuju mnogi faktori, a posebno primenjene pomotehničke mere i različiti režimi skladištenja. Međutim, velike razlike u održavanju čvrstoće između različitih sorti jabuke tokom skladištenja ukazuju na jaku genetsku osnovu ovog svojstva. *Md-ACS1* (1-aminociklopropan-1-karboksilat sintaza) i *Md-ACO1* (1-aminociklopropan-1-karboksilat oksidaza) su dva primarno eksprimirana i najviše proučavana gena uključena u proizvodnju etilena u plodovima tokom sazrevanja. Novopriznate sorte iz oplemenjivačkog programa Univerziteta u Novom Sadu odlikuju se visokom otpornošću na prouzrokovače najznačajnijih gljivičnih oboljenja, ili visokim procentom crvene dopunske boje, ili sa oba svojstva. Molekularni markeri za *Md-ACS1* i *Md-ACO1* korišćeni su za određivanje alelne konstitucije gena za proizvodnju etilena kod novopriznatih sorti 'Ivana', 'Iskra', 'Gordana' i 'Jerina', kao i četiri komercijalne sorte jabuke ('Gala', 'Crveni delišes', 'Zlatni delišes' i 'Greni Smit'). Sorte 'Jerina', 'Iskra' i 'Gordana' bile su heterozigotne za oba gena (*ACS1-1/2* i *ACO1-1/2*) što ukazuje na potencijalno srednje-nisku proizvodnju etilena. Sorta 'Ivana' je bila homozigotna za manje poželjan alel koji definiše normalnu proizvodnju etilena u oba gena (*ACS1-1/1* i *ACO1-2/2*). Sve standardne sorte su imale genotipove prema dosadašnjim nalazima literature. Uočeni rezultati ukazuju da se sve heterozigotne sorte ('Jerina', 'Iskra' i 'Gordana') mogu koristiti za dalje unapređenje, posebno ako se koriste kao roditelji u ukrštanju sa homozigotnim sortama koje imaju nisku proizvodnju etilena, kao što je 'Gala'.

Ključne reči: omekšavanje plodova, etilen, aleli, oplemenjivanje

Zahvalnica: Istraživanje je finansiralo Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije, na osnovu ugovora o realizaciji i finansiranju naučno-istraživačkog rada u 2024. godini, Poljoprivredni fakultet, Univerzitet u Novom Sadu, broj 451-03-66/2024-03/200117.

I/P1

ALLELIC POLYMORPHISM OF *MD-ACS1* AND *MD-ACO1* GENES IN NEWLY RECOGNIZED APPLE (*Malus* × *domestica* Borkh.) CULTIVARS

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Endogenous ethylene production rate plays an important role in apple fruit quality, specifically firmness and its retention during and after storage. The excessive apple fruit softening is undesirable because it results in short shelf life and lower eating quality, including appearance, color, texture, and flavor. Ethylene production and fruit softening is determined by many factors, notably, pomotechnical practices and storage regimes. However, great differences in firmness retention between apple cultivars during storage also suggest a strong genetic basis of this property. The *Md-ACS1* (1-aminocyclopropane-1-carboxylate synthase) and *Md-ACO1* (1-aminocyclopropane-1-carboxylate oxidase) are the two primarily expressed and most studied genes involved in ethylene production in fruits during ripening. Newly released cultivars from the University of Novi Sad apple breeding program are distinguished by high resistance to major fungal diseases, or a high percentage of red overcolor, or both. Molecular markers for *Md-ACS1* and *Md-ACO1* were used for the determination of the allelic constitution of ethylene production genes in newly recognized 'Ivana', 'Iskra', 'Gordana' and 'Jerina' and four commercial apple cultivars ('Gala', 'Delicious', 'Golden Delicious' and 'Granny Smith'). Cultivars 'Jerina', 'Iskra' and 'Gordana' were heterozygous for both genes (*ACS1-1/2* and *ACO1-1/2*) meaning that they should produce medium-low ethylene production. Cultivar 'Ivana' was homozygous for less favorable, normal ethylene production allele in both genes (*ACS1-1/1* and *ACO1-2/2*). All standard cultivars had genotypes according to previous literature findings. Observed results indicate that all heterozygous cultivars ('Jerina', 'Iskra' and 'Gordana') can be used for further improvement especially if they are crossed with homozygous cultivars that has low ethylene production, such as 'Gala'.

Keywords: fruit softening, ethylene, allele, breeding

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I/P2

MORFOLOŠKA OCENA, KVALITET I SENZORNE KARAKTERISTIKE NEKIH INTRODUKOVANIH SORTI JABUKE

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U radu su prikazani rezultati ocene pomoloških, fizičkih i hemijskih parametara plodova jabuke, koji određuju njihove kvalitativne karakteristike kao i senzorni profil. Ispitivanje je obuhvatilo šest introdukovanih sorti jabuka: Pinova, Honeycrisp, Candycrisp, Suncrisp, Cameo i Modi u poređenju sa dve najčešće gajene sorte: Idared i Golden Delicious. Plodovi svih sorti su proizvedeni u komercijalnim i oglednim zasadima u Resenu, Prespanski kraj, uzgajani po standardnoj tehnologiji proizvodnje za taj region. Stabla su kalemljena na podlogu M9. Pomološki i fizičko-hemijski parametri plodova (masa, dužina, prečnik, sadržaj rastvorljivih suvih materija, titrabilne kiseline i čvrstoća) mereni su u laboratoriji nakon berbe. Pored toga, mereni su sadržaj rastvorljivih suvih materija i čvrstoća nakon skladištenja plodova krajem decembra i krajem februara. Senzorno ocenjivanje obavljeno je u tri termina u sezoni - 30. oktobra, 29. decembra i 28. februara, dok je potencijalni potrošač ocenjivao jabuke po izgledu (obliku, veličini, boji), a zatim i po atributima kvaliteta u ishrani (tekstura, aroma, sočnost, hrskavost, ukus). Utvrđene su značajne razlike u fizičko-hemijskim osobinama plodova između sorti, kao i u različitim vremenima merenja. Na osnovu analize ocenjenih senzornih osobina, utvrđeno je da postoje razlike između sorti. Za neke sorte utvrđena je značajna razlika između njihovih ocena za izgled i ukus, kao i između različitih termina ocenjivanja. Na prvom senzornom ocenjivanju (krajem oktobra), prema ukupnom rezultatu, na prva dva mesta su bile sorte Honeycrisp (32,9) i Cameo (32,3). Rezultati ocenjivanja u narednim terminima pokazuju promenljivu prihvatljivost sorti jabuka u različitim periodima konzumne sezone, što je posledica potencijala skladištenja i metaboličkih promena koje se dešavaju u plodovima tokom skladištenja.

Ključne reči: *Malus* × *domestica* Borkh., sorta, procena, preferencija potrošača

I/P2

EVALUATION OF MORPHOLOGICAL, QUALITY AND SENSORY CHARACTERISTICS OF SOME INTRODUCED APPLE VARIETIES

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The paper presents the results of the evaluation of pomological, physical and chemical parameters of apple fruits that determine their quality characteristics as well as their sensory profile. The examination included six newly introduced apple varieties: Pinova, Honeycrisp, Candycrisp, Suncrisp, Cameo and Modi compared with two commonly grown varieties: Idared and Golden Delicious. The fruits of all varieties were produced in commercial and experimental orchards in Resen, Prespa region, grown according to standard production technology for the region. The trees were grafted on M9 rootstock. The pomological, and physicochemical parameters of the fruits (weight, length, diameter, soluble solids content, titratable acids, and firmness) were measured in the laboratory after harvest. In addition, the soluble solids content and firmness were measured after storage of fruits at the end of December and at the end of February. The sensory evaluation was performed in 3 terms in the season - on October 30, December 29 and February 28, while the potential consumer judging the apples on their appearance (shape, size, color) and then on their eating quality attributes (texture, aroma, juiciness, crispness, taste). Significant differences in the physico-chemical properties of the fruits between the varieties as well as between different measurement times were determined. Based on the analysis of the evaluated sensory properties, it was found that there were significant differences between the varieties. For some varieties, a significant difference was found between their ratings for appearance and taste, as well between different terms of evaluation. At the first sensory evaluation (end of October), according to total score Honeycrisp (32.9), and Cameo (32.3) varieties were in the top two places. The results of the evaluation in the next terms show a different acceptance of apple varieties in the different periods of the consumption season, which is due to the storage potential and the metabolic changes that occur in the fruit during storage.

Keywords: *Malus* × *domestica* Borkh., cultivar, assessment, consumer preference

I/P3

MORFOLOŠKE KARAKTERISTIKE RODNIH GRANČICA SORTI KRUŠKE

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U ovom radu prikazane su morfološke karakteristike rodnih grančica kod sedam ekonomski značajnih sorti kruške (Karmen, Moretinijeva rana, Santa Marija, Vilijamovka, Fetelova, Konferans i Kaluđerka) u dvogodišnjem periodu (2022-2023). Ispitivanjima su bile obuhvaćena tri tipa rodnih grančica: naborite, krute i vite rodne grančice. Kod pojedinih tipova rodnih grančica ispitivane su njihove dimenzije, broj mešovitih i vegetativnih pupoljaka. Između ispitivanih sorti utvrđene su značajne razlike u karakteristikama rodnih grančica. Kod sorte Santa Marija utvrđena je najmanja dužina naboritih i krutih rodnih grančica (1,4 cm i 6,2 cm). Najveća dužina naboritih rodnih grančica utvrđena je kod sorte Konferans (3,0 cm), a krutih rodnih grančica kod sorte Kaluđerka (10,8 cm). Pored terminalne pozicije, kod svih sorti, osim sorte Kaluđerka, utvrđeno je prisustvo po jednog do dva mešovita pupoljka i na bočnim pozicijama krutih rodnih grančica. Dužina vitih rodnih grančica varirala je u intervalu od 24,5 cm (Karmen) do 41,4 cm (Konferans), a prečnik od 4,6 mm (Santa Marija) do 6,3 mm (Karmen). Ako se izuzmu sorte Konferans i Kaluđerka, kod ostalih sorti utvrđeno je prisustvo mešovitih pupoljaka i na bočnim pozicijama vitih rodnih grančica. Najveći broj mešovitih pupoljaka na vitim rodnim grančicama utvrđen je kod sorti Vilijamovka (4,8) i Fetelova (4,3). Poznavanje morfoloških karakteristika rodnih grančica kruške može biti značajan parametar u determinaciji sorti. Pored toga, ono je veoma važno i u izvođenju pomotehničkih tretmana u gustoj sadnji kruške.

Ključne reči: *Pyrus communis*, sorta, naborite rodne grančice, krute rodne grančice, vite rodne grančice

Zahvalnica: Ovo istraživanje je realizovano u okviru ugovora o finansiranju naučnoistraživačkog radai zmeđu Univerziteta u Nišu, Poljoprivrednog fakulteta u Kruševcu i Ministarstva za nauku, tehnološki razvoj i inovacije Republike Srbije (br. 451-03-65/2024-03/200383).

I/P3

MORPHOLOGY OF FRUITING BRANCHES OF PEAR CULTIVARS

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In this study, the morphological characteristics of the fruiting branches of seven economically important pear cultivars (‘Carmen’, ‘Butirra Precoce Morettini’, ‘Santa Maria’, ‘Williams’, ‘Abbé Fétel’, ‘Conference’ and ‘Curé’) were investigated over a period of two years (2022-2023). The trials included three types of fruiting branches: one-year old spurs, short fruiting shoots and long fruiting shoots. For each type of fruiting branches, the dimensions, the number of mixed and vegetative buds was measured. Significant differences in the characteristics of the fruiting branches were found between the cultivars tested. The cultivar ‘Santa Maria’ had the shortest length of one-year old spurs and short fruiting shoots (1.4 cm and 6.2 cm). The longest length of one-year old spurs was found in the cultivar‘Conference’ (3.0 cm), and the short fruiting shoots in the cultivar ‘Curé’ (10.8 cm). In all cultivars, with the exception of ‘Curé’, one or two mixed buds were also observed in the lateral positions of the short fruiting shoots in addition to the terminal position. The length of the long fruiting shoots varied in an interval from 24.5 cm (‘Carmen’) to 41.4 cm (‘Conference’), and the diameter from 4.6 mm (‘Santa Maria’) to 6.3 mm (‘Carmen’). Apart from the cultivars ‘Conference’ and ‘Curé’, the presence of mixed buds at the lateral positions of the long fruiting shoots was observed in the other cultivars. The highest number of mixed buds on the long fruiting shoots was found in the cultivars ‘Williams’ (4.8) and ‘Abbé Fétel’ (4.3). The morphological characteristics of the fruiting branches of pears can be an important parameter for cultivar identification. In addition, they are very important parameters when carrying out pomotechnical treatments in dense pear orchards.

Keywords: *Pyrus communis*, cultivar, one-year old spurs, short fruiting shoots, long fruiting shoots

Acknowledgement: This study was realized within the contract for financing of scientific research between the University of Niš, Faculty of Agriculture in Kruševac and the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (No. 451-03-65/2024-03/200383).

I/P4

KARAKTERISTIKE NOVOSTVORENE POZNE SORTE BRESKVE 'LJUBINKA'

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U ovom radu proučavana je novostvorena pozna sorta breskve 'Ljubinka'. Za novu sortu breskve priznata je 2023. godine. Nastala je iz kombinacije ukrštanja 'Flaminia' × 'Hale Tardiva Spadoni' na Poljoprivrednom fakultetu, Univerziteta u Beogradu. Kao standard za poređenje korišćena je sorta 'Autumnglo'. Proučavanje je obavljeno u dvogodišnjem periodu (2021-2022). Ispitivane su najvažnije morfološke osobine, vreme sazrevanja, prinos, fizičke osobine ploda, hemijski sastav ploda i senzorička ocena kvaliteta ploda. Sorta 'Ljubinka' uglavnom ima veliku površinu tamnocrvene nijanse preko zeleno-žute osnovne boje pokožice i svetložuto meso. U odnosu na prijanjanje koštice za meso, plodovi sorte 'Ljubinka' su kalanke. Za sve ispitivane osobine sorta 'Ljubinka'je pokazala bolje vrednosti od standarda. Statistički značajne razlike utvrđene su za masu ploda, dužinu ploda i debljinu ploda. Vreme zrenja sorte 'Ljubinka' bilo je u proseku 06. septembra, a sorte standard 04. septembra. Sorta 'Ljubinka' je imala prinos 11,56 kg/stablu i masu ploda od 162,66 g, a sorta 'Autumnglo' je imala prinos od 9,67 kg/stablu i masu ploda od 128,09 g. Sadržaj rastvorljivih suvih materija i ukupnih kiselina kod sorte 'Ljubinka' bio je 17,41% odnosno 0,70%, a kod sorte standard 15,67% odnosno 0,56%. Sorta 'Ljubinka' imala je takođe bolji izgled, ukus i miris ploda od standardne sorte. Dobijeni rezultati pokazuju da sorta 'Ljubinka' može biti interesantna kao pozna, prinosna i kvalitetna sorta za širenje u proizvodnim zasadima Srbije.

Ključne reči: *Prunus persica*, vreme zrenja, prinos, pomološke osobine, kvalitet ploda

Zahvalnica: Ovaj rad je realizovan u okviru ugovora o finansiranju naučnoistraživačkog rada između Univerziteta u Beogradu, Poljoprivrednog fakulteta i Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (br. 451-03-65/2024-03/200116).

I/P4

CHARACTERISTICS OF THE NEWLY CREATED LATE PEACH CULTIVAR 'LJUBINKA'

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In this paper, the newly created late peach cultivar 'Ljubinka' was studied. It was recognized as a new peach cultivar in 2023. It was created from the crossing combination 'Flaminia' × 'Hale Tardiva Spadoni' at the Faculty of Agriculture, University of Belgrade. The 'Autumnglo' cultivar was used as the standard for the comparison. The study was conducted over a period of two years (2021-2022). The most important morphological traits, ripening time, yield, physical fruit characteristics, chemical composition of the fruit and sensory evaluation of fruit quality, were investigated. The 'Ljubinka' cultivar mostly has a large area of dark red hue over a greenish yellow skin ground color, and light, yellow flesh. In relation to the stone adherence to the flesh, fruits of 'Ljubinka' cultivar are freestone. For all tested characteristics, the cultivar 'Ljubinka' showed better values than the standard. Statistically significant differences were found for fruit weight, fruit length and fruit thickness. The ripening time of the 'Ljubinka' cultivar was on average September 6, and for the standard cultivar it was on September 4. The 'Ljubinka' cultivar had a yield of 11.56 kg/tree and a fruit weight of 162.66 g, while the 'Autumnglo' cultivar had a yield of 9.67 kg/tree and a fruit weight of 128.09 g. The soluble solids and total acid contents of the 'Ljubinka' cultivar were 17.41% and 0.70%, respectively, compared to 15.67% and 0.56%, for the standard cultivar. The 'Ljubinka' cultivar also had a better fruit appearance, taste and aroma than the standard cultivar. The results obtained show that the 'Ljubinka' cultivar can be interesting as a late, high-yielding and high-quality cultivar for to spread in production orchards in Serbia.

Keywords: *Prunus persica*, ripening time, yield, pomological characteristics, fruit quality

Acknowledgement: This paper was realized within the contract for financing of scientific research between the University of Belgrade, Faculty of Agriculture and the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (No. 451-03-65/2024-03/200116).

I/P5

UTICAJ PODLOGA NA BUJNOST I OSOBINE DUGIH RODNIH GRANČICA SORTI KAJSIJE

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U radu je ispitivan uticaj pet generativnih podloga (Krupna zelena renkloda, Belošljiva, Džanarika, Irokez i Crvena ranka) i jedne vegetativne podloge (Myrobalan 29c) na bujnost i morfološke osobine dugih rodnih grančica kod četiri sorte kajsije (Buda, Ruža, NS-4 i Novosadska rodna). Istraživanje je sprovedeno na Oglednom dobru "Radmilovac" Poljoprivrednog fakulteta u Beogradu u periodu od tri godine (2022-2024). Bujnost je određivana na osnovu površine poprečnog preseka debla (PPPD). Proučavane su sledeće osobine dugih rodnih grančica: dužina, debljina, broj generativnih i vegetativnih pupoljaka, njihov odnos i gustina (broj) generativnih pupoljaka po 1 m dužine rodne grančice. Sve ispitivane sorte su imale najveću prosečnu PPPD na podlozi Myrobalan 29c (83,81 cm^2), dok je najmanja vrednost istog parametra dobijena na podlozi belošljiva (54,52 cm^2). Vrednosti PPPD kod sorti kalemljenih na različitim podlogama su se statistički značajno razlikovale. Prosečan broj generativnih pupoljaka na dugim rodnim grančicama je bio najveći na podlozi Myrobalan 29c kod sorte Buda (76,00), a najmanji na podlozi belošljiva kod sorti Novosadska rodna (37,53) i NS 4 (34,80). Broj i gustina generativnih pupoljaka su se značajno statistički razlikovali kod ispitivanih podloga. Na osnovu dobijenih rezultata može se konstatovati da su podloge značajno uticale na bujnost i osobine dugih rodnih grančica ispitivanih sorata.

Ključne reči: *Prunus armeniaca*, podloga, bujnost, duge rodne grančice, generativni pupoljci

I/P5

INFLUENCE OF ROOTSTOCKS ON VIGOUR AND PROPERTIES OF LONG FRUITING BRANCHES IN APRICOT CULTIVARS

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This paper presents the results of studies on the influence of five seedling rootstocks (‘Green Gage’, ‘Belošljiva’, ‘MY-KL-A’ (Myrobalan seedling selection), ‘Iroquois’ and ‘Crvena ranka’) and one clonal rootstock (‘Myrobalan 29c’) on the vigour and morphological characteristics of the long fruiting branches of four apricot cultivars (‘Buda’, ‘Ruža’, ‘NS-4’ and ‘Novosadska Rodna’). The studies were carried out at the "Radmilovac" Experimental station of the Faculty of Agriculture in Belgrade over a period of three years (2022-2024). The vigour of the trees was determined on the bases of the trunk cross-sectional area (TCSA). The following characteristics of the long fruiting branches were analysed: length, thickness, number of flower buds and vegetative buds, their ratio and flower bud density (number of flower buds per 1 m length of fruiting branch). All investigated cultivars have the highest average TCSA on the rootstock ‘Myrobalan 29c’ (83.81 cm^2), while the lowest value of the same parameter was measured on the rootstock ‘Belošljiva’ (54.52 cm^2). The values of TCSA of the tested cultivars on the different rootstocks were statistically significantly different. The average number of flower buds on long fruiting branches was highest in the cultivar ‘Buda’ on the rootstock ‘Myrobalan 29c’ (76.00) and lowest in the cultivars ‘Novosadska Rodna’ (37.53) and ‘NS-4’ (34.80) on the rootstock ‘Belošljiva’. The rootstocks analysed had a statistically significant influence on the number and density of flower buds. The results allow the conclusion that the rootstocks have a significant influence on the vigour and characteristics of the long fruiting branches of the tested cultivars.

Keywords: *Prunus armeniaca,* rootstock, vigour, long fruiting twigs, flower buds

I/P6

DETERMINACIJA NAJBOLJIH OPRAŠIVAČA ZA SORTU TREŠNJE 'CANETOVA'

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Sorta trešnje 'Canetova' izdvojena je selekcijom iz prirodne populacije na Poljoprivrednom fakultetu Univerziteta u Beogradu i priznata je 2015. godine. Zbog pozitivnih pomoloških i proizvodnih osobina, ova sorta se preporučuje za komercijalno gajenje u Republici Srbiji. Kako je 'Canetova', kao i većina sorti trešnje samobesplodna, nameće se potreba izbora odgovarajućih oprašivača za njeno uspešno gajenje, što je bio i cilj ovog rada. Na osnovu identifikovanih *S*-haplotipova i rezultata višegodišnjih proučavanja fenofaze cvetanja, kao potencijalno dobri oprašivači za sortu 'Canetova' odabrane su sorte 'Burlat', 'Lapins' i 'Rita'. Tokom dvogodišnjeg perioda (2023–2024) određena je *in vitro* klijavost polena navedenih potencijalnih oprašivača. Takođe, ispitana je efikasnost rasta polenovih cevčica *in vivo* u stubiću i plodniku tučka sorte 'Canetova' primenom metode fluorescentne mikroskopije, kao i finalno zametanje plodova u svim kombinacijama ukrštanja, uključujući varijantu slobodnog oprašivanja. Prosečne vrednosti klijavosti polena *in vitro* potencijalnih oprašivača kretale su se od 29,75% ('Rita') do 38,56% ('Burlat'). Najniža brojnost polenovih cevčica u svim posmatranim regionima tučka utvrđena je u varijanti slobodnog oprašivanja, dok je najveći broj polenovih cevčica u gornjoj (33,78) i srednjoj (19,98) trećini, kao i u bazi (10,94) stubića utvrđen u kombinaciji oprašivanja polenom sorte 'Burlat'. Među ispitivanim oprašivačima, sorta 'Rita' je indukovala najveći broj polenovih cevčica u plodniku sorte 'Canetova' (3,18). Polenove cevčice sorti 'Lapins' i 'Rita' odlikovale su se najbržim rastom i desetog dana nakon oprašivanja prodrle su u nucleus semenog zametka kod prosečno 56,62%, odnosno 53,17% tučkova sorte 'Canetova'. Stoga su i najviše prosečne vrednosti finalnog zametanja plodova utvrđene u kombinacijama sa sortama 'Lapins' i 'Rita' kao oprašivačima (35,81 i 31,67%, po redosledu). Značajno niže vrednosti finalnog zametanja plodova sorte 'Canetova' dobijene su u varijanti slobodnog oprašivanja (24,04%), kao i u kombinaciji oprašivanja polenom sorte 'Burlat' (11,05%). Rezultati rada ukazuju da sorte 'Lapins' i 'Rita' predstavljaju adekvatne oprašivače za sortu 'Canetova'.

Ključne reči: *Prunus avium* L., klijavost polena *in vitro*, rast polenovih cevčica *in vivo*, zametanje plodova

Zahvalnica: Ova istraživanja su finansirana sredstvima Fonda za nauku Republike Srbije (GRANT No. 7739716), kao i sredstvima Ministarstva nauke, tehnološkog razvoja i inovacija RS (Ugovor o finansiranju broj 451-03-66/2024-03/200215).

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DETERMINATION OF THE BEST POLLENIZERS FOR SWEET CHERRY CULTIVAR 'CANETOVA'

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The sweet cherry cultivar 'Canetova' was selected from a natural population at the Faculty of Agriculture, University of Belgrade, and released in 2015. Due to its good pomological and production properties, this cultivar is recommended for commercial growing in the Republic of Serbia. Like most sweet cherry cultivars, 'Canetova' is self-incompatible, which imposes the need to choose suitable pollenizers for its successful cultivation. Based on the identified *S*-haplotypes and the results of many years of flowering phenophase investigations, the cultivars 'Burlat', 'Lapins' and 'Rita' were chosen as potentially good pollenizers for 'Canetova'. During the two-year period (2023–2024), the *in vitro* pollen germination of the aforementioned pollenizers was determined. In addition, the efficiency of pollen tube growth *in vivo* in the style and ovary of the 'Canetova' pistils was monitored using fluorescence microscopy, and the final fruit set was observed in all crossing combinations, as well as in the open pollination variant. The average values of *in vitro* pollen germination of the studied potential pollenizers ranged from 29.75% ('Rita') to 38.56% ('Burlat'). The lowest number of pollen tubes in all observed regions of the pistil was determined in the open pollination variant, while the highest number of pollen tubes in the upper (33.78) and middle (19.98) thirds, as well as in the base (10.94) of the style, was determined in the crossing combination with 'Burlat'. Among the assessed pollenizers, 'Rita' induced the highest number of pollen tubes in the ovary of the cultivar 'Canetova' (3.18). The pollen tubes of the cultivars 'Lapins' and 'Rita' exhibited the fastest growth and penetrated the nucleus in an average of 56.62% and 53.17% of 'Canetova' pistils, respectively. Therefore, the highest average values of final fruit set were determined when using the cultivars 'Lapins' and 'Rita' as pollenizers (35.81% and 31.67%, respectively). Significantly lower values of fruit set were noted in the open pollination variant (24.04%) and in the crossing combination with 'Burlat' (11.05%). The obtained results show that the cultivars 'Lapins' and 'Rita' are the suitable pollenizers for the cultivar 'Canetova'.

Keywords: *Prunus avium* L., *in vitro* pollen germination, pollen tube growth *in vivo*, fruit set

Acknowledgement: This work was supported by the Science Fund of the Republic of Serbia, (GRANT No. 7739716) and by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract number: 451-03-66/2024-03/200215).

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BIOLOŠKO-POMOLOŠKE OSOBINE POZNIH SORTI TREŠNJE NA PODRUČJU BEOGRADA

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U periodu od šest godina (2017–2022) na području Beograda ispitivane su fenološke osobine, bujnost, rodnost, kvalitet ploda i osetljivost na pucanje ploda deset sorti trešnje poznog vremena sazrevanja. Kao standard sorta je uzeta Germersdorfska. Najraniji prosečan datum početka cvetanja je imala sorta Lapins (1. april), a najkasniji sorta Linda (10. april). Vreme zrenja je bilo od 9. juna (Olympus) do 15. juna (Linda). Najmanji prosečan prinos po stablu imala je standard sorta Germersdorfska (3,4 kg), a najviši sorta Summer Sun (7,0 kg), koji je je jedini bio statistički značajno viši u odnosu na standard sortu. Značajno veću bujnost, izraženu preko površine poprečnog preseka debla, imala je samo sorta Linda. Prosečna masa ploda je bila najmanja kod sorti Summer Sun i Cristalina (8,0 odnosno 8,1 g). Najveću masu ploda (10,2 g) imala je sorta Sunburst i ona je bila statistički značajno viša u odnosu na kontrilu. Sadržaj rastvorljive suve materije je varirao od 17,6% (Olympus i Ferrovia) do 19,6% (Linda), a sadržaj ukupnih kiselina je bio u intervalu od 0,72% (Cristalina) do 0,97% (Summer Sun). Najviše ocene za izgled ploda dobile su sorte Linda i Olylmpus, za čvrstoću ploda sorta Cristalina, a za ukus ploda sorte Germersdorfska i Kordia. Najmanju osetljivost na pucanje ploda je imala sorta Kordia, dok su najosetljivije bile sorte Linda, Cristalina i Summer Sun. Na osnovu dobijenih rezultata, sveukupno najbolje rezultate pokazala je sorta Kordia, posebno u pogledu kvaliteta ploda i manje osetljivosti na pucanje.

Ključne reči: *Prunus avium*, cvetanje, prinos, kvalitet ploda, pucanje ploda

Zahvalnica: Ovo istraživanje je realizovano u okviru ugovora o finansiranju naučnoistraživačkog rada između Univerziteta u Beogradu, Poljoprivrednog fakulteta i Ministarstva za nauku, tehnološki razvoj i inovacije Republike Srbije (br. 451-03-65/2024-03/200116).

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BIOLOGICAL AND POMOLOGICAL CHARACTERISTICS OF LATE SEASON SWEET CHERRY CULTIVARS IN THE BELGRADE REGION

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Over a period of six years (2017–2022), the phenological characteristics, vigor, yield, fruit quality and susceptibility to fruit cracking of ten late-season sweet cherry cultivars were investigated in the Belgrade region. The cultivar 'Germersdorfer' was used as a reference cultivar. The cultivar 'Lapins' had the earliest average start of flowering (April 1), while the cultivar 'Linda' had the latest (April 10). The ripening time was between June 9 ('Olympus') and June 15 ('Linda'). The lowest average yield per tree was recorded for the reference cultivar 'Germersdorfer' (3.4 kg), the highest for the cultivar 'Summer Sun' (7.0 kg), which was the only one statistically significantly higher than the reference cultivar. The cultivar 'Linda' showed a significantly higher vigor, expressed as trunk cross-sectional area. The average fruit weight was lowest for the 'Summer Sun' and 'Cristalina' cultivars (8.0 and 8.1 g, respectively). The cultivar 'Sunburst' had the highest fruit weight (10.2 g), which was statistically significantly higher than that of the reference cultivar. The soluble solids content ranged from 17.6% ('Olympus' and 'Ferrovia') to 19.6% ('Linda'), and the total acidity ranged from 0.72% ('Cristalina') to 0.97% ('Summer Sun'). The cultivars 'Linda' and 'Olylmpus' received the best marks for fruit appearance, 'Cristalina' for firmness and 'Germersdorfer' and 'Kordia' for taste. The cultivar 'Kordia' was the least sensitive to fruit cracking, while the cultivars 'Linda', 'Cristalina' and 'Summer Sun' were the most sensitive. Based on the results obtained, the cultivar 'Kordia' showed the best results overall, especially in terms of fruit quality and lower susceptibility to cracking.

Keywords: *Prunus avium*, flowering, yield, fruit quality, fruit cracking

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UTICAJ PODLOGE NA PUCANJE PLODOVA SORTI TREŠNJE

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Pucanje plodova trešnje, uzrokovano kišom pre berbe predstavlja jedan od najznačajnijih faktora gubitka prinosa u mnogim proizvodnim područjima, izazivajući ogromne komercijalne gubitke širom sveta. Iako je pucanje plodova trešnje predmet istraživanja već duži niz godina, postignut je mali napredak u razumevanju metaboličkih osnova koje utiču na osetljivost različitih sorti na pucanje. Mnogi mehanizmi koji dovode do pucanja ploda tesno su povezani i sa tehnologijom gajenja. Iako dosadašnja istraživanja ukazuju da je najveći uzrok pucanja direktno prodiranje vode kroz pokožicu ploda, pucanje plodova može nastati i indirektnim prodiranjem vode u plod. Indeks pucanja ploda testiran je tokom dve uzastopne godine (2020. i 2021). Ispitivan je uticaj jedne generativne podloge (sejanac magrive) i pet vegetativnih podloga (Kolt, Oblačinska višnja, M×M 14, Gizela 6 i Gizela 5) na indeks pucanja ploda kod tri sorte trešnje (Karmen, Kordija i Regina). Dobijeni rezultati ukazuju da je na indeks pucanja ploda značajan uticaj ostvaren tokom različitih klimatskih uslova u ispitivanim godinama. Indeks pucanja ploda varirao je od 5,2 u prvoj godini, do 51,2 u drugoj godini ispitivanja. Prosečno najmanji indeks pucanja ploda ostvaren je pod uticajem podloge Gizela 6 (15,3), dok je najveći indeks zabeležen kod svih ispitivanih sorti koje su kalemljene na podlogu Oblačinska višnja. Na osnovu iznetih rezultata, može se smatrati da je izbor adekvatne podloge pri podizanju zasada jedan od načina za smanjenje pucanja ploda.

Ključne reči: trešnja, indeks pucanja ploda, podloga, sorta

Zahvalnica: Ovaj rad je realizovan u okviru ugovora o finansiranju naučnoistraživačkog rada između Univerziteta u Beogradu, Poljoprivrednog fakulteta i Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (br. 451-03-65/2024-03/200116).

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IMPACT OF ROOTSTOCK ON FRUIT CRACKING IN SWEET CHERRY CULTIVARS

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Sweet cherry fruit cracking caused by pre-harvest rain is one of the most important factors leading to yield loss in many production areas, causing substantial commercial losses worldwide. Although cherry fruit cracking has been the subject of research for many years, little progress has been made in understanding the metabolic basis that influences the susceptibility of different cultivars to cracking. Many of the mechanisms that lead to fruit cracking are closely related to cultivation technology. While previous research indicates that the primary cause is the direct penetration of water through the fruit skin, cracking can also be caused by the indirect water penetration into the fruit. The fruit cracking index was tested during two consecutive years (2020 and 2021). The influence of a seedling rootstock (Mahaleb seedling) and five clonal rootstocks (Colt, Oblacinska sour cherry, M×M 14, Gisela 6, and Gisela 5) on the fruit cracking index of three cherry varieties (Carmen, Kordia, and Regina) was examined. The results indicate that the fruit cracking index was significantly influenced by the different climatic conditions in the years studied. The fruit cracking index varied from 5.2 in the first year to 51.2 in the second year of testing. The lowest index was achieved under the influence of the Gisela 6 rootstock (15.3), while the highest fruit cracking index was recorded for all varieties grafted onto the Oblacinska sour cherry rootstock. On the basis of the present results, the choice of a suitable rootstock when establishing orchards can be considered as one of the ways to reduce fruit skin cracking.

Keywords: sweet cherry, fruit cracking index, rootstocks, cultivar

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IDENTIFIKACIJA S-HAPLOTIPA SORTI I PERSPEKTIVNIH SELEKCIJA VIŠNJE STVORENIH U INSTITUTU ZA VOĆARSTVO, ČAČAK

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Višnja (*Prunus cerasus* L.) je tetraploidna vrsta voćaka koja obuhvata samooplodne, delimično samooplodne i samobesplodne genotipove. Imajući u vidu poliploidnu prirodu, njena genetička osnova samooplodnosti/samobesplodnosti je složenija u poređenju sa diploidnim vrstama roda *Prunus*. Rad na oplemenjivanju višnje u Institutu za voćarstvo, Čačak ima višedecenijsku tradiciju i rezultirao je priznavanjem pet sorti – dve u ranijem periodu i tri nove sorte priznate 2015. godine. U skladu sa ciljevima oplemenjivanja višnje u svetu, dobijanje samooplodnih sejanaca je takođe jedan od prioriteta u okviru programa stvaranja novih sorti Instituta za voćarstvo, Čačak. U radu su predstavljeni rezultati identifikacije *S*-haplotipa (aleli *S-RNaze* i *SFB* gena) kod pet priznatih sorti ('Čačanski rubin', 'Iskra', 'Nevena', 'Sofija' i 'Šumadinka') i dve perspektivne selekcije ('GV-6' i 'GV-10') višnje koje se trenutno nalaze u postupku priznavanja za nove sorte. Identifikacija je bazirana na metodi lančane reakcije polimeraze (PCR metoda), koristeći: i) dva različita para konsenzusnih prajmera specifičnih za drugi intron *S-RNaze*, ii) dostupne alel-specifične prajmere za oba gena *S*-lokusa; iii) genetičke testove za razlikovanje funkcionalnih i nefunkcionalnih varijanti *S-RNaza* i *SFB*-a (upotrebom dCAPS i insert-specifičnih prajmera), iv) DNK fragment analizu regiona prvog introna *S-RNaze*, i v) sekvenciranje odabranih PCR proizvoda. Identifikovano je ukupno sedam *S*-haplotipova (S_1, S_4, S_6, S_9, S_{13}, S_{35} i S_{36}), uključujući mutirane varijante gena koji determinišu inkompatibilni fenotip polena i stubića. Kompletni *S*-haplotipovi su određeni kod pet genotipova, dok su po tri *S*-haplotipa identifikovana kod sorte 'Sofija' i perspektivne selekcije 'GV-6'. Utvrđeno je da su u ispitivanom materijalu funkcionalne varijante S_1-haplotipa i nefunkcionalna varijanta S_{36b2} najzastupljeniji aleli, sa frekvencijom od 20%. Rezultati ovog istraživanja su od posebnog značaja za planiranje ukrštanja u okviru budućih oplemenjivačkih programa, posebno onih usmerenih ka dobijanju samooplodnih sejanaca. Takođe su ključni za pravilno određivanje adekvatnih sortnih kompozicija oprašivača u komercijalnim zasadima, u svrhu opšteg podizanja nivoa proizvodnje ove vrste voćaka.

Ključne reči: *Prunus cerasus* L., *S-RNaza*, *SFB*, *S*-lokus, gametofitna samo-inkompatibilnost

Zahvalnica: Istraživanja u ovom radu su realizovana sredstvima Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (Ugovor br. 451-03-66/2024-03/200215) i Fonda za nauku Republike Srbije po programu IDEJE – CherrySeRB (Ugovor br. 7739716).

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IDENTIFICATION OF *S*-HAPLOTYPE IN SOUR CHERRY CULTIVARS AND PROMISING SELECTIONS DEVELOPED AT FRUIT RESEARCH INSTITUTE, ČAČAK

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Sour cherry (*Prunus cerasus* L.) is a tetraploid fruit species that includes self-compatible (SC), partially SC and self-incompatible (SI) genotypes. Due to its polyploid nature, sour cherry exhibits more complex genetics in SC/SI compared to diploid *Prunus* species. Sour cherry breeding work at the Fruit Research Institute, Čačak (FRI) has a decades-long tradition, resulting in five cultivars that have been named and released so far (two in the previous period and three in 2015). The development of SC sour cherry genotypes is a high priority among the other FRI breeding goals, as well as worldwide. This study was undertaken primarily to identify the *S*-haplotypes (*S-RNase* and *SFB* alleles) in the cultivars released within the FRI breeding programme ('Čačanski Rubin', 'Iskra', 'Nevena', 'Sofija' and 'Šumadinka') and two promising sour cherry genotypes ('GV-6' and 'GV-10') that are undergoing the procedure of recognition as new cultivars. The identification was based on the polymerase chain reaction (PCR) method, using two different consensus primer pairs specific to the second intron of *S-RNase*, allele-specific primers for both genes of *S*-locus, genetic tests to reveal the pollen-part and stylar-part mutants (using dCAPS and insert specific primers), DNA fragment analysis to amplify the *S-RNase* first intron, and sequencing of PCR products. In total, seven *S*-haplotypes (S_1, S_4, S_6, S_9, S_{13}, S_{35} and S_{36}), including their pollen-part or stylar-part mutants, were identified. Complete *S*-haplotypes were determined in five genotypes; three *S*-haplotypes were identified in the cultivar 'Sofija' and the promising selection 'GV-6'. Among the assessed cultivars and selections, the functional variant S_1 and the non-functional variant S_{36b2} were the most frequent, each occurring in 20% of the haplotypes. The obtained results provide important information for future cross-breeding programmes aimed at maximizing the number of SC seedlings, as well as for orchard management to achieve high-yielding sour cherry production.

Keywords: *Prunus cerasus* L., *S-RNase*, *SFB*, *S*-locus, gametophytic self-incompatibility

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ISPITIVANJE SAMOOPLODNOSTI GENOTIPOVA VIŠNJE STVORENIH U INSTITUTU ZA VOĆARSTVO, ČAČAK

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Oplođenje kod višnje (*Prunus cerasus* L.) je kontrolisano biološkim mehanizmom gametofitne samo-inkompatibilnosti (GSI). Iako se manifestuje na sličan način kao kod drugih vrsta familije *Rosaceae*, GSI kod višnje je znatno kompleksniji zbog tetraploidne prirode i postojanja funkcionalnih i nefunkcionalnih alelnih formi oba gena *S*-lokusa koji se eksprimiraju u stubiću i polenu. Ovaj fenomen uslovljava samooplodnost, delimičnu samooplodnost i samobesplodnost u reproduktivnom ponašanju, kao i potrebu za oprašivačima u komercijalnim zasadima višnje. Ispitivanje statusa samooplodnosti sorti/selekcija stvorenih u Institutu za voćarstvo, Čačak 'Šumadinka' ('Köröser Weichsel' × 'Heimanns Konserven Weichsel'), 'Sofija' ('Čačanski Rubin' × 'Heimanns Konserven Weichsel'), 'Nevena' ('Köröser Weichsel' × 'Heimanns Konserven Weichsel'), 'V/106' ('Köröser Weichsel' × 'Heimanns Konserven Weichsel'), 'GV-6' i 'GV-10' (izdvojene iz prirodne populacije u okolini Čačka), sprovedeno je u dvogodišnjem periodu, u poređenju sa standardnom sortom 'Heimanns Konserven Weichsel'. Istraživanje je uključivalo polinacioni ogled u polju, monitoring parametara efikasnosti rasta polenovih cevčica *in vivo* metodom fluorescentne mikroskopije, kao i zametanja plodova pri samooprašivanju. Kod genotipova 'Nevena', 'V/106' i 'GV-10', polenove cevčice su svoj rast završavale pretežno u gornjoj i srednjoj trećini stubića, sa sporadičnim prodorima u niže regije tučka. Dinamika rasta polenovih cevčica je bila efektivnija u stubićima sorti 'Šumadinka', 'Heimanns Konserven Weichsel' i 'Sofija' – kod ovih sorti, polenove cevčice su svoj rast završavale u mikropili trećeg dana, a u nucelusu semenog zametka desetog dana nakon samooprašivanja. Na osnovu stepena fertilizacije (0,00%; 2,78% i 0,00%, po redosledu) i zametanja plodova (0,00%; 0,00% i 0,10%, po redosledu), genotipovi 'Nevena', 'V/106' i 'GV-10' se mogu svrstati u grupu samobesplodnih, dok 'Šumadinka' (17.92%; 16.31%, po redosledu) i 'Heimanns Konserven Weichsel' (18,75%; 17,50%, po redosledu) pripadaju samooplodnim sortama. Sa relativno visokim vrednostima stepena fertilizacije (21,05%; 23,18%, po redosledu), ali nižim vrednostima zametanja plodova pri samooprašivanju (11,57%; 7,24%), 'Sofija' i 'GV-6' se mogu svrstati u kategoriju delimično samooplodnih genotipova višnje.

Ključne reči: *Prunus cerasus*, sorta, samooprašivanje, polenove cevčice, zametanje plodova

Zahvalnica: Istraživanja u ovom radu su realizovana sredstvima Ministarstva nauke, tehnološkog razvoja i inovacija RS (Ugovor br. 451-03-66/2024-03/200215) i Fonda za nauku Republike Srbije po programu IDEJE – CherrySeRB (Ugovor br. 7739716).

I/P10

EXAMINATION OF SELF-(IN)COMPATIBILITY IN SOUR CHERRY GENOTYPES DEVELOPED AT FRUIT RESEARCH INSTITUTE, ČAČAK

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Fertility in sour cherry (*Prunus cerasus* L.) is controlled by a gametophytic self-incompatibility (GSI) system. Despite the fact it's manifests similarly to other *Rosaceae* species, GSI in sour cherries is more complex due to tetraploidy and the presence of pollen-part and stylar-part mutants that cause genetic changes at *S*-locus. The phenomenon implies self-incompatible, partially self-compatible and self-compatible reproductive behavior of sour cherry genotypes, as well as requirement for pollenisers in commercial orchards. Self-(in)compatibility status of sour cherry cultivars/selections realized at Fruit Research Institute, Čačak 'Šumadinka' ('Köröser Weichsel' × 'Heimanns Konserven Weichsel'), 'Sofija' ('Čačanski Rubin' × 'Heimanns Konserven Weichsel'), 'Nevena' ('Köröser Weichsel' × 'Heimanns Konserven Weichsel'), 'V/106' (Köröser Weichsel × 'Heimanns Konserven Weichsel'), 'GV-6' and 'GV-10' (both selected from natural population in the Čačak vicinity) was examined over two years, and compared to standard 'Heimanns Konserven Weichsel'. Examination included self-pollination experiment in the field, monitoring the parameters of pollen tubes growth efficacy *in vivo* by fluorescent microscopy, and fruit set recording. In the pistils of 'Nevena', 'V/106' and 'GV-10', pollen tubes ended their growth predominantly in the upper and middle parts of the style, with sporadically penetrated tubes in lower pistil's part. Pollen tubes kinetics was more efficient in the styles of 'Šumadinka', 'Heimanns Konserven Weichsel' and 'Sofija', being in the micropyle on the 3rd day, and in the nucellus of the ovary on the 6th day after pollination. According to fertilization percentage (0.00%; 2.78% and 0.00%, respectively) and fruit set (0.00%; 0.00% and 0.10%, respectively), 'Nevena', 'V/106' and 'GV-10' could be classified as self-incompatible cultivars, whereas 'Šumadinka' (17.92%; 16.31%, respectively) and 'Heimanns Konserven Weichsel' (18.75%; 17.50%, respectively) behaved as self-compatible. Showing relatively high values of fertilization percentage (21.05%; 23.18%, respectively), but lower values of fruit set (11.57%; 7.24%) after selfing, 'Sofija' and 'GV-6' could be classified as partially self-compatible genotypes.

Keywords: *Prunus cerasus*, cultivar, self-pollination, pollen tubes, fruit set

Acknowledgement: This study was supported by the Ministry of Science, Technological Development and Innovation of the RS (Contract number: 451-03-66/2024-03/200215) and the Science Fund of the RS, program IDEAS – CherrySeRB (Grant No. 7739716).

I/P11

SELEKCIJA HIBRIDA BADEMA U BEOGRADSKOM PODRUČJU

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Badem se u Srbiji gaji na okućnici i u samo nekoliko manjih zasada. U našim agroekološkim uslovima je moguće gajiti badem i u većim komercijalnim zasadima. Tokom godina rada na kolekcionisanju, hibridizaciji, selekciji i evaluaciji izdvojeno je više genotipova badema sa poboljšanim osobinama. Tokom 2022. i 2023. godine obavljena su ispitivanja fenoloških karakteristika, produktivnosti i kvaliteta ploda četiri hibrida badema i standardne sorte 'Tuono' u beogradskom regionu. U poređenju sa sortom 'Tuono' hibrid 2018/4 je cvetao četiri dana ranije, dok je hibrid 2018/1 cvetao jedan dan kasnije. Najduži period cvetanja je zabeležen kod hibrida 2018/4 (19 dana). Najranije vreme zrenja (24. avgust) je imao hibrid 2017/2, a najkasnije hibrid 2018/4 (29. avgust). Prosečna ocena produktivnosti je bila najniža kod hibrida 2017/2 (2,3), dok je najveću ocenu dobio hibrid 2018/4 (4,4). Randman jezgre je kod hibrida 2017/2 bio najniži (21,1%), a kod hibrida 2018/4 je bio najviši (32,8%). Najviši sadržaj ulja je utvrđen kod hibrida 2018/4 (56,3%), dok su jezgre sorte 'Tuono' imali najniži sadržaj (48,2%). Na osnovu sadržaja amigdalina koji je varirao od 0,78 g/100 g (hibrid 2018/4) do 0,86 g/100 g (hibrid 2017/2) svi hibridi imaju slatku jezgru, za razliku od sorte 'Tuono' čija je jezgra blago gorka (1,32 g/100 g). Antioksidativni kapacitet (DPPH EC $_{50}$) je bio najveći kod sorte 'Tuono' (1,63), a zatim kod hibrida 2018/4. Hibrid 2018/4 je pokazao najbolje rezultate u pogledu produktivnosti, randmana jezgre i sadržaja ulja, pa se može smatrati perspektivnim za gajenje u agroekološkim uslovima Srbije.

Ključne reči: *Prunus dulcis*, hibrid, cvetanje, produktivnost, randman jezgre, kvalitet

Zahvalnica: Ovaj rad nastao kao rezultat finansiranja naučnog istraživanja između Poljoprivrednog fakulteta Univerziteta u Beogradu i Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (broj ugovora: 451-03-65/2024-03/200116).

I/P11

ALMOND HYBRID SELECTION IN THE BELGRADE AREA

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In Serbia, almonds are grown in home gardens and only in a few small plantations. Under our agro-ecological conditions, it is possible to grow almonds in larger commercial plantations. Through years of collection, hybridization, selection and evaluation work, almond hybrids with more positive characteristics have been obtained. A comparative evaluation of phenological characteristics, productivity and kernel quality of four almond hybrids and the cultivar 'Tuono' was carried out in 2022 and 2023 in the Belgrade region. Compared to 'Tuono', the time of flowering onset ranged from 5 days earlier (hybrid 2018/4) to 1 day later (hybrid 2018/1). The longest flowering period was observed in hybrid 2018/4 (19 days). The earliest harvest date (August 24) was recorded for hybrid 2017/2, while hybrid 2018/4 had the latest (August 29). The average productivity was lowest for hybrid 2017/2 (score 2.3), and highest for hybrid 2018/4 (score 4.4). Kernel percentage was lowest in hybrid 2018/2 (21.1%) and highest in hybrid 2018/4 (32.8%). The oil content ranged from 56.3% (hybrid 2018/4) to 48.2% ('Tuono'). Based on the amygdalin content, which varied from 0.78 g/100 g (hybrid 2018/4) to 0.86 g/100 g (2017/2), all hybrids have a sweet kernel, except for the cultivar 'Tuono', which has a slightly bitter kernel (1.32 g/100 g). In terms of antioxidant capacity (DPPH EC 50), the highest value was determined for the cultivar 'Tuono' (1.63), followed by hybrid 2018/4. Hybrid 2018/4 showed the best results in terms of productivity, highest kernel percentage and oil content, so it can be considered promising for cultivation under Serbian agro-ecological conditions.

Keywords: *Prunus dulcis*, hybrid, flowering, productivity, kernel percentage, quality

Acknowledgement: This paper was realized within the contract for financing of scientific research between the University of Belgrade, Faculty of Agriculture and the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (No. 451-03-65/2024-03/200116).

I/P12

POMOLOŠKE OSOBINE PLODA PITOMOG KESTENA (*Castanea sativa* Mill.) NA PODRUČJU SKADARSKOG JEZERA

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U cilju inventarizacije i monitoringa populacija pitomog kestena na području Skadarskog jezera, data je kompletna morfološka karakterizacija ploda 30 genotipova kestena. Definisano je 15 morfoloških karakteristika, od čega je, prema međunarodnom deskriptoru za pitomi kesten (UPOV, 1989) analizirano i opisano devet osobina ploda (oblik i boja ploda, veličina i kontrast hiluma, sjaj ploda, prijanjanje omotača za jezgru, stepen prodiranja omotača u jezgru, šupljina unutar jezgra i boja mesa jezgre). Preostale karakteristike ploda su merene (dužina, visina, debljina, masa ploda i masa jezgre) odnosno izvedene iz istih (randman jezgre). Utvrđena je velika varijabilnost u ispitivanim parametrima, zavisno od genotipa. Genotip S15 izdvojio se oblikom (poprečno širok) i bojom (crno-smeđa) ploda. Takođe, bio je značajno najveće dužine (32,01 mm), širine (32,97 mm), debljine (22,89 mm) i mase (11,05 g) ploda. Najveći randman jezgre zabeležen je kod genotipa S7 (87,53%), a potom i kod S9 (87,11%) i S8 (87,06%). Najmanji randman jezgre u proseku utvrđen je kod genotipa S20 (81,83%). Ekstrakt jezgre genotipa S15, izdvojenog kao najboljeg, pokazao se kao veoma bogat izvor ukupnih fenola (23,36 mg GAE/ml), sa veoma velikom sposobnošću da neutrališe slobodni DPPH• radikal (31,08 mg TE/ml), ali je istovremeno imao niži sadržaj ukupnih flavonoida (15,28 mg RE/ml). Ustanovljen je visok stepen varijabilnosti ispitivanih genotipova u svim pomološkim karakteristikama, te se ovo područje može okarakterisati kao značajan prirodni genetički resurs pitomog kestena.

Ključne reči: *Castanea sativa* Mill., plod, morfometrija, jezgra, hemijska svojstva

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POMOLOGICAL FRUITS CHARACTERISTICS OF CHESTNUT (*Castanea sativa* Mill.) IN THE AREA OF SKADAR LAKE

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For the purpose of inventory and monitoring of chestnut populations in the area of Skadar Lake, a complete morphological characterization of the fruit of 30 chestnut genotypes was given. Fifteen morphological characteristics were defined, of which, according to the International Chestnut Descriptor (UPOV, 1989), nine fruit characteristics were analyzed and described (nut shape and colour, size and contrast of hilum, glossiness, adherence of pellicle to kernel, degree of penetration of seed coat into embryo, cavity inside the flesh, colour of flesh). The remaining characteristics of the fruit were measured (length, height, thickness, nut weight and kernel weight) or derived from them (nutpercentage). Great variability was found in the examined parameters, depending on the genotype. Genotype S15 was distinguished by the shape (transversely wide) and color (black-brown) of the nut. Also, it was significantly the largest in length (32.01 mm), width (32.97 mm), thickness (22.89 mm) and weight (11.05 g) of the nut. The highest kernel percentage was recorded with genotype S7 (87.53%), followed by S9 (87.11%) and S8 (87.06%). The lowest kernel percentage on average was found with genotype S20 (81.83%).The kernel extract of genotype S15, selected as the best, proved to be a very rich source of total phenols (23.36 mg GAE/ml), with a very high ability to neutralize the free DPPH• radical (31.08 mg TE/ml), but it has at the same time a lower content of total flavonoids (15.28 mg RE/ml). A high degree of variability of the examined genotypes in all pomological characteristics has been established, and this area can be characterized as a significant natural genetic resource of the European chestnut.

Keywords: *Castanea sativa* Mill., fruit, morphometry, kernel, chemical properties

I/P13

PROTOKOL ZA PRED-SELEKCIJU PATULJASTIH VARIJETETA RUŽE

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Ruže (*Rosa* sp.) obuhvataju veliki broj varijeteta koji pronalaze svoje mesto ne samo u uređenju zatvorenih i otvorenih zelenih prostora, već i kao sveže voće, zatim u farmaceutskoj i prehrambenoj industriji. Zbog velikog značaja i mogućnosti koje njihova upotreba pruža, predmet su konstantnog oplemenjivačkog rada, sa ciljem kreiranja varijeteta koji mogu da odgovore na nepovoljne uslove okruženja izazvane klimatskim promenama, ali i specifične zahteve krajnjih korisnika. Jedna od važnih osobina prilikom odabira varijeteta jeste i njihova bujnost. Kako je testiranje potencijalnih varijeteta sa željenim osobinama dug i složen proces, potrebno je ispitati mogućnosti brže selekcije. Cilj ovog rada bio je da se ispita povezanost anatomskih osobina stabla – provodnih tkiva i elemenata, sa bujnošću ispitivanih varijeteta. U decembru 2023. godine, prikupljeni su jednogodišnji izdanci dve sorte *Rosa* × *hybrida* L.: 'Morava Reka' (MR), žbun srednje bujnosti koji dostiže visinu od 50 cm, i 'Milky Pixie' (MP), minijaturna 'patio' ruža visine do 30 cm. Poprečni preseci stabla su posmatrani na svetlosnom mikroskopu Motic Digital BA310, nakon čega su anatomski parametri mereni u programu Motic Images Plus 2.0 (Motic China Group Co., Ltd., Xiamen, Fujian, Kina). Rezultati su ukazali na izražene razlike u anatomskim osobinama sorti različite bujnosti. Sorta veće bujnosti odlikovala se većim udelom ksilema (57,3%) u odnosu na površinu preseka, u poređenju sa patuljastom sortom MP kod koje je utvrđena vrednost od svega 14,6%. Isto je ustanovljeno i u pogledu floema, sa udelom od 9,2% kod MR i 3,2% kod MP. Prosečna vrednost traheja kod MR iznosila je 751,8 μm^2, što je bilo tri puta veće od vrednosti dobijene kod MP (254,5 μm^2). Može se zaključiti da veća hidraulična provodljivost ksilema, ukazuje na veću bujnost biljaka. Stoga se otvara mogućnost korišćenja navedenog anatomskog pristupa u pred-selekciji varijeteta ruža patuljastog rasta, čime se znatno skraćuje postupak masovne selekcije.

Ključne reči: anatomija, bujnost, provodna tkiva, *Rosa* × *hybrida* L.

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

I/P13

PROTOCOL FOR PRE-SELECTION OF DWARF GARDEN ROSE VARIETIES

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Roses (*Rosa* sp.) encompass a large number of varieties that find their place not only in the landscaping of indoor and outdoor green spaces, but also as a fresh fruit, or in the pharmaceutical and food processing industries. They are the subject of constant breeding work aimed at creating varieties that can respond to unfavorable environmental conditions and specific requests of final users. One of the important characteristics when selecting varieties is their vigor. Since testing potential varieties with desired features is long and complex, the possibilities for faster selection need to be explored. This study aimed to investigate the connection between the stem anatomical traits – the conducting tissues and elements, and the vigor of the investigated varieties. In December 2023, one-year-old stems from two varieties of *Rosa* × *hybrida* L. were sampled: 'Morava Reka' (MR), a medium-sized shrub reaching up to 50 cm in height, and 'Milky Pixie' (MP), a miniature patio shrub growing up to 30 cm in height. The anatomical parameters were observed and measured using a Motic Digital BA310 light microscope, and Motic Images Plus 2.0 software (Motic China Group Co., Ltd., Xiamen, Fujian, China). The results indicated significant differences in the anatomical traits of varieties with different vigor. The variety characterized by higher vigor had a higher xylem share of 57.3% relative to the cross-section area, compared to the dwarf variety MP (14.6%). The same was determined for the phloem, with a share of 9.2% in MR and 3.2% in MP stems. The average vessel lumen area in MR was 751.8 μm^2, which was three times higher than the value calculated in MP (254.5 μm^2). It can be concluded that a higher xylem hydraulic conductivity, indicates higher plant vigor. This opens up the possibility of using the proposed anatomical approach in pre-selecting dwarf rose varieties, significantly shortening the mass selection process.

Keywords: anatomy, vigor, conducting tissues, *Rosa* × *hybrida* L.

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I/P14

POKAZATELJI RODNOSTI I FENOLOŠKE KARAKTERISTIKE RAZLIČITIH GRUPA SORTI VINOVE LOZE

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U Republici Srbiji gaje se sorte koje pripadaju različitim ekološko-geografskim grupama, a gaje se i stvorene sorte vinove loze. Ovaj rad imao je za cilj da predstavi razlike između grupa sorti u vrednostima pokazatelja rodnosti (broj cvasti po pupoljku) i fenologiji (godišnjem ciklusu razvoja). Na Oglednom polju za vinogradarstvo u Sremskim Karlovcima tokom 2023. i 2024. godine ispitivane su sorte koje pripadaju *pontica-balkanica* ('Bagrina', 'Beli bakator', 'Bela dinka', 'Skadarka', 'Stanušina'), *occidentalis-gallica* ('Šardone', 'Traminac') grupama sorti, kao i stvorene vinske sorte ('Müller-thurgau', 'Neoplanta', 'Petra', 'Rani rizling'), stvorene stone sorte ('Demir kapija', 'Kraljica vinograda', 'Karmen', 'Beogradska besemena', 'Black magic'), i po jedna sorta iz grupa *pontica-georgica* ('Rkaciteli') i *orientalis-caspica* ('Muskat krokan'). Pored predstavnika vrste *Vitis vinifera*, u ogled je bila uključena i vrsta *Vitis amurensis*. U 2024. godini kod svih sorti odvijanje fenoloških faza je bilo pomereno u znatno raniji period godine u odnosu na 2023. godinu. Kod skoro svih sorti, izuzev 'Beogradske besemene' i vrste *Vitis amurensis*, broj cvasti po okcu je bio manji u 2024. godini u odnosu na 2023. godinu. Uočena je unutar-grupna varijabilnost između sorti u rodnosti i toku odvijanja fenofaza. U obe godine sorte koje imaju gene *Vitis amurensis*-a su ispoljile visoke vrednosti pokazatelja rodnosti i prve su počinjale pupoljiti. 'Müller-thurgau' i 'Black magic' istakli su se kao veoma rodne sorte. Sorte 'Bagrina' i 'Skadarka' su, u poređenju sa svim ostalim sortama, u obe godine pozno počinjale najvažnije fenofaze.

Ključne reči: pokazatelji rodnosti, fenologija, sorta, vinova loza

Zahvalnica: Istraživanje je finansiralo Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije, na osnovu ugovora o realizaciji i finansiranju naučno-istraživačkog rada u 2024. godini, Poljoprivredni fakultet, Univerzitet u Novom Sadu, broj 451-03-66/2024-03/200117.

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INDICATORS OF YIELD AND PHENOLOGICAL CHARACTERISTICS OF DIFFERENT GROUPS OF GRAPEVINE VARIETIES

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In the Republic of Serbia, grapevine varieties belonging to different eco-geographical groups are cultivated, as well as created varieties. The aim of this study was to present differences between groups of varieties in terms of yield indicators (number of inflorescences per bud) and phenology (annual cycle of development). The experiment was conducted at the Experimental field for viticulture in Sremski Karlovci during 2023 and 2024, on the varieties belonging to the *pontica-balkanica* ('Bagrina', 'Beli Bakator', 'Bela Dinka', 'Skadarka', 'Stanušina'), *occidentalis-gallica* ('Chardonnay', 'Traminer') groups of varieties, as well as created wine varieties ('Müller-Thurgau', 'Neoplanta', 'Petra', 'Early Riesling'), created table varieties ('Demir Kapija', 'Queen of the Vineyard', 'Karmen', 'Belgrade Seedless', 'Black Magic'), and one variety each from the *pontica-georgica* ('Rkatsiteli') and *orientalis-caspica* ('Muscat Krokan'). In addition to representatives of the *Vitis vinifera* species, the *Vitis amurensis* species was also included in the trial. In 2024, phenological phases for all varieties occurred significantly earlier than in 2023. For almost all varieties, except 'Beogradska besmena' and *Vitis amurensis*, the number of inflorescences per bud was lower in 2024 compared to 2023. Variability was observed within varieties regarding yield and the timing of phenophases. In both years, varieties with *Vitis amurensis* genes showed high yield and were the first to begin bud break. 'Müller-Thurgau' and 'Black Magic' were particularly productive. Compared to other varieties, 'Bagrina' and 'Skadarka' were the latest to start the key phenological phases in both years.

Keywords: indicators of yield, phenology, variety, grapevine

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I/P15

ANALIZA RODNOG POTENCIJALA CRNIH VINSKIH SORTI GAJENIH NA PODRUČJU TREBINJA

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U ovom radu predstavljeni su trogodišnji rezultati istraživanja potencijala rodnosti četiri crne vinske sorte (blatina, vranac, merlo i kaberne sovinjon) gajene na području Trebinja. Rezultati su pokazali da sorta blatina ima značajno manji broj razvijenih i rodnih lastara u poređenju sa sortama vranac i kaberne sovinjon, kao i manji broj grozdova po čokotu u poređenju sa kaberne sovinjonom. Statistički značajne razlike su uočene među sortama za sve pokazatelje rodnosti okaca i lastara, osim broja okaca po čokotu, koji je bio konstantan za sve sorte (14) i sve posmatrane godine. Uticaj godine bio je veoma značajan za broj razvijenih lastara, značajan za broj rodnih lastara, ali nije bio značajan za broj grozdova po čokotu. Kombinovani uticaj sorte i godine bio je veoma značajan za broj razvijenih i rodnih lastara. Koeficijent potencijalne rodnosti sorte blatina (1,24) bio je znatno manji nego kod kaberne sovinjona (1,68), dok se statistički nije značajno razlikovao od ostalih sorti. Koeficijenti relativne (1,68) i apsolutne rodnosti (2,29) sorte blatina bili su znatno veći nego kod sorte vranac (1,13 i 1,74), dok se nisu značajno razlikovali od merloa i kaberne sovinjona. Postojala je statistički veoma značajna razlika u rodnosti okaca među ispitivanim sortama. Uticaj godine bio je veoma značajan za sva tri koeficijenta rodnosti, dok je kombinovani uticaj sorte i godine bio statistički veoma značajan za koeficijente apsolutne i relativne rodnosti.

Ključne reči: koeficijenti rodnog potencijala**,** osobine čokota

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ANALYSIS OF THE FERTILITY POTENTIAL OF RED WINE GRAPE VARIETIES GROWN IN THE TREBINJE AREA

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In this paper, three-year research results on the fertility potential of four red wine grape varieties (Blatina, Vranac, Merlot, and Cabernet Sauvignon) grown in the Trebinje area are presented. The results showed that the Blatina variety has a significantly lower number of developed and fertile shoots compared to the Vranac and Cabernet Sauvignon varieties, as well as a lower number of clusters per vine compared to Cabernet Sauvignon. Statistically significant differences were observed among the varieties for all indicators of bud and shoot fertility, except for the number of buds per vine (14), which was constant for all varieties and all observed years. The effect of the year was very significant for the number of developed shoots, significant for the number of fertile shoots, but not significant for the number of clusters per vine. The combined effect of variety and year was very significant for the number of developed and fertile shoots. The coefficient of potential fertility of the Blatina variety (1.24) was significantly lower than that of Cabernet Sauvignon (1.68), while it did not differ significantly from the other varieties. The coefficients of relative (1.68) and absolute fertility (2.29) of the Blatina variety were significantly higher than those of the Vranac variety (1.13 and 1.74), while they did not differ significantly from Merlot and Cabernet Sauvignon. There was a statistically very significant difference in bud fertility among the examined varieties. The effect of the year was very significant for all three fertility coefficients, while the combined effect of variety and year was statistically very significant for the coefficients of absolute and relative fertility.

Keywords: coefficients of fertility potential, vine characteristics

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AMPELOGRAFSKA KARAKTERIZACIJA NOVOPRIZNATIH KLONOVA SORTE „ŽILAVKA“

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Istraživanja su obavljena u vinogradu manastira Tvrdoš, Bosna i Hercegovina. Vinograd pripada rejonu Hercegovine, podrejonu srednje Neretve i Trebišnjice i Mostarskom vinogorju. Predmet ispitivanja su novopriznati klonovi sorte Žilavka pod nazivima: „Tvrdoš“, „Bazilika“, „Atanasije“, „Sara“ i „Dunja“. Klonovi se nalaze na sortnoj listi Ministarstva poljoprivrede, vodoprivrede i šumarstva Republike Srbije. Prikazani su rezultati fenoloških osmatranja, rodnosti, mehaničkog sastava grozda i bobice i hemijski parametri grožđanog soka-šire (sadržaj šećera, sadržaj ukupnih kiselina, pH vrednost). Za potrebe mehaničke analize grozda i bobice uzorkovano je grožđe u punoj zrelosti i u laboratoriji Katedre za vinogradarstvo Poljoprivrednog fakulteta Univerziteta u Beogradu određena je dužina, širina grozda, masa grozda i svih bobica, masa šepurine, i učešće pokožice, semenki i mezokarpa u grozdu i bobici. Rezultati fenoloških osmatranja ukazuju da nije bilo značajne razlike između klonova u dužini odvijanja fenofaza. Fenofaza suzenja trajala je u proseku 14 dana, cvetanja 12, a od suzenja do pune zrelosti proteklo je 162 dana. Najnižim koeficijentom relativne rodnosti odlikovao se klon „Atanasije” (1.17), a najvišim klon „Sara” (1.67). Isti trend variranja između klonova utvrđen je i za koeficijente apsolutne i potencijalne rodnosti. Statističkom analizom vrednosti parametara mehaničke analize grozdova utvrđene su značajne razlike između pojedinih klonova. Klon „Dunja“ imao je najmanju utvrđenu masu grozda i masu svih bobica u grozdu (188,4 i 179,0 g), dok je klon „Atanasije” imao najveću utvrđenu masu (249,0 i 237,0 g). Klon „Bazilika“ odlikovao se visokim učešćem pokožice u grozdu (6,89%), kao i semenki (3,25%), a dok je klon „Tvrdoš“ bio sa najvećim učešćem mezokarpa (90,24%). Po sadržaju šećera u širi izdvajali su se klonovi „Bazilika“ (22,38%) i „ Atanasije“ (22,06%), što je ocenjeno kao statistički značajno u odnosu na ostale klonove i kontrolu. Ispitivani klonovi po rezultatima za većinu parametara se statistički značajno razlikuju i imajući u vidu njihov enološki potencijal mogu se preporučiti za proizvodnju vrhunskih belih vina.

Ključne reči: Žilavka, klon, fenologija, mehanička analiza, grozd i bobica

Zahvalnica: Rad je rezultat projekta broj 451-03-65/2024-03/200116 finansiranog od strane Ministarstava nauke, tehnološkog razvoja i inovacija Republike Srbije.

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AMPELOGRAPHIC CHARACTERIZATION OF THE NEWLY SELECTED CLONES OF THE ŽILAVKA VARIETY

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The study was conducted in the vineyard of the Tvrdoš monastery, Bosnia and Herzegovina. The vineyard belongs to the Herzegovina region, the sub-region of the middle Neretva and Trebišnjica and the Mostar vine area. The subject of the study are the newly separated clones of the Žilavka variety with the names: "Tvrdoš", "Basilika", "Atanasije", "Sara" and "Dunja". The clones are on the list of varieties of the Ministry of Agriculture, Water Management and Forestry of the Republic of Serbia. The results of phenological observations, fertility, mechanical composition of clusters and berries and chemical parameters of grape juice-must (sugar content, total acidity, pH value) are presented. For the mechanical analysis of the clusters and berries, the grapes were sampled at full maturity and the length, width of the clusters, the weight of the clusters and all berries, the mass of the cluster stem and the proportion of the skin, seeds and mesocarp in the cluster were determined in the laboratory of the Department of Viticulture of the Faculty of Agriculture University of Belgrade. The results of the phenological observations show that there was no significant difference between the clones in the length of phenophase development. The phenophase of bleeding lasted on average 14 days, flowering 12 days, from bleeding to full ripening 162 days. The lowest coefficient of relative fertility was found in the clone "Atanasije" (1.17), and the highest in the clone "Sara" (1.67). The same tendency of variation between the clones was observed for the absolute and potential fertility coefficients. Statistical analysis of the values of the mechanical analysis parameters and the clusters revealed significant differences between the individual clones. The clone "Dunja" had the lowest determined mass of the cluster and the mass of all berries in the cluster (188.4 and 179.0 g), while the clone "Atanasije" had the highest determined mass (249.0 and 237.0 g). The "Basilika" clone was characterized by a high percentage of skin in the bunch (6.89%) and seeds (3.25%), while the "Tvrdoš" clone had the highest percentage of mesocarp (90.24%). The clones "Basilika" (22.38%) and "Atanasije" (22.06%) stood out in terms of sugar content, which was found to be statistically significant compared to the other clones and the control. According to the results, the clones tested differed statistically significantly in most parameters and can be recommended for the production of top quality white wines in view of their oenological potential.

Keywords: Žilavka, clone, phenology, mechanical analysis, grape and berry

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OSOBINE NOVOSTVORENE STONE SORTE VINOVE LOZE 'TEONA'

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Tokom trogodišnjeg perioda ispitivanja (2020-2022) proučavane su najvažnije ampelografske i proizvodne osobine novostvorene stone sorte vinove loze 'Teona' koja je dobijena iz kombinacije ukrštanja 'Crveni Drenak' × 'Afuz Ali'. Sorta je stvorena na Poljoprivrednom fakultetu, Univerziteta u Beogradu. Ona je u odnosu na proučavane osobine upoređivana sa standardnom sortom 'Afuz Ali'. U pogledu ampelografskih osobina sorta 'Teona' predstavlja jedinstven genotip i ima potpuno otvoren vrh mladog lastara, opušten položaj lastara, dugačke rašljike, petodelan list, hermafroditan tip cveta, srednje zbijen grozd, jajast oblik bobice, crvenu boju pokožice, umereno čvrsto meso i neutralan ukus. Od proizvodnih osobina, statistički značajne razlike sorte 'Teona' u odnosu na sortu standard utvrđene su za vreme zrenja, prinos grožđa, dužinu grozda, masu bobice, dužinu bobice i širinu bobice. U proseku, sorta 'Teona' je poznijeg vremena zrenja (4. oktobar) u poređenju sa sortom standard (24. septembar). Sorta 'Teona' imala je prinos od 2,31 kg/m^2, masu grozda od 571,0 g i masu bobice od 5,85 g, a sorta 'Afuz Ali' je imala prinos od 1,64 kg/m^2, masu grozda od 397,6 g i masu bobice od 5,17 g. Sadržaj šećera i ukupnih kiselina u širi kod sorte 'Teona' bio je 16,8% odnosno 7,2 g/l, a kod sorte 'Afuz Ali' 17,6% odnosno 6,5 g/l. Zbog niza pozitivnih osobina, prvenstveno poznog vremena zrenja, lepog i atraktivnog izgleda grozda i bobice, od sorte 'Teona' se očekuje njeno širenje u proizvodne vinograde Srbije.

Ključne reči: *Vitis vinifera*, ampelografske osobine, vreme zrenja, prinos, kvalitet grožđa

Zahvalnica: Ovaj rad je realizovan u okviru ugovora o finansiranju naučnoistraživačkog rada između Univerziteta u Beogradu, Poljoprivrednog fakulteta i Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (br. 451-03-65/2024-03/200116).

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PROPERTIES OF THE NEWLY CREATED TABLEGRAPEVINE CULTIVAR 'TEONA'

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During the three-year tested period (2020-2022), the most important ampelographic and productive properties of the newly created table grapevine cultivar 'Teona' which originated from the crossing combination 'Crveni Drenak' × 'Afuz Ali', were studied. The cultivar was created at the Faculty of Agriculture, University of Belgrade. It was compared with the standard cultivar 'Afuz Ali' in terms of the studied properties. Regarding the ampelographic properties, the 'Teona' cultivar represents unique genotype and has a fully open tip of the young shoot, drooping shoot attitude, long tendrils, five lobes in the mature leaf, hermaphrodite flower type, medium bunch density, ovoid berry shape, red color of the berry skin, moderately firm flesh and neutral flavor. Statistically significant differences in production traits between the 'Teona' cultivar and the standard cultivar were found for ripening time, grape yield, bunch length, berry weight, berry length and berry width. On average, the 'Teona' cultivar had a later ripening time (October 4) than the standard cultivar (September 24). The 'Teona' cultivar had a grape yield of 2.31 kg/m^2, a bunch weight of 571.0 g and a berry weight of 5.85 g, while the 'Afuz Ali' cultivar had a grape yield of 1.64 kg/m^2, a bunch weight of 397.6 g and a berry weight of 5.17 g. The sugar and total acid content in the must of the 'Teona' cultivar was 16.8%, and 7.2 g/l respectively, while that of the 'Afuz Ali'cultivar was 17.6%, and 6.5 g/l respectively. Due to a number of positive properties, especially the late ripening time, beautiful and attractive appearance of bunches and berries, the 'Teona' cultivar is expected to spread in production vineyards in Serbia.

Keywords: *Vitis vinifera*, ampelographic properties, ripening time, yield, grape quality

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AMPELOGRAFSKE I PROIZVODNE OSOBINE SORTI IZ GRUPE PINOT U RESAVSKOM VINOGORJU

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Cilj ovog rada je da se utvrde sličnosti i razlike ampelografskih i najvažnijih privredno-tehnoloških osobina tri sorte iz grupe Pinot (Pinot Blanc, Pinot Gris i Pinot Noir) u agroekološkim uslovima Resavskog vinogorja. Ogled je postavljen u oglednom vinogradu Poljoprivredno-veterinarske škole sa domom učenika "Svilajnac", na lokalitetu Čair. Sve tri sorte su u dvogodišnjem periodu (2021-2022) ispitivane pod istim uslovima: razmak sadnje bio je 2,8 × 0,75 m, formiran je Gijov jednogubi uzgojni oblik, zimskom rezidbom je ostavljeno 10 okaca po čokotu i primenjene sve standardne agrotehničke i ampelotehničke mere. Laboratorijska ispitivanja su sprovedena u Laboratoriji za hortikulturu, Poljoprivrednog fakulteta i Laboratoriji za prehrambenu tehnologiju Poljoprivredno-veterinarske škole, „Svilajnac". Posmatranjem ampelografskog profila, kao što je bilo očekivano, ispitivane sorte su ispoljile dosta sličnosti. Ukupno je analizirano 48 karakteristika odabranih iz OIV deskriptora i korišćenih za GRAPEGEN06. U ovom istraživanju, za 26 osobina, ocene su bile jednake kod sve tri sorte. Sorte Pinot Noir i Pinot Blanc su imale iste ocene za dve osobine (OIV 072 i OIV 155), Pinot Noir i Pinot Gris za tri osobine (OIV 003, OIV 006 i OIV 204), a Pinot Blanc i Pinot Gris za četiri osobine (OIV 051*, OIV 081-1, OIV 083-2 i OIV 084). Sve tri sorte su se jedna od druge razlikovale osim po boji pokožice (OIV 225) i po boji dorzalne strane internodije (OIV 007), gde je ona kod sorte Pinot Noir bila zelena sa crvenim linijama, kod Pinot Blanc zelena, a kod Pinot Gris crvena, što predstavlja jasnu i lako uočljivu razliku u polju. Listovi ispitivanih sorti su bili okruglasti, sitni, do srednje krupni. Merenjem dimenzija glavnih nerava, zubaca i uglova na listu i ocenjivanjem dobijenih vrednosti utvrđeni su profili svake sorte, pa su tako kod ugla između N3 i N4 (OIV 609) ocene kod sve tri sorte bile različite (Pinot Gris - 27°, Pinot Blanc - 42° i Pinot Noir - 47°). Prosečno najveći prinos ostvarila je sorta Pinot Blanc (9,25 t/ha), a najmanji sorta Pinot Gris (6,11 t/ha). Sve ispitivane sorte su imale povoljne vrednosti pokazatelja mehaničkog sastava, kao i povoljan hemijski sastav šire za proizvodnju visokokvalitetnih vina. Sorta Pinot Gris se izdvojila po većem udelu pokožice u bobici (5,34%), sadržaju šećera (24,1%), kao i sadržaju ukupnih kiselina u širi (5,55 g/l), pa se može smatrati da je najbolji kvalitet grožđa u uslovima Resavskog vinogorja postignut upravo kod ove sorte.

Ključne reči: ampelografija, Pinot, Resavsko vinogorje, vinsko grožđe

Zahvalnica: Ovaj rad je nastao kao rezultat istraživanja u okviru ugovora: 451-03-65/2024-03/200116.

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THE AMPELOGRAPHIC AND PRODUCTION CHARACTERISTICS OF THREE VARIETIES OF THE PINOT GROUP IN RESAVA WINE-GROWING AREA

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This work aims to determine the similarities and differences in the ampelographic and main economic and technological characteristics of three varieties of the Pinot group (Pinot Blanc, Pinot Gris and Pinot Noir) under the agroecological conditions of the Resava vineyards. Trait is located in the vineyard of the Agricultural and Veterinary School with the dormitory "Svilajnac", on the hill of Chair. All three varieties were tested 2021-2022, under the same conditions: The planting distance was 2.8 m × 0.75 m, the training system was sigle Guyot, with 10 buds per vine left over from winter pruning, and all standard agro- and ampelotechnical practices were applied. The laboratory tests were conducted in the Horticulture Laboratory of the Faculty of Agriculture and in the Food Technology Laboratory of the School of Agriculture and Veterinary Medicine „Svilajnac". The analyzed varieties showed many similarities, as was to be expected when looking at the ampelographic profile. A total of 48 characteristics selected from the OIV descriptors and used for GRAPEGEN06 were analyzed. In his research, the score for 26 characteristics was the same for all three varieties. Pinot Noir and Pinot Blanc had the same score for two characteristics (OIV 072 and OIV 155), Pinot Noir and Pinot Gris for three characteristics (OIV 003, OIV 006 and OIV 204) and Pinot Blanc and Pinot Gris for four characteristics (OIV 051*, OIV 081-1, OIV 083-2 and OIV 084). All three varieties differed from each other, except for the skin color (OIV 225) and the color of the dorsal side of internodes (OIV 007), which was green with red lines for Pinot Noir, green for Pinot Blanc and red for Pinot Gris, which is a clear and easily recognisable difference in the field. The leaves of the varieties analyzed were round, small to medium in size. The profiles of each variety were determined by measuring the dimensions of main veins, denticles and angles to the leaf. Thus, the values for the angle between N3 and N4 (OIV 609) were different for all three varieties (Pinot Gris - 27°, Pinot Blanc - 42° and Pinot Noir - 47°). The highest average yield was achieved by the Pinot Blanc variety (9.25 t/ha), the lowest by the Pinot Gris variety (6.11 t/ha). All tested grape varieties showed favourable values for the indicators of mechanical composition and a favourable chemical composition of the must for producing quality wines. The Pinot Gris variety was characterised by a higher skin content in the berry (5.34%), a higher sugar content (24.1%) and a higher total acidity in the must (5.55 g/l), so it can be assumed that this variety in particular achieved the best grape quality under the conditions of the Resava vineyard.

Keywords: ampelography, Pinot, Resava wine growing region, wine grape

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KARAKTERISTIKE NOVOSTVORENIH SORTI VINOVE LOZE 'NAISA' I 'JEFIMIJA'

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U radu su prikazane najvažnije morfološke i proizvodno-tehnološke karakteristike novostvorenih sorti vinove loze 'Naisa' i 'Jefimija', namenjenih za proizvodnju belih vina. Sorta 'Naisa' dobijena je ukrštanjem sorti 'Smederevka' × 'Traminac crveni', a sorta 'Jefimija' je nastala iz kombinacije ukrštanja 'Smederevka' × 'Rizling rajnski'. Karakteristike novostvorenih sorti su upoređivane sa roditeljskim partnerima ('Smederevka', 'Traminac crveni' i 'Rizling rajnski'). Ispitivane sorte su se značajno razlikovale po morfološkim osobinama i predstavljaju jedinstvene genotipove. Novopriznata sorta 'Naisa' ima potpuno otvoren vrh mladog lastara, trodelan list, poluotvoren oblik peteljkinog sinusa lista, širokoeliptičan oblik bobice, roze boju pokožice i neutralan ukus. Novopriznata sorta 'Jefimija' ima potpuno otvoren vrh mladog lastara, trodelan list, slabo otvoren oblik peteljkinog sinusa lista, okrugao oblik bobice, žutu boju pokožice i neutralan ukus. Sorta 'Naisa' je imala prinos od 4,55 kg/čokotu i masu grozda od 181,95 g, dok je sorta 'Jefimija' imala prinos od 3,65 kg/čokotu i masu grozda 183,75 g. Sorta 'Smederevka' kao jedan od roditelja obe novostvorene sorte imala je prinos grožđa od 4,34 kg/čokotu i masu grozda od 346,97 g. Sorta 'Traminac crveni' imala je prinos od 2,97 kg/čokotu i masu grozda od 139,89 g, dok je sorta 'Rizling rajnski' imala prinos od 3,19 kg/čokotu i masu grozda od 150,89 g. Sadržaj šećera i ukupnih kiselina u širi kod sorte 'Naisa' iznosio je 21,5% i 7,8 g/l, dok je za sortu 'Jefimija' bio 21,6% i 8,3 g/l. Vino obe sorte je bilo pitko, harmonično, sa specifičnim sortnim mirisom i ukusom i sadržalo je 13,2% vol. alkohola kod sorte 'Naisa', odnosno 12,9% vol. alkohola kod sorte 'Jefimija'. Na osnovu ispoljenih pozitivnih karakteristika obe sorte su priznate 2023. godine i stavljene u Registar priznatih sorti poljoprivrednog bilja Republike Srbije.

Ključne reči: vinova loza, hibridizacija, prinos, kvalitet grožđa, kvalitet vina

I/P19

CHARACTERISTICS OF NEWLY CREATED GRAPEVINE VARIETIES 'NAISA' AND 'JEFIMIJA'

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The paper presents the most important morphological and production-technological characteristics of newly created grapevine varieties 'Naisa' and 'Jefimija', intended for the production of white wines. The 'Naisa' variety was obtained by crossing varieties 'Smederevka' × 'Traminer Red', and variety 'Jefimija' was created from a combination of crossing of 'Smederevka' × 'Riesling Rhine'. The characteristics of newly created varieties were compared to parental partners ('Smederevka', 'Traminer Red' and 'Riesling Rhine'). The examined varieties differed significantly according to morphological properties and represent unique genotypes. The newly recognized variety of the 'Naisa' has a fully open tip of the young shoot, three lobes in the mature leaf, a half open arrangement of lobes of leaf petiole sinus, a broad ellipsoid shape of the berry, rose color of the berry skin, and neutral taste. The newly recognized variety of 'Jefimija' has a fully open tip of the young shoot, three lobes in the mature leaf, a slightly open arrangement of lobes of leaf petiole sinus, globose shape of the berry, yellow color of the berry skin and neutral taste. Variety 'Naisa' had a yield of 4.55 kg/vine and bunch weight of 181.95g, while the 'Jefimija' variety had a yield of 3.65 kg/vine and bunch weight 183.75 g. The variety 'Smederevka' as one of the parents of both newly created varieties had grape yield of 4.34 kg/vine and bunch weight of 346.97. Variety 'Traminer Red' was a yield of 2.97 kg/vine and bunch weight of 139.89, while the 'Riesling Rhine' variety had a yield of 3.19 kg/vine and bunch weight 150.89 g. Sugar and total acid content in the must of variety 'Naisa' amounted to 21.5% and 7.8 g/l, while for the 'Jefimija' variety was 21.6% and 8.3 g/l, respectively. The wine of both varieties was drinkable, harmoniously, with a specific varietal aroma and taste and contained 13.2% vol. alcohol at the 'Naisa' variety and 12.9% vol. alcohol at the 'Jefimija' variety. Based on the presented positive characteristics, both varieties were recognized in 2023 and placed in the Register of recognized varieties of agricultural plants of the Republic of Serbia.

Keywords: grapevine, hybridization, yield, grape quality, wine quality

II/PO1

VINOGRADARSTVO U NOVOJ REALNOSTI

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Gajenje vinove loze je temelj globalne poljoprivredne ekonomije, podržavajući industriju vina, stonog grožđa i suvog grožđa. Klimatske promene, sa svojim višestrukim uticajima, postaju značajna briga za vinogradarstvo. Grožđe je izuzetno osetljivo na ekološke faktore, i čak male promene u temperaturi, obrascima padavina i ekstremnim vremenskim uslovima mogu značajno uticati na kvalitet i količinu grožđa. Ova diskusija ispituje naučno razumevanje načina na koji klimatske promene utiču na rast vinove loze, izazove sa kojima se suočavaju vinogradi, kao i mere koje se sprovode kako bi se ublažili ti uticaji.

Klimatske promene odnose se na dugoročne promene u temperaturi, padavinama i drugim atmosferskim uslovima, koje su prvenstveno izazvane povećanjem emisije gasova sa efektom staklene bašte. Ove promene pojačavaju i menjaju osnovne ekološke parametre od kojih zavisi vinova loza. Prosečne globalne temperature su porasle za otprilike 1,0-1,5 °C iznad predindustrijskog nivoa, sa očekivanjima daljeg povećanja. Ovaj porast utiče na fenološke faze vinove loze, utičući na njihove cikluse rasta i razvoj plodova. Mnogi regioni doživljavaju intenzivnije i manje predvidljive obrasce padavina, što dovodi do perioda suše i obilnih padavina.

Prema nedavno objavljenom radu Vršiča i saradnika (2024a), gde su proučavani podaci o prosečnim i ekstremnim temperaturama i padavinama sa šest meteoroloških stanica u tri vinogradarske regije Slovenije (Podravje, Posavje i Primorska) u periodu od 1952. do 2022. godine, pokazuje se da je u periodu od 1991. do 2022. godine došlo do zagrevanja u vegetacionoj sezoni u svim regionima za 1,4-1,7 °C, osim u južnom delu Primorske (stanica Koper) gde je porast iznosio 0,6 °C, u poređenju sa referentnim periodom 1961-1990. Takođe, trendovi pokazuju smanjenje ukupnih godišnjih padavina posle 1991. godine, ali je to bilo značajno samo na jednoj unutrašnjoj lokaciji (Maribor), dok su se ukupne padavine tokom vegetacione sezone značajno smanjile na tri lokacije (Maribor, Bilje i Koper). Ova varijabilnost direktno utiče na vlažnost zemljišta, dostupnost vode i učestalost bolesti u vinogradima.

Talasi vrućine, mraz, grad i šumski požari postaju češći zbog klimatskih promena. Takvi ekstremni događaji mogu devastirati useve grožđa, smanjujući prinose i umanjujući kvalitet grožđa. Povećane koncentracije CO_2 u atmosferi utiču na fiziologiju biljaka tako što pojačavaju fotosintezu, ali i menjaju ravnotežu jedinjenja u grožđu, kao što su šećeri, kiseline i fenoli, koji su ključni za kvalitet vina. Ovi faktori kolektivno stvaraju izazovno okruženje za proizvodnju grožđa, zahtevajući adaptivne mere kako bi se očuvali i kvalitet i količina prinosa grožđa.

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Vinova loza je izuzetno osetljiva na temperaturne fluktuacije, a globalno zagrevanje pomera vreme ključnih fenoloških faza, kao što su kretanje pupoljaka, cvetanje, šarak (početak zrenja) i berba. Sa toplijim zimama i prolećima, vinova loza često doživljava ranije kretanje pupoljaka. Ovo pomeranje može izložiti mlade pupoljke kasnim mrazevima, povećavajući rizik od oštećenja od mraza i smanjenja prinosa. Kako temperature rastu, vinova loza prolazi kroz brže cikluse zrenja. To može dovesti do ranijih berbi, često pre nego što grožđe postigne uravnotežen fenolni i aromatski profil. U regionima kao što su Bordo i Burgundija, gde je ravnoteža zrelosti ključna za očuvanje tradicionalnih stilova vina, ovo postaje veliki problem. Više temperature dovode do povećanja akumulacije šećera u grožđu, što rezultira vinima sa većim sadržajem alkohola. Istovremeno, nivoi kiselina opadaju kako temperature rastu, što može uticati na svežinu, strukturu i potencijal starenja vina. Vršič i saradnici (2024b) navode da je, kao rezultat klimatskog zagrevanja, grožđe u severoistočnoj Sloveniji sazrevalo 26 dana ranije ('Sauvignon Blanc') do 35 dana ranije ('Welschriesling'). Trendovi su pokazali smanjenje ukupne kiselosti, što se može pripisati višim temperaturama tokom vegetacione sezone, posebno tokom perioda sazrevanja grožđa (šarak).

Dostupnost vode je još jedan ključni faktor za zdravlje i produktivnost vinove loze. Klimatske promene pogoršavaju vodni stres kroz povećanu evapotranspiraciju usled viših temperatura i produženog perioda suše u mnogim regionima gde se gaji grožđe. Sušni uslovi ograničavaju rast vinove loze, što dovodi do smanjenog formiranja plodova i manjih bobica. Dok manje bobice mogu dovesti do koncentrisanijih ukusa, ekstremne suše mogu negativno uticati na kvalitet grožđa izazivanjem preuranjenog sazrevanja, sušenja i smanjenog sadržaja soka. Loze pod stresom od vode mogu ući u stanje mirovanja, prestajući sa razvojem plodova, a ponekad i umiru. Dugotrajna suša može oslabiti loze, čineći ih podložnijim štetočinama i bolestima. Neredovni i intenzivni događaji padavina stvaraju uslove pogodne za gljivične bolesti kao što su pepelnica i plamenjača. Ove bolesti uspevaju u okruženjima sa visokom vlažnošću, koja postaju sve češća zbog klimatskih promena. Obe bolesti mogu ozbiljno uticati na vinovu lozu oštećujući lišće, smanjujući fotosintezu i narušavajući kvalitet plodova. Botritisna trulež grozda je još jedna bolest koja postaje problematična sa povećanom vlažnošću, naročito tokom zrenja. Prekomerne padavine mogu dovesti do zasićenja zemljišta vodom, što remeti funkciju korena i unos kiseonika, povećavajući verovatnoću bolesti korena. Takvi uslovi mogu izazvati zaostajanje u rastu i niži kvalitet plodova.

Povišeni nivoi CO_2 imaju složen efekat na vinovu lozu. Dok povećani CO_2 stimuliše fotosintezu, što dovodi do bržeg rasta loze, on takođe menja ravnotežu između vegetativnog rasta i razvoja plodova. Ovo može rezultirati (i) prekomernim vegetativnim rastom - u nekim slučajevima, vinova loza razvija više lišća nego plodova, stvarajući guste krošnje koje zadržavaju vlagu i povećavaju rizik od gljivičnih infekcija, (ii) promenama u sastavu grožđa - viši nivoi CO_2 takođe mogu uticati na koncentraciju sekundarnih metabolita u grožđu, koji su odgovorni za ukus, aromu i boju - ove promene mogu dovesti do vina sa manje izražajnim i složenim profilima, (iii) povećanim pritiskom štetočina - više temperature i blaže zime omogućavaju štetočinama da prežive u regionima gde ranije nisu bile prisutne.

Glavni izazov klimatskih promena je očuvanje kvaliteta grožđa. Vinova loza je osetljiva i na temperaturu i na dostupnost vode, a promene ovih faktora mogu izmeniti sastav grožđa, utičući na kvalitet vina. Sa višim temperaturama, grožđe akumulira više šećera, što rezultira vinima sa

većim sadržajem alkohola. Dok neki stilovi vina imaju koristi od povećanog alkohola, prekomerni nivoi alkohola mogu učiniti vina neuravnoteženim i manje prijatnim. Više temperature smanjuju prirodnu kiselost u grožđu, što utiče na svežinu, hrskavost i potencijal starenja vina. Ovo je posebno problematično za vina iz hladnijih klimatskih uslova, kao što su rizling i šardone, gde je kiselost ključna za očuvanje njihovog karakterističnog stila.

Klimatske promene utiču na sintezu fenolnih jedinjenja (odgovornih za tanine i boju) i aromatskih jedinjenja (koji doprinose ukusu). U regionima pod stresom od toplote, razvoj fenola može biti nepotpun, što dovodi do vina sa manje složenosti i strukture. Sušni uslovi smanjuju snagu vinove loze, što dovodi do nižih prinosa. Dok manji vodni stres može rezultirati grožđem višeg kvaliteta i koncentrisanijih plodova, ozbiljne suše smanjuju i prinos i kvalitet. Efikasno upravljanje vodom je ključno u regionima koji doživljavaju vodni stres usled klimatskih promena. Nekoliko strategija se primenjuje kako bi se ublažili efekti suše i nestašice vode – (i) kap po kap navodnjavanje, (ii) reciklaža vode i prikupljanje kišnice, (iii) malčiranje i pokrovni usevi, (iv) izbor sorti i podloga, (v) upravljanje krošnjom (povećana pokrivenost lišćem za zaštitu od sunca, poboljšana cirkulacija vazduha za smanjenje vlažnosti), (vi) integrisano upravljanje štetočinama i bolestima, (vii) biološka kontrola, (viii) očuvanje i obnavljanje zdravlja zemljišta itd.

Klimatske promene predstavljaju složen skup izazova za gajenje vinove loze, utičući na kvalitet i količinu proizvodnje grožđa. Povećanje temperatura, nestašica vode, pojačan pritisak štetočina i ekstremni vremenski događaji preoblikuju pejzaž vinogradarstva. Međutim, kroz adaptivne mere, kao što su poboljšano upravljanje vodom, odabir sorti grožđa otpornijih na klimatske promene, integrisano upravljanje štetočinama i prilagođavanje praksi u vinogradu i proizvodnji vina, uzgajivači grožđa mogu ublažiti ove uticaje. Budućnost vinogradarstva verovatno će uključivati kombinaciju tradicionalnih tehnika i inovativnih pristupa kako bi se očuvala industrija u suočavanju sa promenljivom klimom. Otpornost vinske industrije zavisiće od njene sposobnosti da se prilagodi ovim izazovima, a pritom očuva kvalitet i raznolikost koji definišu svet vina.

Ključne reči: klimatske promene, vodeni stres, toplotni talasi, prakse

II/PO1

GRAPEVINE GROWING IN NEW REALITY

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Grapevine cultivation is a cornerstone of the global agricultural economy, supporting the wine, table grape, and raisin industries. Climate change, with its multi-dimensional impacts, is becoming a significant concern for viticulture. Grapes are highly sensitive to environmental factors, and even slight changes in temperature, precipitation patterns, and weather extremes can substantially affect grape quality and quantity. This discussion examines the scientific understanding of how climate change influences grapevine growth, the challenges faced by vineyards, and the measures being implemented to mitigate these impacts.

Climate change refers to long-term alterations in temperature, precipitation, and other atmospheric conditions, primarily driven by increased greenhouse gas emissions. These changes are intensifying and altering the fundamental environmental parameters that grapevines rely upon. Average global temperatures have risen by approximately 1.0-1.5 °C above pre-industrial levels, with further increases expected. This rise affects the phenological stages of grapevines, influencing their growth cycles and fruit development. Many regions are experiencing more intense and less predictable rainfall patterns, leading to periods of drought and heavy rainfall.

According to recently published paper by Vršič et al. (2024a), which studied average and extreme temperature and precipitation data from six meteorological stations in three wine-growing regions of Slovenia (Podravje, Posavje in Primorska) from 1952-2022, shows that in the period 1991-2022, there was a warming in the growing season in all regions by 1.4-1.7 °C, except the southern part of Primorska (Koper station) by 0.6 °C, compared to the reference period 1961-1990. Moreover, the trends show a decrease in total annual precipitation after 1991, but this was significant only at one inland location (Maribor), while the total precipitation during the growing season decreased significantly at three locations (Maribor, Bilje, and Koper). This variability directly impacts soil moisture, water availability, and disease prevalence in vineyards.

Heatwaves, frost, hailstorms, and wildfires are becoming more common due to climate change. Such extreme events can devastate grape crops, reducing yields and diminishing grape quality. Rising atmospheric CO_2 concentrations affect plant physiology by enhancing photosynthesis but also altering the balance of grape compounds such as sugars, acids, and phenolics, critical for wine quality. These factors collectively create a challenging environment for grape production, requiring adaptive measures to safeguard both the quality and quantity of grape harvests.

II/PO1

Grapevines are highly sensitive to temperature fluctuations, and global warming is shifting the timing of key phenological stages such as bud break, flowering, veraison (the onset of ripening), and harvest. With warmer winters and springs, grapevines often experience earlier bud break. This advancement can expose young buds to late frosts, increasing the risk of frost damage and reducing yields. As temperatures rise, grapevines experience faster ripening cycles. This can lead to early harvests, often before grapes have achieved balanced phenolic and aromatic ripeness. In regions such as Bordeaux and Burgundy, where ripeness balance is critical for maintaining traditional wine styles, this is becoming a major concern. Higher temperatures result in increased sugar accumulation in grapes, leading to wines with higher alcohol content. Simultaneously, acidity levels tend to drop as temperatures rise, which can affect the freshness, structure, and aging potential of wines. Vršič et al. (2024b) report that as a result of climate warming, grapes in north-eastern Slovenia ripened 26 ('Sauvignon Blanc') to 35 ('Welschriesling') days earlier. The trends showed a decrease in total acidity, which can be attributed to the higher temperatures during the growing season, especially during the ripening period of the grapes (véraison).

Water availability is another critical factor in grapevine health and productivity. Climate change is exacerbating water stress through both increased evapotranspiration due to higher temperatures and prolonged periods of drought in many grape-growing regions. Drought conditions limit grapevine growth, leading to reduced fruit set and smaller berry sizes. While smaller berries may lead to more concentrated flavours, extreme droughts can negatively affect grape quality by inducing premature ripening, shrivelling, and reduced juice content. Water-stressed vines may enter a state of dormancy, ceasing to develop fruit and sometimes succumbing to vine mortality. Long-term drought can weaken vines, making them more susceptible to pests and diseases. Irregular and intense rainfall events foster conditions favourable for fungal diseases such as powdery mildew and downy mildew. These diseases thrive in high-humidity environments, which are becoming more prevalent due to climate change. Both diseases can severely affect grapevines by damaging leaves, reducing photosynthesis, and compromising fruit quality. Botrytis bunch rot is another disease that becomes problematic with increased humidity, especially during ripening. Excessive rainfall can lead to waterlogged soils, which disrupt root function and oxygen uptake, increasing the likelihood of root diseases. Such conditions can cause stunted growth and lower fruit quality.

Elevated CO_2 levels have a complex effect on grapevines. While increased CO_2 stimulates photosynthesis, leading to faster vine growth, it also alters the grapevine's balance between vegetative growth and fruit development. This can result in (i) excessive vegetative growth - in some cases, grapevines develop more foliage than fruit, creating dense canopies that trap moisture and increase the risk of fungal infections, (ii) changes in grape composition - higher CO_2 levels can also affect the concentration of secondary metabolites in grapes, which are responsible for flavour, aroma, and colour leading to wines that are less expressive and lower in complexity, (iii) increased pest pressure - warmer temperatures and milder winters are allowing pests to survive in regions where they previously were not a concern.

The primary challenge of climate change is maintaining grape quality. Grapevines are sensitive to both temperature and water availability, and changes in these factors can alter grape composition, affecting wine quality. With higher temperatures, grapes accumulate more sugars, resulting in wines with higher alcohol content. While some wine styles benefit from increased

alcohol, excessive alcohol levels can make wines unbalanced and less approachable. Warmer temperatures reduce the natural acidity in grapes, which affects the freshness, crispness, and aging potential of wines. This is particularly problematic for cool-climate wines, such as Rieslings and Chardonnays, where acidity is essential for maintaining their characteristic style.

Climate change affects the synthesis of phenolic compounds (responsible for tannins and colour) and aromatic compounds (which contribute to the flavour profile). In regions experiencing heat stress, the phenolic development may be incomplete, leading to wines with less complexity and structure. Drought conditions reduce grapevine vigour, leading to lower yields. While some water stress can result in higher-quality, concentrated fruit, severe droughts reduce both yield and quality. Efficient water management is critical in regions experiencing water stress due to climate change. Several strategies are being employed to mitigate the effects of drought and water scarcity – (i) drip irrigation, (ii) water recycling and harvesting, (iii) mulching and cover crops, (iv) variety and rootstock selection, (v) canopy management (increased leaf cover for sun protection, improved airflow to reduce humidity), (vi) integrated pest and disease management, (vii) biological control, (viii) soil health and regeneration etc.

Climate change poses a complex set of challenges for grapevine growing, affecting both the quality and quantity of grape production. Rising temperatures, water scarcity, increased pest pressure, and extreme weather events are reshaping the landscape of viticulture. However, through adaptive measures such as improved water management, the selection of climate-resilient grape varieties, integrated pest management, and adjustments in vineyard and winemaking practices, grape growers can mitigate these impacts. The future of viticulture will likely involve a combination of traditional techniques and innovative approaches to sustain the industry in the face of a changing climate. The resilience of the wine industry will depend on its ability to adapt to these challenges while maintaining the quality and diversity that define the world of wine.

Keywords: climate change, water stress, heat waves, measures

II/PO2

UTICAJI KLIMATSKIH PROMENA U EVROPSKOM SEKTORU VINARSTVA

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Vinarstvo je suštinski povezano sa klimatskim uslovima jer rast i razvoj vinove loze u velikoj meri zavise od atmosferskih faktora. Očekivane klimatske promene predstavljaju značajan izazov za vinogradarstvo, koje ima veliki ekonomski i kulturni značaj u Evropi. Ova studija procenjuje uticaje klimatskih promena na evropsko vinogradarstvo analizirajući simulacije klimatskih modela zasnovane na projekcijama Međuvladinog panela za klimatske promene (IPCC) prema scenarijima emisija gasova sa efektom staklene bašte RCP4.5 i RCP8.5 do kraja 21. veka. Bioklimatski indeksi su izračunati na visokoj prostornoj rezoluciji na teritoriji Evrope kako bi se ocenila pogodnost za gajenje vinove loze pod sadašnjim klimatskim uslovima i klimatskim scenarijima za budućnost, sa fokusom na promene ključnih klimatskih veličina. Pored toga, projekcije parametara vezanih za vinovu lozu, kao što je prinos, razvijene su povezivanjem klimatskih podataka sa STICS crop modelom. Ovaj model uključuje detaljne podatke o zemljištu, terenu i praksama u vinogradu specifičnim za svaki evropski vinogradarski region. Prinosi su simulirani pod trenutnim klimatskim uslovima i na osnovu projekcija buduće klime kako bi se identifikovali signali klimatskih promena. Rezultati pokazuju značajno zagrevanje i promenu u trendovima padavina u celoj Evropi, pri čemu su identifikovane promene više naglašene u slučaju RCP8.5 scenarija. U južnoj Evropi očekuje se da promene imaju negativne efekte na rast vinove loze, zahtevajući mere prilagođavanja kako bi se ublažio stres izazvan visokim temperaturama i nedostatkom vode. U centralnoj Evropi mogu se očekivati promene u obrascima rasta vinove loze, što potencijalno može uticati na tipičnost vina. Nasuprot tome, u severnoj Evropi se očekuje da će više temperature poboljšati uslove za gajenje vinove loze. Simulacije prinosa ukazuju na smanjenje prinosa u južnoj Evropi, naročito u centralnim delovima Iberijskog poluostrva, i povećanje prinosa u centralnim i severnim regionima Evrope. Ovi rezultati takođe ukazuju na širenje potencijalnih područja za uzgoj vinove loze ka severu, što može dovesti do stvaranja novih vinogradarskih regiona u severnoj Evropi. Iako klimatske promene donose značajne izazove evropskom sektoru proizvodnje vina, efikasne strategije prilagođavanja će biti od ključne važnosti. Južni regioni će zahtevati opsežna prilagođavanja, dok će centralni i severni regioni takođe morati da se prilagode izmenjenim klimatskim uslovima, uprkos povećanom potencijalu za gajenje vinove loze.

Ključne reči: klimatske promene, prilagođavanje, klimatska scenarija, bioklimatski indeksi, prinos

II/PO2

CLIMATE CHANGE IMPACTS IN THE EUROPEAN WINEMAKING SECTOR

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Winemaking is intrinsically linked to climatic conditions, as grapevine growth and development are profoundly influenced by atmospheric factors. Anticipated climate change poses substantial challenges for viticulture, which is of significant economic and cultural importance in Europe. This study evaluates the potential impacts of climate change on European viticulture by analyzing climate model simulations based on the Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathways (RCP 4.5 and RCP 8.5) projections through the end of the century. High-resolution bioclimatic indices were computed across Europe to assess the suitability for viticulture under current and future climate scenarios, with a focus on changes in key climate variables. Additionally, projections of grapevine parameters, such as yields, were developed by coupling climatic data with the STICS crop model. This model incorporated detailed soil, terrain, and crop management parameters specific to each European winemaking region. Yield simulations under both current and projected future climates were conducted to identify climate change signals. The results reveal a significant warming and changes in precipitation trends across Europe, with more pronounced changes under RCP 8.5. In southern Europe, these projections are expected to negatively affect grapevine growth, necessitating adaptive measures to mitigate heat and water stress. Central Europe may experience shifts in grapevine growth patterns, potentially impacting wine typicity. In contrast, northern Europe is projected to benefit from warmer temperatures, enhancing conditions for grapevine cultivation. Yield simulations indicate a decrease in yields for southern Europe, particularly within inner Iberia, and an increase in yields for central and northern regions. The results also indicate a northward expansion of potential grapevine growth areas, leading to the emergence of new winemaking regions in northern Europe. While climate change introduces significant challenges for the European wine sector, effective adaptation strategies will be essential. Southern regions will require substantial adjustments, while central and northern regions will also need to adapt to evolving climatic conditions, despite improved viticultural potential.

Keywords: climate change, adaptation, climate scenarios, bioclimate indices, yield

II/U1

PORAST RIZIKA OD KLIMATSKIH OPASNOSTI USLED KLIMATSKIH PROMENA I PLANIRANJE ADAPTACIJE NA NACIONALNOM NIVOU U VOĆARSTVU I VINOGRADARSTVU U SRBIJI

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Ubrzane klimatske promene prouzrokuju povećanje učestalosti i intenziteta klimatskih opasnosti, kao što su toplotni talasi, jake oluje i intenzivne padavine (uključujući i grad), suše, poplave, požari, itd. Trendovi porasta će se nastaviti do sredine 21. veka. Nakon toga, klimatske promene će se stabilizovati u slučaju ispunjenja Pariskog sporazuma ili, u slučaju neuspeha globalnih politika za smanjenje emisija gasova sa efektom staklene bašte, očekuje se dalje ubrzavanje klimatskih promena . U Srbiji, adaptacija na klimatske promene na nacionalnom nivou je u početnom stadijumu i pokrenuta je donošenjem Programa za prilagođavanje na izmenjene klimatske uslove. Rizici od klimatskih promena u poljoprivredi su u potpunosti procenjeni, u skladu sa sadašnjim znanjem i dostupnosti podataka, i opcije za adaptaciju i mere su određene za period 2023-2030, a konkretnije kroz Akcioni plan za 2024-2026. U izradi Programa, tri načela EU Strategije za adaptaciju su uzeta u obzir, tj. adaptacija treba da bude: pametna (da se oslanja na naučna znanja), brza (da izdvaja prioritete za brze intervencije zbog neizbežnih uticaja) i sistemska (da se implementira kroz dokumenta politike i zakonodavstvo). U ovom radu su predstavljeni: metodologije za procenu rizika u voćarstvu (13 vrsta) i vinogradarstvu, rezultati koji su ukazali na prioritete u smanjivanju rizika (specifične za lokaciju i vrstu) i mere koje treba da dovedu do implementacije adaptacije u praksi. Smanjivanje rizika takođe podrazumeva izgradnju kapaciteta za adaptaciju, odnosno proširivanje znanja, obezbeđivanje sledeće generacije inženjera i finansijskih prilika. Nedostaci u izgradnji procesa adaptacije su preostali zbog toga što nisu obuhvaćene aktivnosti koje bi obezbedile pristupačna poljoprivredna osiguranja i buduće inženjere. Trenutno opadajući trend u upisivanju studenata u prvu godinu studija iz oblasti poljoprivrede i šumarstva (od 2016. do 2022. za 27,5%) pokazuje da opada adaptivni kapacitet u Srbiji. Ovo doprinosi povećanju budućih rizika, što će onemogućiti budući održivi razvoj, otporan na klimatske promene, i štete i gubici mogu preći tačku preokreta.

Ključne reči: klimatske opasnosti, adaptacija, voćarstvo, vinogradarstvo, Srbija

II/U1

INCREASING RISKS OF CLIMATE HAZARDS UNDER CLIMATE CHANGE AND ADAPTATION PLANNING ON NATIONAL LEVEL IN FRUIT PRODUCTION AND VITICULTURE IN SERBIA

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Accelerated climate change causes increasing frequency and intensity of climate hazards, like heat waves, severe storms and intensive precipitation (including hail), droughts, floods, fires, etc. Trends of their intensification will continue by the mid- 21st century period. Afterwards, climate change will stabilize in case of the fulfillment of Paris agreement or, in case of failure of global policy for reduction of GHG emissions, further acceleration of climate change is expected. In Serbia, adaptation to climate change in agriculture on national level is in its initial stage and started with Climate Change Adaptation Programme (CCAP). Risks from climate change in agriculture are fully evaluated, according to currently available data and knowledge, and adaptation options and measures are determined for the period 2023-2030, and more specifically under Action Plan for 2024-2026. During the development of CCAP, three principles of EU Adaptation Strategy are considered, i.e. adaptation should be: smart (to rely on scientific knowledge), fast (to select priorities with unavoidable damages) and systemic (to implement adaptation through policy and regulations). In this paper are presented: methodologies for risk assessment in fruit growing (13species) and viticulture, results which led to the priorities for risk reduction (specific to species and location) and measures which would lead to the implementation of adaptation into practice. Risk reduction also includes building adaptive capacities, which consider building knowledge, roster of next generation engineers and financial opportunities. Gaps in building adaptation process remain because of the lack of actions related to affordable agricultural insurance policies and to building the capacities of future engeneers. Currently decreasing trend in the number of new students in the area of agriculture and forestry (from 2016 to 2022 by 27.5%), shows decreasing trend of adaptive capacity of Serbia. This contributes to increasing future risks, which will disable future sustainable development resilient to climate change, and damages and losses could be over the tipping point.

Keywords: climate hazards, adaptation, fruit production, viticulture, Serbia

II/U2

REJONIZACIJA GAJENJA KAJSIJE U ČAČANSKOM KRAJU - MERA ADAPTACIJE NA KLIMATSKE PROMENE

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Okolina Čačka je regija poznata po voćarskoj proizvodnji, posebno po proizvodnji šljive, kajsije i jabuke. U navedenom kraju se nalazi čak 11% od ukupnog broja stabala kajsije u Srbiji, a u rodnim godinama se proizvede 3 - 4.000 t plodova kajsije (12-15% od ukupne proizvodnje u Srbiji). Oscilacije u proizvodnji po godinama i od zasada do zasada, prvenstveno su uzrokovane nepovoljnim klimatskim prilikama (prolećni mrazevi). Tokom desetogodišnjeg perioda (2015 – 2024. godine) u oblasti severozapadno od Čačka (u kojoj se kajsije najviše i gaji), praćena su 22 zasada kajsije koja su se nalazila u različitim lokalitetima. Pri odabiru zasada za praćenje posebno se vodilo računa da se zasadi nalaze i u najnižim (250-300 m n.v.) i u najvišim delovima regije (500-550 m n.v.), kao i u njegovim središnjim delovima. Za svaki od zasada zabeležena je nadmorska visina, nagib terena, ekspozicija zasada, kao i horizontalna i vertikalna udaljenost od najbližeg vodotoka. U navedenoj oblasti postavljene su 2 meteo stanice (iMETOS IMT 300, Pessl Instruments, Weiz, Austria). Jedna se nalazila u nizijskoj oblasti regije (255 m n.v.), a druga na 380 m n.v. Od meteoroloških podataka sa meteo stanica, posebno su praćene najniže zimske temperature, kao i pojava mrazeva tokom i posle cvetanja. Tokom 10 ispitivanih godina prinosi su značajno varirali i po godinama i od zasada do zasada. Obradom dobijenih podataka utvrđeno je koji su lokaliteti pokazali najstabilniju rodnost i urađena je mapa rejonizacije. Na osnovu dobijenih rezultata, kao najoptimalnija zona za gajenje kajsije, se pokazala zona sa nadmorskom visinom od 320 – 450 m n.v. uz uslov da se zasad nalazi na minimum 30 m visinske razlike u odnosu na najbliži vodotok. Zona povećanih rizika je unutar granica 300 – 320 m, odnosno 450 – 500 m n.v. Van navedenih granica (na lokalitetima ispod 300 i preko 500 m n.v., kao i na parcelama koji su sa visinskom razlikom manjom od 30 m u odnosu na najbliži vodotok), ne bi trebalo podizati zasade kajsije.

Ključne reči: kajsija, lokalitet, temperatura, nadmorska visina

REIONIZATION OF APRICOT CULTIVATION IN THE ČAČAK REGION - AN ADAPTATION MEASURE TO CLIMATE CHANGE

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The area around Čačak is known for its fruit production, particularly of plums, apricots, and apples. This region contains 11% of the total number of apricot trees in Serbia, and in productive years, it produces 3,000 to 4,000 tons of apricots (12-15% of Serbia's total production). Fluctuations in production from year to year and from orchard to orchard are primarily due to unfavorable climatic conditions (spring frosts). Over ten years (2015 – 2024), 22 apricot orchards in the northwestern part of Čačak were monitored. Special attention was given to ensure that the orchards were situated in both the lowest (250-300 meters above sea level) and highest parts of the region (500-550 meters above sea level), as well as in its central parts. For each orchard, data on altitude, terrain slope, orchard exposure, and the horizontal and vertical distance from the nearest watercourse were recorded. Two weather stations (iMETOS IMT 300, Pessl Instruments, Weiz, Austria) were installed, one at 255 meters above sea level and the other at 380 meters above sea level. Meteorological data, especially the lowest winter temperatures and occurrences of frost during and after flowering, were monitored. Over the 10 years, yields varied significantly. Analysis of the data identified the locations with the most stable yields and resulted in the creation of a regionalization map. The optimal zone for apricot cultivation was found to be at an altitude of 320 – 450 meters above sea level, provided that the orchard is located at a minimum elevation difference of 30 meters from the nearest watercourse. Zones at increased risk are within 300 – 320 meters and 450 – 500 meters above sea level. Outside these limits (below 300 and above 500 meters, and in parcels with less than 30 meters elevation difference from the nearest watercourse), apricot orchards should not be established.

Keywords: apricot, location, temperature, altitude

II/U3

KARAKTERIZACIJA ZEMLJIŠTA VINOGRADA U SRBIJI: VAŽNOST, VREME I OBIM ANALIZA

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Autentičnost vina i zaštićene geografske oznake vina povezuju se s mestom nastanka, odnosno prirodnim karakteristikama područja, uključujući zemljište, kao i za druge komponente *terroir*-a. Kod karakterizacije zemljišta vinograda kao identiteta jedne vinarije, često se opisno navode karakteristike zemljišta bez utemeljenih istraživanja i analiza. Ovaj rad se bavi potrebnim elementima karakterizacije zemljišta, počev od pedoloških istraživanja i određivanja autohtonog tipa zemljišta, fizičkih karakteristika, parametara plodnosti uključujući makro i mikroelemente, sadržaja opasnih i štetnih materija, do bioloških karakteristika zemljišta. Pored toga, navedeni su razvijeni modeli za geostatističku obradu i prostorno mapiranje podataka. Materijal objedinjuje karakterizaciju zemljišta šest vinogradarskih rejona tokom prethodno realizovanih projekata: Pocersko-Valjevskog, Vranjskog, Niškog, Mlavskog, rejona Tri Morave i Šumadijskog. U ovom radu se razmatra i adekvatno vreme analiza i karakterizacije zemljišta. Zemljište pod vinogradima je pod jakim antropogenim uticajem, gde čovek moćnim meliorativnim merama u zasnivanju u velikoj meri menja prirodne karakteristike zemljišta, stvarajući tip zemljišta Rigosol. Detaljnije analize zemljišta se najčešće sprovode prilikom zasnivanja vinograda, dok naknadno sprovedene meliorativne mere značajno menjaju ovo početno stanje. Nivo intervencije prilikom zasnivanja je neophodan u cilju unapređenja zemljišta i stvaranja optimalnih uslova za rast i razvoj vinove loze, što se odražava na kvalitet grožđa i time predstavlja zaštitu i održivost cele investicije. Nakon zasnivanja vinograda, zemljište je potrebno ponovo karakterisati, dalje pratiti i pažljivo održavati u stalno dobrom stanju. Ovo se posebno odnosi na meliorativne mere koje je potrebno kontinuirano sprovoditi, kao što su kalcizacija i fosfatizacija u većini ispitivanih vinogradarskih rejona. Investicija u analize i karakterizaciju zemljišta je opravdana u poređenju sa ostalim potrebnim ulaganjima u vinogradarstvu i spram rezultata koji se mogu ostvariti unapređenjem zemljišta.

Ključne reči: zemljište, vinogradi, tipovi zemljišta, analiza zemljišta, karakterizacija zemljišta

II/U3

VINEYARD SOIL CHARACTERIZATION IN SERBIA: IMPORTANCE, TIMING, AND SCOPE OF ANALYSIS

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The authenticity of wine and protected geographical indications are associated with the place of origin, specifically the natural characteristics of the area, including the soil, as well as other components of the *terroir*. In the characterization of vineyard soils as the identity of a winery, soil characteristics are often described without substantiated research and analysis. This paper addresses the necessary elements of soil characterization, starting with pedological research and the determination of the indigenous soil type, water-physical characteristics, fertility parameters including macro and microelements, the absence of hazardous and harmful substances, and biological soil characteristics. Additionally, developed models for geostatistical processing and spatial mapping of data are presented. The material consolidates the characterization of soils from six vineyard regions during previously implemented projects: Pocerina-Valjevo, Vranje, Niš, Mlava, Tri Morave, and Šumadija regions. This paper also examines the appropriate timing for soil analysis and characterization. Vineyard soils are under strong anthropogenic influence, where powerful ameliorative measures at the establishment significantly alter the natural soil characteristics, creating a type of soil known as Rigosol. Detailed soil analyses are most often conducted at the time of vineyard establishment, while subsequent ameliorative measures significantly change this initial state. The level of intervention at the establishment is necessary to improve the soil and create optimal conditions for the growth and development of the vine, which affects grape quality and thus represents the protection and sustainability of the entire investment. After the vineyard is established, the soil needs to be re-characterized, further monitored, and carefully maintained in a consistently good condition. This is particularly true for ameliorative measures that need to be continuously implemented, such as liming and phosphatization in most of the examined vineyard regions. Investment in soil analysis and characterization is justified compared to other necessary investments in viticulture and the results that can be achieved by improving the soil.

Keywords: soil, vineyards, soil types, soil analysis, soil characterization

II/U4

PROCENA POTREBE ZA NAVODNJAVANJEM ŠLJIVE (*Prunus domestica* L.) U TOPLIČKOM OKRUGU U USLOVIMA KLIMATSKIH PROMENA

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Najveća proizvodnja šljive (*Prunus domestica* L.) u Srbiji odvija se u Topličkom okrugu, na površini od oko 6500 ha, što čini 50% ukupne voćarske proizvodnje ovog okruga. Proizvodnja šljive na ovom području pretežno se odvija u uslovima prirodnog vlaženja (bez navodnjavanja). Projekcije buduće klime ukazuju da se na teritoriji Srbije može očekivati povećanje temperature vazduha, što potencijalno može ugroziti proizvodnju ove voćne vrste, posebno sa aspekta povećanja potrebe za vodom. Stoga, u ovom radu ispitan je uticaj klimatskih promena na potrebe šljive za navodnjavanjem, kako bi poljoprivrednici Topličkog okruga mogli da planiraju i prilagode proizvodnju ove voćne vrste budućim klimatskim uslovima. Potreba za vodom određena je na osnovu klimatskih podataka za referentni period (1986-2005 (R)), period bliske budućnosti (2021-2040 (I)), period sredine veka (2041-2060 (II)) i kraj veka (2081-2100 (III)). Za pomenute periode proračunata je evapotranspiracija kulture (šljive) – ETc, zatim efektivne padavine – Pe i deficit vode – In. Klimatski podaci za R, I, II i III period dobijeni korišćenjem ansambla od osam regionalnih klimatskih modela iz baze EURO CORDEX projekta. Rezultati ukazuju da će se deficit vode povećavati do kraja veka i to za čak 77 mm i 197,5 mm u nezatravljenim i 84,99 mm i 222,57 mm u zatravljenim zasadima u II i III periodu, redom u odnosu na referentni period. Najveći deficiti vode očekuju se u periodu od cvetanja do sazrevanja plodova, a do kraja veka iznose 134,50 mm i 150,17 mm u nezatravljenim i zatravljenim zasadima, redom. Posebno je važno istaći da je šljiva tokom obrazovanja koštice (20-30 dana od cvetanja) najosetljivija na nedostatak vode, te se može očekivati opadanje zametnutih plodova i smanjenje prinosa. Na osnovu navedenih rezultata može se uvideti značajno povećanje potrebe šljive za navodnjavanjem u Topličkom okrugu do kraja veka, te da će za postizanje visokih prinosa biti neophodna primena zalivnih sistema.

Ključne reči: navodnjavanje, klimatske promene, šljiva, Toplički region

ASSESSMENT OF IRRIGATION REQUIREMENTS FOR PLUMS (*Prunus domestica* L.) IN THE TOPLICA DISTRICT UNDER CLIMATE CHANGE CONDITIONS

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The largest plum (*Prunus domestica* L.) production in Serbia occurs in the Toplica District, covering an area of approximately 6,500 hectares, which constitutes 50% of the district's total fruit production. Plum cultivation in this area is primarily rainwater-reliant (non-irrigated). Projections of future climate conditions indicate a potential increase in air temperature in Serbia, which could threaten the production of this fruit species, particularly regarding increased water requirement. Therefore, this study examines the impact of climate change on the irrigation water needs of plums to enable producers in the Toplica District to plan and adapt their production of this fruit species to the future climatic conditions. Crop water requirement was determined based on climate data for the reference period (1986-2005 (R)), near-term period (2021-2040 (I)), mid-century period (2041-2060 (II)), and end-of-century period (2081-2100 (III)). For these periods, the plum evapotranspiration (ETc), effective precipitation (Pe), and water deficit (In) were calculated. Climate data for the R, I, II, and III periods were obtained using an ensemble of eight regional climate models from the EURO CORDEX project database. The results indicate that the water deficit will increase until the end of the century, by as much as 77 mm and 197.5 mm in non-grassed and 84.99 mm and 222.57 mm in grassed orchards during the II and III periods, respectively, compared to the reference period. The greatest water deficits are expected during the period from flowering to fruit ripening, reaching up to 134.50 mm and 150.17 mm in non-grassed and grassed orchards, respectively, by the end of the century. It is particularly important to note that plums are most sensitive to water deficiency during the stone hardening phase (20-30 days after flowering), which could result in fruit drop and yield reduction. Based on these results, a significant increase in the irrigation water requirement of plums in the Toplica District is anticipated by the end of the century, and the implementation of irrigation systems will be necessary to achieve high yields.

Keywords: irrigation, climate change, plum, Toplica district

II/PO3

ENOLOGIJA U DUHU KLIMATSKIH PROMENA

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Optimalni uslovi za gajenje vinove loze, a posebno za postizanje visokog kvaliteta vina, postoje ukoliko su u svom delovanju usklađeni sledeći klimatski činioci: sunčeva svetlost, temperatura, padavine i vetar. Poznato je da korišćenje fosilnih goriva dovodi do povećanja količine CO_2 i drugih gasova odgovornih za efekat staklene bašte i globalnog zagrevanja. Koncentracija CO_2 na početku 20. veka bila je 260 ppm, danas je 380 ppm, a do kraja 21. veka očekuje se nivo od 450 do 1000 ppm. Povišene temperature kao posledica navedenih promena prouzrokuju skraćenje vremena potrebnog za sazrevanje grožđa za 10 do 15 dana, pri čemu svi delovi bobice ne postižu potrebnu zrelost. Kao rezultat ovoga grožđe se bere pre postizanja pune zrelosti, što se posebno odnosi na pokožicu i semenke. U proizvodnji crvenih vina, veoma važan, ako ne i odlučujući uticaj na kvalitet vina ima stepen zrelosti pokožice, naročito semenki, koje često do momenta berbe ne postižu svoju zrelost. Navedena klimatske promene zbog svega rečenog utiču na sve izraženiju neravnotežu između tehnološke (industrijske) i fenolne zrelosti. Ova neravnoteža znači da se trpkost različito razvija u različitim delovima bobice, što objašnjava zašto vina od nezerlog grožđa sadrže mnogo adstringentnih tanina iz semenki i relativno malo tanina iz pokožice bobice. Kod belih sorti grožđa beleži se pomeranje vremena berbe, naročito kod ranih sorti poput Šardonea i Pino blana ka avgustu mesecu. Berba grožđa belih sorti za proizvodnju vina "*in stricto sensu*" se sprovodi kada u proseku sadrže oko 21 - 22% šećera i uprkos pomerenoj, uslovno rečeno ranijoj berbi, šira sadrži nizak sadržaj titrabilnih kiselina i visoku pH vrednost. Ovako nizak sadržaj kiselina u startu, tokom fermentacije a kasnije i tokom odležavanja vina zavisno od uslova, opada za 30 do 60 %, što se odražava na svežinu, sazrevanje i mikrobiološku stabilnost vina. Takođe, bele sorte u dugim periodima suše nakupljaju visok sadržaj proteina, što iz godine u godinu iziskuje sve veće količine upotrebljenog bentonita za njihovo uklanjanje, kako bi se izbeglo zamućenje budućeg vina i učinilo vino stabilnim. Ovo sredstvo za posledicu kod pojedinih sorti dovodi do osiromašenja vina u aromatičnim materijama a takođe i u ekstraktu što se odražava na punoću (telo) vina. U radu su predstavljene dinamike količine šećera i kiselina pojedinih belih sorti vinogorja Srbije desetak godina unazad, kao i količine bentonita upotrebljene za bistrenje šire, kao i za naknadno bistrenje vina.

Ključne reči: globalno zagrevanje, šira belog grožđa, titrabilni aciditet

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II/PO3

OENOLOGY IN THE SPIRIT OF CLIMATE CHANGES

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Optimal conditions for viticulture and especially for the production of quality wines are given when the following climatic factors are in harmony: solar radiation, temperature, rainfall and wind. We know that the use of fossil fuels leads to an increase in CO_2 and other gases that are responsible for the greenhouse effect and global warming. The CO_2 concentration at the beginning of the 20th century was 260 ppm, today it is 380 ppm and is expected to reach 450-1000 ppm by the end of the 21st century. Increased temperatures as a result of these changes will shorten the ripening period of the grapes by 10 to 15 days, during which time not all parts of the berry will reach full ripeness. As a result, the grapes are harvested before they are fully ripe, especially the skins and seeds. In the production of red wines, the degree of ripeness of the skin has a very important, if not decisive, influence on the quality of the wine, especially in the case of the seeds, which often only ripen at harvest. The climatic changes mentioned above are leading to an increasing imbalance between technological (industrial) and phenolic maturity. This imbalance means that astringency develops differently in the different parts of the berry, which may explain why wines from unripe grapes contain many astringent tannins from the seeds and relatively few tannins from the skin of the berry. In the case of white grape varieties, the harvest time shifts to the month of August, especially for early varieties such as Chardonnay and Pinot Blanc. The grapes of white varieties for the production of wine "*in stricto sensu*" are harvested when they contain an average of around 21 - 22% sugar, and despite the postponed, conditionally earlier harvest, the must contains a low content of titratable acids and a high pH value. This low acidity decreases by 30 to 60%, during fermentation and later during the aging of the wine, depending on the conditions, which is reflected in the freshness, maturation and microbiological stability of the wine. The white varieties also accumulate a high protein content during long dry periods, which requires increasing amounts of bentonite used from year to year to remove it so that the future wine does not become cloudy and remains stable. As a result, in certain varieties, this agent leads to a depletion of the wine's aromatic substances and also of the extract, which is reflected in the fullness (body) of the wine. The article presents the dynamics of sugar and acidity levels of certain white wine varieties in Serbian vineyards ten years ago, as well as the amount of bentonite used to clarify the must and the subsequent clarification of the wine.

Keywords: global warming, white wine must, titrabile acidity

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UTICAJ TEMPERATURE VAZDUHA NA DINAMIKU RASTA I KVALITET PLODA JABUKE

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U periodu od tri godine (2018–2020) u ataru sela Dolova, opština Pančevo ispitivan je uticaj temperature vazuha tokom letnjih meseci na dinamiku rasta i kvalitet ploda kod najvažnijih sorti jabuka. U zasadu jabuke, nakon obavljene hemijske i ručne prorede plodova, počev od 1. juna kod 20 izabranih plodova, meren je prečnik. Merenja su vršena na svakih sedam dana, do početka berbe. Berba plodova je obavljena između fiziološke i pune zrelosti. Nakon berbe, određen je ukupan prinos po stablu i izmerena je masa ploda. Prosečna srednja dnevna temperatura vazduha u ispitivanom periodu bila je najveća 2018. godine (21,1 ºC), a najmanja 2020. godine (20,1 ºC). Srednja dnevna temperatura vazduha za isti period u 2019. godini iznosila je 20,4 ºC. Kod sve četiri ispitivane sorte (Gala, Crveni delišes, Zlatni delišes i Greni smit), najmanji dnevni prirast su imali plodovi tokom 2018. godine. Prosečno, on je iznosio od 0,31 mm kod sorte Gala do 0,36 mm kod sorte Zlatni delišes. Kod sorte Gala najveći prosečan dnevni prirast plodova, zabeležen je u 2019. godini (0,39 mm), kod sorte Crveni delišes u 2019. godini (0,41 mm), a kod sorte Greni smit u 2020. godini (0,42 mm). Sve četri ispitivane sorte su imale izrazito usporen dnevni rast plodova u periodu od kraja jula do sredine avgusta 2018. godine, što se poklapa sa ekstremno visokim temperaturma u tom periodu godine. Pojava visokih temperatrua, značajno je uticala na rast plodova, što je dovelo do smanjenje prosečne mase ploda tokom berbe. Ovo se naročito zapaža kod sorti Gala, Crveni delišes i Greni smit.

Ključne reči: jabuka, temperatura vazduha, dinamika rasta ploda

INFLUENCE OF AIR TEMPERATURE ON GROWTH DYNAMICS AND QUALITY OF APPLES

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In the period of three years (2018–2020) in the region of the village of Dolovo, municipality of Pančevo, the influence of air temperature during the summer months on the growth dynamics and fruit quality of the most important apple varieties was investigated. In the apple orchard, after chemical and manual fruit thinning, starting from June 1, the diameter of 20 selected fruits was measured. Measurements were made every seven days, until the start of the harvest. Fruits were harvested between physiological and full maturity. After harvesting, the total yield per tree was determined and the weight of the fruit was measured. The average mean daily air temperature in the examined period was the highest in 2018 (21.1 ºC), and the lowest in 2020 (20.1 ºC). The average daily air temperature for the same period in 2019 was 20.4 ºC. In all four tested varieties (Gala, Delicious, Golden Delicious and Granny Smith), the fruits had the smallest daily increment during 2018. Average values varied from 0.31 mm for the Gala variety to 0.36 mm for the Golden Delicious variety. In the Gala variety, the highest average daily fruit increment was recorded in 2019 (0.39 mm), in the Delicious variety in 2019 (0.41 mm), and in the Granny Smith variety in 2020 (0.42 mm). All four examined varieties had extremely slow daily fruit growth in the period from the end of July to the middle of August 2018, which coincides with extremely high temperatures in that period of the year. The occurrence of high temperatures significantly affected fruit growth, which led to a decrease in average fruit weight during harvest. This is especially noticeable in the varieties Gala, Delicious andGranny Smith.

Keywords: apple, air temperature, dynamics of fruit growth

II/P2

SEZONSKO VARIRANJE BOJE POKOŽICE RAZLIČITIH KULTIVARA JABUKA

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Boja pokožice je jedan od najvažnijih atributa jabuke, budući da potrošači povezuju boju s svježinom, što je ključno za prihvaćanje plodova jabuke u usporedbi s drugima. Jednostavni algoritmi temeljeni na jednoj L*, a*, b* koordinati korišteni su za klasifikaciju plodova s karakterističnom bojom kožice. Cilj istraživanja provedenog između 2017. i 2018. godine bio je evaluirati sezonsku promjenu boje tri sorte jabuka ('Golden Delicious', 'Idared' i 'Jonagold'). Plodovi su ubrani sa stabala posađenih na podlozi M.9 u pojedinačnim redovima 3,8 × 1,2 m, a stabla su imala oblik vretena. Voćnjak je bio zaštićen i održavan u skladu s preporukama za integralne komercijalne voćnjake. Uzorak se sastojao od 30 plodova svake sorte, ubranih s 9 stabala. Plodovi su ubrani u fazi fiziološke zrelosti. Boja pokožice jabuka mjerena je ručnim tristimulus reflektantnim kolorimetrom Konica Minolta (Chroma meter CR-400, Sensing Inc). Numeričke vrijednosti a* i b* pretvorene su u ugao nijanse (h°) i hromu (C). Analizirani CIE L* a* b* parametri ilustrovali su razlike u osnovnoj boji pokožice između sorti jabuka. Najveće vrijednosti svjetloće, a*, b* koordinata i hrome (C) zabilježene su kod sorte 'Golden Delicious' tokom obje sezone, dok je kod ove sorte registrovan najmanji ugao nijanse u obje sezone. Kod sorti 'Golden Delicious' i 'Idared' utvrđeno je značajno variranje svih parametara boje između sezona uzgoja, sa izuzetkom parametra b* kod sorte 'Idared'. Značajne sezonske varijacije parametara boje kod sorte 'Jonagold' nisu uočene, osim u slučaju ugla nijanse. Između sorti 'Jonagold' i 'Idared' su utvrđene, u obje eksperimentalne sezone, značajne razlike u svim parametrima boje, osim u uglu nijanse u drugoj sezoni.

Ključne reči: sorte jabuke, sezona, analiza boje, CIE L*a*b*

II/P2

SEASONAL SKIN COLOR VARIATIONS IN VARIOUS APPLE CULTIVARS

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Skin color is one of the most important attributes of apple, since consumers associate it with freshness and it is critical in the acceptance of apple fruits among other attributes. Simple algorithms based on a single L*, a*, b* coordinate have been used for the classification of fruits with a characteristic skin color. The aim of the research conducted between 2017 and 2018 was to evaluate seasonal color variation of three apple cultivars ('Golden Delicious', 'Idared' and 'Jonagold'). Fruits were picked from trees planted on M.9 rootstock in single 3.8 × 1.2 m rows, the trees having a spindle shape. The orchard was protected and maintained in line with the recommendations for integrated commercial orchards. The sample size was 30 fruits of each cultivar picked from 9 trees. The fruits were collected in the physiological maturity stage. The apple skin color was measured with a handheld tristimulus reflectance Konica Minolta colorimeter (Chroma meter CR-400, Sensing Inc). The numerical values of a* and b* were converted into Hue angle (h°) and chroma (C). The analyzed CIE L* a* b* parameters illustrated the differences in the skin base color between apple cultivars. The greatest value of lightness, a*, b* coordinates and chroma (C) were observed in cultivar 'Golden Delicious' during both seasons, while in this cultivar was registered the minimum hue angle in both seasons. In the 'Golden Delicious' and 'Idared' cultivars, significant variation in all color parameters between growing seasons was obtained, except for the b* parameter in the 'Idared' cultivar. Significant seasonal variations in color parameters for the 'Jonagold' cultivar were not registered, except for the hue angle. Between the 'Jonagold' and 'Idared' cultivars in both experimental seasons the significant differences in all color parameters were found, except for the Hue angle in the second season.

Keywords: apple cultivars, season, color analysis, CIE L*a*b*

II/P3

POLOŽAJ I MORFO-ANATOMIJA FLORALNIH NEKTARIJA KRUŠKE (*Pyrus communis* L.) SORTE „KIEFFER"

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Floralne nektarije kruške sorte „Kieffer" su proučene pomoću svetlosnog mikroskopa (LM) i skenirajućeg elektronskog mikroskopa (SEM) u cilju istraživanja potencijalne uloge nektarijskih stoma u infekciji biljke patogenom bakterijom. Pomoću SEM-a proučeni su položaj i površinska struktura žlezde, uključujući veličinu i gustinu stoma. Pregledom uzdužnih preseka cvetova pod LM-om omogućena je detaljna analiza celokupne strukture žlezdanog tkiva koja je obuhvatila merenje veličine epidermalnih i sekretornih ćelija i debljine kutikule, brojanje slojeva sekretornih ćelija i opis strukture stoma. SEM istraživanje je otkrilo da se floralne nektarije kruške nalaze na adaksijalnoj površini levkastog receptakuluma, oblažući unutrašnju šoljoliku površinu hipantijuma bezmalo do osnove najdubljeg kruga prašnika, ali prostirući se u kontinuitetu takođe niz zidove uske cevaste šupljine koja okružuje osnove stubića, skoro dostižući do plodnika. Nektarije su zaštićene slojem relativno tanke i glatke kutikule koja prekriva spoljašnju konveksnu površinu epidermalnih ćelija. Pošto su modifikovane stome, gusto i ravnomerno raspoređene po celoj površini nektarija, izlučeni nektar se obilno akumulira u šoljolikoj strukturi hipantijuma. Analiza svetlosnim mikroskopom otkrila je da se nektarijsko tkivo sastoji od jednoslojnog epidermisa izgrađenog od perpendikularno izduženih ćelija prekrivenih kutikulom i višeslojnog subepidermalnog sekretornog tkiva, sastavljenog od 7-11 redova metabolički veoma aktivnih malih i kompaktnih ćelija nepravilnog oblika sa tamno obojenim protoplastom. Ispod žlezdanog, nalazi se nežlezdani parenhim hipantijuma prožet provodnim snopićima koji se jasno razlikuje po primetno krupnijim ćelijama. Modifikovane stome, kroz koje se luči nektar, formirane su od dve specijalizovane ćelije koje nemaju sposobnost regulisanja veličine otvora koji neposredno vodi u veliki međućelijski prostor – stominu duplju. Kapljice nektara u različitim fazama sekrecije su veoma često zapažene iznad otvorenih stoma u obliku mehurića različite veličine koji se izlučuju na površinu nektarije.

Ključne reči: kruška, floralne nektarije

II/P3

THE POSITION AND MORPHO-ANATOMY OF FLORAL NECTARIES OF PEAR (*Pyrus communis* L.) CULTIVAR 'KIEFFER'

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The floral nectary of pear cultivar 'Kieffer' was studied using a light microscope (LM) and scanning electron microscope (SEM) in order to explore a possible glandular stomatal contribution in plant patogenic bacterial infection. SEM allowed the position of the gland to be specified and surface structure, including stomatal size and density, to be observed. An examination of longitudinal sections of flowers under LM allowed the entire glandular tissue area to be analyzed in detail by measuring the size of epidermal and secretory cells and the thickness of the cuticle, as well as by counting the secretory cell layers and describing the stomatal structure. The SEM study reveals that the pear floral nectary is located on the adaxial surface of the funnel-shaped flower receptacle, lining the inner cup-like surface of the hypanthium and extending apically almost to the insertion point of the innermost filaments. To the opposite side, its large part extends down the walls of the narrow tubular cavity surrounding the style bases, nearly reaching the apical part of the ovary. The nectary is protected by a layer of relatively thin cuticle covering the outer convex surface of the epidermal cells. Since modified stomata, throughout which nectar is secreted, are densely and evenly distributed over the entire nectary surface, the secretion accumulates abundantly in cup-shaped structure of hypanthium. The nectariferous tissue, viewed by LM, is composed of a single-layered epidermis of perpendicularly elongated cells covered with a cuticle, overlying multi-layered subepidermal secretory tissue, composed of 7-11 rows of metabolically very active small and compact cells irregular in shape with dark-staining protoplasts. The subnectariferous nonglandular parenchyma, located in the hypanthium and associated with vascular bundles, is clearly different from those of the adjacent multi-layered nectariferous parenchyma by the noticeably larger cells. The nectar is secreted through modified stomata with large substomatal chambers underneath. Nectar droplets in various stages of secretion is very often observed above open stomata in the form of bubble-like appearance moving towards the surface.

Key words: pear, floral nectary

II/P4

OPTIMIZACIJA STERILIZACIJE ZA USPOSTAVLJANJE *IN VITRO* KULTURE AUTOHTONIH SORTI ŠLJIVE

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Cilj ovog istraživanja je bio utvrđivanje najefikasnijeg protokola sterilizacije za uspostavljanje *in vitro* kultura devet bezvirusnih autohtonih genotipova šljive (‘Belošljiva’, ‘Crvena Ranka’, ‘Crnošljiva’, ‘Cerovački Piskavac’, ‘Dragačevka’, ‘Moravka’, ‘Požegača’, ‘Sitnica’ i ‘Trnovača’) i tri genotipa zaražena plum pox virusom (‘Belošljiva’ PPV+, ‘Crvena Ranka’ PPV+ i ‘Sitnica’ PPV+). Testirani agensi za sterilizaciju su bili varikina i živa(II)hlorid ($HgCl_2$), svaki u kombinaciji sa etanolom. Aseptične kulture su uspostavljene korišćenjem jednonodalnih reznica sa mladara sakupljenih tokom proleća (april–jun). Sterilizacije je uključivala: potapanje reznica u mlaku vodu sa nekoliko kapi Tween 20, ispiranje pod tekućom vodom iz česme, sterilizaciju sa 70% etanolom, zatim tretman sa 10% (v/v) varikinom (15 minuta) ili 0,1% $HgCl_2$ (tri minuta samostalno ili u kombinaciji sa 0,01% Tween 20), i finalno ispiranje sa sterilnom destilovanom vodom. Nakon sterilizacije, eksplantati su gajeni na Murashige & Skoog medijumu sa 2 mg/l N6-benziladenin, 0,5 mg/l indol-3-buterne kiseline, i 0,1 mg/l giberelinske kiseline. Nakon četiri nedelje su utvrđeni procenti kontaminacije, nekroze i uspešnog pokretanja sterilnih lisnih rozeta. Svaki tretman sterilizacije je uključivao 15-20 eksplanata po genotipu i ponovljen je tri puta. Generalno, $HgCl_2$ (0,1%) primenjen tri minuta, sam ili sa Tween 20, se pokazao kao efikasniji za indukciju sterilnih lisnih rozeta u poređenju sa 10% varikinom (15 minuta). Međutim, ‘Sitnica’ PPV+ i ‘Moravka’ nisu pokazali značajne razlike između tretmana. ‘Cerovački Piskavac’ je imao veći procenat inicijacije sa varikinom. Procenat regeneracija je varirao od 6,2% do 61,1% sa varikinom, i od 12,5% do 90% i 17,4% do 77,1% sa $HgCl_2$ primenjenim samostalno ili sa Tween 20, po redosledu. Najviši procenat inicijacije (90,0%) je postignut kod ‘Dragačevke’ nakon tretmana sa $HgCl_2$, dok je najniži (6,2%) bio kod ‘Sitnice’ sa varikinom. Uprkos svojoj efikasnosti, $HgCl_2$ je pokazao veću toksičnost, što je dovelo do povećane nekroze i neuspeha inicijacije rozeta kod nekoliko genotipova. Ova studija naglašava važnost optimizacije protokola sterilizacije za uspešno uspostavljanje *in vitro* kultura autohtonih šljiva, uz pažljivo razmatranje toksičnosti $HgCl_2$.

Ključne reči: *Prunus domestica* L., *in vitro* kultura, sterilizacija, varikina, živa(II)hlorid

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II/P4

STREAMLINING STERILIZATION FOR *IN VITRO* CULTURES OF INDIGENOUS PLUM CULTIVARS

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This study aimed to determine the most effective sterilization protocol for initiating *in vitro* cultures of nine virus-free autochthonous plum genotypes ('Belošljiva', 'Crvena Ranka', 'Crnošljiva', 'Cerovački Piskavac', 'Dragačevka', 'Moravka', 'Požegača', 'Sitnica', and 'Trnovača') and three PPV-infected genotypes ('Belošljiva'PPV+, 'Crvena Ranka' PPV+, and 'Sitnica' PPV+). The sterilizing agents tested were bleach, mercuric chloride ($HgCl_2$), each combined with ethanol. Aseptic cultures were established using single-node cuttings from branches collected during the spring (April–June). The sterilization procedure involved submergence in lukewarm water with few drops of Tween 20, washing under running tap water, sterilization with 70% ethanol, followed by treatment with either 10% (v/v) commercial bleach solution (15 minutes) or 0.1% $HgCl_2$ (3 minute-treatment alone or in combination with 0.01% Tween 20), and finally, rinsing with sterile distilled water. Post-sterilization, explants were cultured on Murashige & Skoog medium supplemented with 2 mg/l N6-benzyladenine, 0.5 mg/l indole-3-butyric acid, and 0.1 mg/l gibberellic acid. Over four weeks, the percentages of contamination, necrosis, and successful initiation of sterile leaf rosettes were recorded. Each sterilization treatment involved 15-20 explants per genotype, repeated three times. $HgCl_2$ (0.1%) for three minutes, alone or with Tween 20, generally yielded higher rosette initiation percentages compared to a 15-minute treatment with 10% bleach. However, 'Sitnica'PPV+ and 'Moravka' showed no significant differences between treatments. 'Cerovački Piskavac' had a higher initiation percentage with bleach. Regeneration ranged from 6.2% to 61.1% with bleach, and from 12.5% to 90% and 17.4% to 77.1% with $HgCl_2$ alone or with Tween 20, respectively. The highest initiation percentage (90.0%) was in 'Dragačevka' after $HgCl_2$ treatment, while the lowest (6.2%) was in 'Sitnica' with bleach. Despite its effectiveness, $HgCl_2$ exhibited higher toxicity, leading to increased necrosis and failed rosette initiation in several genotypes. This study underscores the importance of optimizing sterilization protocols for successful *in vitro* culture of indigenous plums, with careful consideration of $HgCl_2$'s toxicity.

Keywords: *Prunus domestica* L., *in vitro* culture, sterilization, bleach, mercuric(II)chloride

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II/P5

EFEKAT ZADIMLJAVANJA NA SMANJENJE IZMRZAVANJA CVETOVA I POBOLJŠANJE PROIZVODNIH OSOBINA SORTE TREŠNJE 'KARMEN'

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Poslednjih godina proizvodnja trešnje u Srbiji se suočava sa klimatskim promenama u kojima prolećni mrazevi mogu u potpunosti da limitiraju proizvodnju plodova ove vrste. Postoji veći broj načina sprečavanja dejstva delovanja niskih temperatura, a zadimljavanje u uslovima Srbije predstavlja jednu od najčešće primenjivanih mera. Ispitivanje je sprovedeno 2021. godine tokom pojave apsolutne minimalne temperature vazduha -1,6 °C. Cvetni pupoljci sorte Karmen na podlozi Gizela 6, su se nalazili u fenofazi belih balona (BBCH 57). Za zadimljavanje je korišćena mešavina vlažne i suve slame kako bi se obezbedilo formiranje dimne zavese, postepenim sagorevanje navedenog materijala. Zadimljavanje je vršeno tokom 3 časa najnižih izmerenih temperatura. Komparativan uticaj zadimljavanja je analiziran na tretiranoj parceli i kontrolnoj parceli gde nije vršeno zadimljavanje tokom dejstva poznog mraza. Osim stepena izmrzavanja, utvrđen je i efekat na vreme sazrevanja, prinos i kvalitativna svojstva ploda. Zadimljavanje je imalo efekat na povećanje temperature za 0,8°C u tretiranom zasadu. Povećanje temperature imalo je efekat smanjenja stepena izmrzavanja cvetova u fazi belih balona (23,64%) u poređenju sa kontrolnim tretmanom gde je procenat izmrzavanja bio znacajnije veći (38,73%). Plodovi sa tretirane parcele sazrevali su dva dana ranije u odnosu na kontrolnu parcelu. Dejstvo zadimiljavanja se odrazilo na povećanje prinosa na tretiranoj parceli, dok nije imalo značajan uticaj na kvalitet plodova u odnosu na netretiranu površinu.

Ključne reči: trešnja, zadimljavanje, oštećenja od mraza, proizvodne osobine, kvalitet ploda

Zahvalnica: Ovaj rad je realizovan u okviru ugovora o finansiranju naučnoistraživačkog rada između Univerziteta u Beogradu, Poljoprivrednog fakulteta i Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (br. 451-03-65/2024-03/200116).

II/P5

THE EFFECTS OF SMOKE FUMIGATION ON REDUCING FLOWER FROST DAMAGE AND THE IMPROVEMENT OF THE PRODUCTION TRAITS OF THE 'CARMEN' CHERRY VARIETY

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In recent years, sweet cherry production in Serbia has been facing climate change, where spring frosts can completely limit the production of this fruit. There are several ways to prevent the effects of low temperatures, and smoke fumigation in Serbian conditions is one of the most commonly applied measures. The study was conducted in 2021 during the occurrence of an absolute minimum air temperature of -1.6 °C. Flower buds of the Carmen cultivar on the Gisela 6 rootstock were in the white balloon phenophase (BBCH 57). A mixture of wet and dry straw was used for smoking to ensure the formation of a smoke curtain through the gradual burning of the material. Smoking was carried out for 3 hours during the lowest temperatures measured. The comparative effect of smoking was analyzed on the treated plot and the control plot where smoking was not performed during the late frost. In addition to the degree of freezing, the effects on ripening time, yield, and the qualitative properties of the fruit were also determined. Smoking caused an increase of 0.8 °C in the temperature of the treated orchard. The increase in temperature resulted in a reduction in the degree of freezing of the flowers in the white balloon phase (23.64%) compared to the control treatment, where the percentage of freezing was significantly higher (38.73%). Fruits from the treated plot ripened two days earlier compared to the control plot. The effect of smoking was reflected in an increase in yield in the treated plot, while it had no a significant impact on the quality of the fruits compared to the untreatedplot.

Keywords: sweet cherry, smoke fumigation, frost damage, productive traits, fruit quality

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II/P6

UTICAJ VARIJANTE OPRASIVANJA NA ZAMETANJE PLODOVA SORTE VISNJE LENKA

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'Lenka' je sorta višnje (*Prunus cerasus* L.) stvorena na Poljoprivrednom fakultetu Univerziteta u Beogradu, priznata 2014. godine. Zbog krupnog ploda i prijatnog ukusa preporučuje se za stonu potrošnju i preradu. Kako je jedan od najvažnijih koraka u tehnologiji gajenja višnje izbor adekvatnih oprašivača, cilj ovog rada je bio da se ispita zametanje plodova u različitim varijantama oprašivanja (samooprašivanje, slobodno oprašivanje i unakrsno oprašivanje polenom sorti 'Érdi Bötermö', 'Sofija' i 'Šumadinka', i na osnovu toga preporuče adekvatni oprašivači za sortu 'Lenka'. Ogled je realizovan u kolekcionom zasadu višnje na Oglednom dobru "Radmilovac" Poljoprivrednog fakulteta u Beogradu tokom trogodišnjeg perioda (2022–2024). Funkcionalna sposobnost polena oprašivača i sorte 'Lenka' utvrđena je primenom testa klijavosti *in vitro* na hranljivoj podlozi sa 1% agara i 12% saharoze, na temperaturi od 17°C. Efikasnost oplođenja utvrđena je poređenjem broja inicijalno (28 dana nakon oprašivanja) i finalno (u fazi sazrevanja ploda) zametnutih plodova u odnosu na broj oprašenih cvetova. Prosečne vrednosti klijavosti polena *in vitro* su varirale od 14,90% ('Érdi Bötermö') do 34,70% ('Šumadinka'). Broj inicijalno i finalno zametnutih plodova se razlikovao između primenjenih varijanti oprašivanja. Očekivano, najmanji broj inicijalno i finalno zametnutih plodova dobijen je u varijanti samooprašivanja (31,20% i 3,90%, respektivno). Najmanji broj inicijalno zametnutih plodova utvrđen je u varijanti unakrsnog oprašivanja sortom 'Érdi Bötermö' (32,10%), a najveći pri slobodnom oprašivanju (41,00%). Nasuprot ovome, najviše vrednosti finalnog zametanja plodova dobijene su u varijanti unakrsnog oprašivanja i kretale su se od 9,80% ('Érdi Bötermö') do 12,70% ('Šumadinka'). Prosečna vrednost finalnog zametanja plodova u varijanti slobodnog oprašivanja iznosila je 9,65%. Na osnovu dobijenih rezultata, sorte 'Šumadinka' i 'Sofija' se mogu preporučiti kao dobri oprašivači za sortu 'Lenka'.

Ključne reči: *Prunus cerasus*, klijavost polena *in vitro*, inicijalno i finalno zametanje plodova

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II/P6

THE INFLUENCE OF POLLINATION MODE ON FRUIT SET OF SOUR CHERRY CULTIVAR 'LENKA'

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'Lenka' is a sour cherry cultivar developed at Faculty of Agriculture, University of Belgrade, and was recognized in 2014. Due to its large fruit and pleasant taste, it is recommended for fresh consumption and processing. One of the most important steps in cherry growing technology is the selection of adequate pollenizers. Therefore, this study aimed to recommend adequate pollenizers for 'Lenka' based on the values of the fruit set achieved under different pollination modes (self-pollination, open-pollination, and cross-pollination with 'Érdi Bötermö', 'Sofija' and 'Šumadinka'). The experiment was carried out in a collection cherry orchard at the "Radmilovac" Experimental Farm, Faculty of Agriculture in Belgrade, during a three-year period (2022–2024). The functional ability of pollen ('Lenka' and pollenizers) was determined using *in vitro* germination test on a culture medium containing 1% agar and 12% sucrose at 17°C. Fertilization efficiency was determined by comparing the number of initial (28 days after pollination) and final (at harvest) fruit set in relation to the number of pollinated flowers. The average values of *in vitro* pollen germination varied from 14.90% ('Érdi Bötermö') to 34.70% ('Šumadinka'). Different initial and final fruit set values were determined between the applied pollination variants. As expected, the lowest percentage of initial and final fruit set was obtained under self-pollination (31.20 and 3.90%, respectively). The lowest initial fruit set was obtained with 'Érdi Bötermö' as pollenizer (32.10%), while the highest was in the variant of open pollination (41.00%). In contrast, the highest values of the final fruit set were obtained in the cross-pollination variant, amounting from 9.80% ('Érdi Bötermö') to 12.70% ('Šumadinka'). The average value of the final fruit set obtained in the open-pollination variant was 9.65%. Based on the results obtained, cultivars 'Šumadinka' and 'Sofija' can be recommended as suitable pollenizers for the cultivar 'Lenka'.

Keywords: *Prunus cerasus*, *in vitro* pollen germination, initial and final fruit set

Acknowledgment: This work was supported by the Science Fund of the Republic of Serbia, GRANT No7739716: Genetic potential of Serbian autochthonous cherry genotypes for temperature-adaptable reproductive behaviour and nutraceutical value – CherrySeRB.

UTICAJ KONCENTRACIJE ŠEĆERA U NEKTARU RAZLIČITIH KLONOVA OBLAČINSKE VIŠNJE NA POSETU PČELA

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Značaj višnje kao voćne vrste za Srbiju je veliki. Po površini na kojoj se gaji nalazi se na trećem mestu posle šljive i jabuke. U sortimentu dominiraju klonovi "Oblačinske" višnje. Najveći značaj u prenošenju polena između cvetova višnje ima medonosna pčela. Ova voćna vrsta ima vrlo važnu ulogu u osiguravanju nektara i polena za razvoj medonosne pčele u rano proleće. Cilj ovog istraživanja bila je analiza koncentracije šećera u nektaru šesnaest različitih klonova Oblačinske višnje i frekvencija posete cvetova od strane medonosne pčele. Trogodišnje istraživanje sprovedeno je u voćnjaku na eksperimentalnom dobru "Radmilovac" koji je deo Poljoprivrednog fakulteta, Univerziteta u Beogradu. Nektar je ekstrahovan iz cvetova mikrokapilarom, nakon 24-časovne izolacije. Koncentracija šećera u nektaru je merena korišćenjem ručnog refraktometra. Učestalost poseta pčela cvetovima različitih klonova Oblačinske višnje praćena je u desetominutnom periodu na označenoj grani sa potpuno otvorenim cvetovima kod svakog klona. Ovo posmatranje ponovljeno je tokom tri dana punog cvetanja. Analizom podataka utvrđeno je da postoje razlike u koncentraciji šećera u nektaru kod različitih klonova Oblačinske višnje i učestalosti posete pčela njihovim cvetovima. Koncentracija šećera u nektaru i poseta pčela se kretala od 23,00±6,76% i 2,78±1,86 pčela/grani za 10 minuta posmatranja (klon IV/8) do 38,00±17,26% i 4,00±2,06 pčela (klon VII/2n). Postoji pozitivna međusobna povezanost između koncentracije šećera u nektaru i učestalosti posete pčela i ona je bila statistički značajna ($P<0,05$). Zahvaljujući najvećoj koncentraciji šećera u nektaru i frekvenciji posete pčela klon VII/2n može biti perspektivan za umnožavanje u područjima Srbije sa razvijenim pčelarstvom.

Ključne reči: medonosna pčela, nektar, koncentracija šećera, "Oblačinska" višnja

II/P7

INFLUENCE OF SUGAR CONCENTRATION IN NECTAR OF DIFFERENT CLONES OF "OBLAČINSKA" SOUR CHERRY ON THE VISITATION OF BEES

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The significance of the sour cherry as a fruit species for Serbia is great. According to the area on which it is grown, it is in third place after plums and apples. The assortment is dominated by "Oblačinska" sour cherry clones. Honeybee has the greatest importance in the transfer of pollen among the flowers of the sour cherry. This fruit species plays a very important role in providing nectar and pollen for the development of honey bees in early spring. The aim of this research was to analyze the concentration of sugar in the nectar of sixteen different "Oblačinska" sour cherry clones and the frequency of flower visits by honey bees. The three-year research was carried out in the orchard on the Experimental Station "Radmilovac" which is the part of the Faculty of Agriculture, University of Belgrade, Serbia. The nectar was extracted from the flowers with a microcapillary following 24-hour isolation. Sugar concentration of nectar was measured with a manual light refractometer. The frequency of visits by bees to the flowers of different clones of "Oblačinska" sour cherry was monitored in a ten-minute period on the marked flowering branch per tree. This observation was repeated during three blooming days. The analysis of the data found that there are differences in the concentration of sugar in the nectar of the different "Oblačinska" sour cherry clones and in the frequency of visits by bees to its flowers. The concentration of sugar in nectar and the number of bee visits ranged from 23.00±6.76% and 2.78±1.86 bees (clone IV/8) to 38.00±17.26% and 4.00±2.06 bee/per brunch 10 minutes of monitoring (clone VII/2n). There is a positive correlation between the concentration of sugar in the nectar and the frequency of bee visits, and it was statistically significant ($P<0.05$). Thanks to the highest concentration of sugar in the nectar and the frequency of bee visits, clone VII/2n can be promising for cultivation in areas of Serbia with developed beekeeping.

Keywords: honey bee, nectar, sugar concentration, "Oblačinska" sour cherry

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II/P8

UPOREDNO PROUČAVANJE TEHNIKA *IN VITRO* OŽILJAVANJA SORTI MALINE 'MEEKER' I 'WILLAMETTE'

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Cilj ove istraživačke studije bio je uspostavljanje protokola za fazu ožiljavanja kod dve sorte maline, 'Meeker' i 'Willamette'. Tokom faze ožiljavanja korišćen je hranljivi medijum sa mineralnim solima smanjenim na polovinu i nepromenjenim organskim kompleksom, sa varijacijama u hormonskom sastavu. Ispitani su efekti vrsta (IBA, NAA i IAA) i koncentracija (1 i2 mg/l) auksina. Testirano je dvanaest kombinacija, uključujući šest sa aktivnim ugljem (1 mg/l) i šest bez njega. Svi medijumi su sadržali agar i saharozu u koncentraciji 7,2 odnosno 20 g/l, redom. Subkultura je trajala mesec dana, nakon čega su analizirani parametri ožiljavanja: procenat ožiljavanja, prosečan broj korena, dužina korena i dužina ožiljenih biljaka. Medijum koj sadrži 1 mg/l IBA u kombinaciji sa aktivnim ugljem uticao je na najveću stopu ožiljavanja kod sorte 'Willamette' (78,33%), kao i kod sorte 'Meeker' (85,70%). Ova kombinacija takođe je rezultirala najvećom dužinom korena i brojem korenova za obe sorte. Za sortu 'Meeker', medijum koji sadrži 1 mg/l IBA sa aktivnim ugljem je uticao na najveću dužinu ožiljenih biljaka (1,74 cm), dok je za sortu 'Willamette' najveća dužina biljaka postignuta sa spomenutom kombinacijom, nezavisno od prisustva aktivnog uglja (1,92 i 1,85 cm, redom). Sveukupno, ovo istraživanje pruža detaljan protokol za poboljšanje efikasnosti *in vitro* ožiljavanja maline, posebno za sorte 'Meeker' i 'Willamette'. Preporučeni protokol može značajno koristiti rasadnicima i istraživačima koji teže unapređenju razmnožavanja i proizvodnji bezvirusnih sadnica ovih ekonomski važnih sorti maline.

Ključne reči: ožiljavanje, malina, auksin, aktivni ugalj

Zahvalnica: Istraživanje je podržano od strane Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (projekat br. TR-31064 i Ugovor o realizaciji i finansiranju naučnoistraživačkog rada Instituta za voćarstvo, Ugovor br. 451-03-66/2024-03/200215451).

A COMPARATIVE STUDY OF *IN VITRO* ROOTING TECHNIQUES FOR 'MEEKER' AND 'WILLAMETTE' RASPBERRY CULTIVARS

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The objective of this research was to establish a rooting phase protocol for two raspberry cultivars, 'Meeker' and 'Willamette'. During the rooting phase, a medium with mineral salts reduced to half strength and an unchanged organic complex was used, with variations in the hormonal composition. The effects of auxin types (IBA, NAA, and IAA) and concentrations (1 and 2 mg/l) were examined. Twelve combinations were tested, including six with activated charcoal (1 mg/l) and six without it. All media contained agar and sucrose at a concentration of 7.2 and 20 g/l, respectively. The subculture lasted one month, after which rooting parameters were analyzed: rooting percentage, average number of roots, root length, and length of rooted plants. The medium containing 1 mg/l IBA with activated charcoal showed the highest rooting percentages for 'Willamette' (78.33%) and 'Meeker' (85.70%). This combination also resulted in the greatest root length and number of roots for both cultivars. For 'Meeker', 1 mg/l IBA with activated charcoal led to the greatest length of rooted plants (1,74 cm), while for cultivar 'Willamete', the greatest plant length was achieved with this combination, regardless of the presence of activated charcoal (1.92 and 1.85 cm, respectively). Overall, this research provides a detailed protocol to improve the *in vitro* rooting efficiency of raspberry plants, particularly for the 'Meeker' and 'Willamette' cultivars. The recommended protocol can significantly benefit nurseries and researchers aiming to enhance the propagation and production of virus free plants of these economically important raspberry cultivars.

Keywords: rooting, raspberry, auxin, activated charcoal

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II/P9

UTICAJ KLIMATSKIH PROMENA NA PLODONOŠENJE I FUNKCIONALNOST TRNJINE U ZELENOJ INFRASTRUKTURI

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Višegodišnji monitoring je izvor podataka koji dokumentuje i omogućava bolje razumevanje uticaja klimatskih promena i ekstrema na dugoročne promene fenologije trnjine u suburbanoj zelenoj infrastrukturi Beograda što ima i šire ekološke posledice. Stoga je analiziran odgovor fenofaze plodonošenja trnjine na klimatske elemente u periodu 2007-2024. Rezultati potvrđuju da je: (1) plodonošenje u direktnoj korelacji sa fenofazom cvetanja; (2) početak, ali i kraj fenofaze plodonošenja je u značajnoj korelaciji sa temperaturom vazduha, insolacijom i padavinama; (3) izostanak plodonošenja uslovljen je ekstremnim klimatskim događajima u aprilu mesecu i (4) rano dozrevanje plodova uslovljeno je visokim temperaturama tokom vegetacionog perioda, jakom insolacijom i sušom. Odgovor fenoloških obrazaca plodonošenja trnjine na klimatske promene, u istraživanom području, potvrđuje da što je veća akumulacija toplote veći je efekat dnevnih temperatura na početak plodonošenja. Rezultati istraživanja su polazna osnova za proučavanje promena fenoloških obrazaca plodonošenja trnjine kao odgovora na klimatske promene u suburbanoj zelenoj infrastrukturi. Takođe, su značajni i za istraživanja u voćarstvu, hortikulturi, pejzažnoj arhitekturi i definisanje smernica za pejzažni dizajn u cilju unošenja vrednosti fizionomske kompozicije predela i promovisanje trnjine kao vrste budućnosti. Naša studija naglašava da optimizovano upravljanje po fenološkim obrascima trnjine može doprineti maksimalnom funkcionisanju i opstanku vrste u uslovima klimatskih promena.

Ključne reči: *Prunus spinosa* L., klimatske promene, fenologija, adaptivnost, otpornost

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THE IMPACT OF CLIMATE CHANGE ON FRUITING AND FUNCTIONALITY OF BLACKTHORN IN GREEN INFRASTRUCTURE

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Long-term monitoring provides invaluable data that documents and deepens our understanding of how climate change and extreme weather events affect the phenology of blackthorn within Belgrade's suburban green infrastructure, with broader ecological implications. This study specifically analysed the response of blackthorn's fruiting phenophases to climatic factors over the period from 2007 to 2024. The findings confirmed that: (1) fruiting was directly correlated with the flowering phase; (2) the timing of both the start and end of fruiting was strongly linked to air temperature, sunlight exposure, and precipitation levels; (3) fruiting failure was driven by extreme climatic events in April; and (4) early fruit ripening was associated with high temperatures during the growing season, intense sunlight, and drought conditions. The response of blackthorn's phenological patterns to climate change in the study area underscores that increased heat accumulation intensifies the effect of daily temperatures on the onset of fruiting. These results offer an important foundation for understanding changes in blackthorn's fruiting patterns as a response to climate change within suburban green spaces. Additionally, these findings are significant for research in fruit growing, horticulture, landscape architecture, and for defining guidelines in landscape design aimed at introducing value of the physiognomic composition of the landscape and promoting blackthorn as a species of the future. Our study emphasises that optimised management based on the phenological patterns of blackthorn can contribute to the species' maximum functioning and survival under climate change conditions.

Keywords: *Prunus spinosa* L., climate change, phenology, adaptability, resilience

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II/P10

VIŠESTRUKI FENOLOŠKI ODGOVORI *Chaenomeles japonica* (Thunb.) Lindl. ex Spach NA KLIMATSKE PROMENE U URBANOJ SREDINI

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Analizirani su fenološki podaci za japansku dunju tokom 18 uzastopnih godina u blokovskom zelenilu, na levoj obali Save, na Novom Beogradu i odgovarajući meteorološki podaci za referentni (1991-2020) i period istraživanja. Izvršena je komparacija datuma razmicanja cvetnih pupoljaka (09 BBCH), pojave prvih otvorenih cvetova (60 BBCH), kraja cvetanja (69 BBCH) i pojave zrelih plodova (89 BBCH) u periodu 2007-2024. Fenološki obrasci cvetanja i plodonošenja su se potvrdili kao značajni biološki pokazatelji klimatskih promena. Odnosno potvrđen je uticaj temperatura vazduha pre i za vreme fenofaza, kao i padavina i insolacije. Evidentiran je raniji početak i kasniji završetak vegetacionog perioda. Izdvojena je 2024. godina tokom koje je zabeležen početak vegetacionog perioda odnosno cvetanja u februaru koje se kontinuirano nastavilo i tokom narednih 6 meseci. Takođe, je dozrevanje plodova počelo 90 dana ranije, a početak listopada krajem jula. Zabeležene su i ožegotine na plodovima. Naši nalazi doprinose boljem razumevanju fenoloških odgovora s obzirom da su plodovi japanske dunje profitabilni i koriste se u proizvodnji džemova, sirupa, aroma i likera. Rezultati su korisna platforma za razumevanje mogućih promena u strukturi urbanih cenoza i međuvrsnih odnosa u cilju definisanja principa održivog dizajna koji podržava estetiku pejzaža, očuvanje životne sredine i staništa za ptice i životinje, a doprineće i razvoju mera prilagođavanja ove voćarske vrste u svetlu aktuelnih i očekivanih klimatskih promena.

Ključne reči: fenologija, BBCH skala, blokovsko zelenilo, temperature vazduha, padavine, insolacija

Zahvalnica: Autori se zahvaljuju Ministarstvu nauke, tehnološkog razvoja i inovacija Republike Srbije za finansiranje naučnih istraživanja Univerziteta u Beogradu – Šumarskog fkulteta u 2024, br. 451-03-65/2024-03/200169.

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MULTIPLE PHENOLOGICAL RESPONSES OF *Chaenomeles japonica* (Thunb.) Lindl. ex Spach TO CLIMATE CHANGE IN AN URBAN ENVIRONMENT

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Phenological data for Japanese quince were analysed over 18 consecutive years in city block greenery, located on the left bank of the Sava River in New Belgrade, along with corresponding meteorological data for the reference period (1991-2020) and the study period. A comparison was made between the dates of bud burst (09 BBCH), the appearance of the first open flowers (60 BBCH), the end of flowering (69 BBCH), and the appearance of ripe fruit (89 BBCH) during the 2007-2024 period. The phenological patterns of flowering and fruiting were confirmed as significant biological indicators of climate change. In other words, the influence of air temperatures before and during the phenophases, as well as precipitation and solar radiation, was confirmed. An earlier start and a later end of the growing season were recorded. The year 2024 stood out, with the start of the growing season, i.e., flowering, recorded in February which continuously continued over the next six months. Additionally, fruit ripening began 90 days earlier, and leaf fall started at the end of July. Fruit scorch was also recorded. Our findings contribute to a better understanding of phenological responses, given that the fruit of the Japanese quince is profitable and used in the production of jams, syrups, flavors, and liqueurs. The results provide a useful platform for understanding potential changes in the structure of urban ecosystems and interspecies relationships, aiming to define principles of sustainable design that support landscape aesthetics, environmental conservation, and habitats for birds and animals. Furthermore, they will aid in developing adaptation measures for this fruit species in light of current and anticipated climate change.

Keywords: phenology, BBCH scale, block greenery, air temperature, precipitation, solar radiation

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II/P11

GEOGRAFSKA OZNAKA VOJVODINA - PROSTORNA ANALIZA PROMENA I KLASIFIKACIJA OZNAKE PO VINOGRADARSKIM BIOKLIMATSKIM INDEKSIMA

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Geografska oznaka Vojvodina je najnovija registrovana zaštićena oznaka geografskog porekla za vina Srbije. U svrhu izrade specifikacije proizvoda za geografsku oznaku, sprovedena je naučna studija koja je obuhvatila analizu klimatskih parametara (klimatskih bazičnih elemenata *terroir*-a) za klimatološki period od 30 godina (1988-2017). Ovi parametri su upoređivani sa podacima iz rejonizacije vinogradarskih područja za period 1961-2010, zarad utvrđivanja klimatskih promena u okviru ove geografske oznake. Prostroni podaci klimatskih bazičnih elemenata *terroir*-a geografske oznake Vojvodina su obrađeni u QGIS v 2.18, potom ArcGIS softveru i na kraju predstavljeni kao tematske mape. Za posebnu evaluaciju klimatskih uslova geografske oznake Vojvodina primenjen je Konceptualni multifaktorijalni prostorni *terroir* model (Conceptual Multifactorial Spatial *Terroir* model – CMST model) kojim je celokupno područje klasifikovano po modelovanim klasama pogodnosti. U ovom radu predstavljeni su dobijeni atributski i prostorni podaci za neke najvažnije vinogradarske bioklimatske indekse kao bazične elemente *terroir*-a geografske oznake Vojvodina, i to: Srednja vegetaciona temperatura vazduha (AVG), Vinklerov indeks (WI), Huglinov heliotermički indeks (HI), Indeks svežine noći (CI) i Indeks suše (DI) za klimatološke periode 1961-2010. i 1988-2017. Vrednosti većine bioklimatskih indeksa, osim CI, poboljšale su se u odnosu na raniji klimatološki period (rejonizacija), što u slučaju pre svega WI zahteva i izmenu domaće zakonske regulative. Na osnovu izvršenog CMST modelovanja i mapiranja za period 1988-2017, može se zaključiti da se, na osnovu vrednosti AVG, najveći deo teritorije geografske oznake Vojvodina (62,65%) klasifikuje kao *veoma (vrlo) pogodan* (vrednost 4), dok je u ranijem periodu (1961-2010) najveći deo teritorije (73,33%) pripadao *manje pogodnoj* klasi (vrednost 2). Po pitanju WI najveći deo geografske oznake – 54,86% teritorije pripada *veoma (vrlo) pogodnoj* klasi CMST modela (vrednost 4), dok 18,55% ima *najpogodniju* klasu (vrednost 5) za klimatološki period 1988-2017. Na osnovu klimatskih klasa po opštoj podeli WI, čak 95,3% teritorije geografske oznake Vojvodina pripada III klimatskoj klasi (C I klimatskoj zoni po EU klasifikaciji). Na značajne klimatske promene ukazuju podaci za raniji period 1961-2010. za koji je najveći deo teritorije (91,15%) pripadao *manje pogodnoj* CMST klasi (vrednost 2), odnosno 91,15% II opštoj WI klimatskoj klasi (B klimatskoj zoni po EU klasifikaciji). Najveći deo (86,05%) teritorije geografske

oznake Vojvodina pripada *najpogodnijoj* klasi HI (vrednost 5) CMST modela za period 1988-2017, dok je za period 1961-2010. ta modelovana klasa učestvovala sa 49,37%. Najveća površina (78,60%) geografske oznake ima *najpogodniju* klasu pogodnosti CI u okviru CMST modela (vrednost 5) za period 1988-2017. Međutim, evidentno je delimično pogoršanje ovog klimatskog bazičnog elementa *terroir*-a u odnosu na raniji klimatološki period (1961-2010) kada je čak 98,99% teritorije oznake imao *najpogodniju* CMST klasu. Po pitanju DI, najveći deo teritorije geografske oznake Vojvodina (64,36%) pripada *veoma (vrlo) pogodnoj* klasi pogodnosti CMST modela (vrednost 4), dok 35,64% oznake pripada *pogodnoj* klasi pogodnosti ovog modela (vrednost 3). Za raniji klimatološki period (1961-2010) čak 90,54% teritorije je pripadao humidnijoj, odnosno *manje pogodnoj* klasi (vrednost 2) CMST modela. Utvrđene i na osnovu CMST klasa pogodnosti prostorno predstavljene promene vrednosti analiziranih vinogradarskih bioklimatskih indeksa kao klimatskih bazičnih elemenata *terroir*-a geografske oznake Vojvodina ukazuju na neophodnost prilagođavanja vinogradarske i vinarske proizvodnje ove oznake tim promenama, uključujući i uvođenje određenih mera adaptacije – prvenstveno zbog pogoršanja Indeksa svežine noći (CI).

Ključne reči: geografska oznaka Vojvodina, CMST model, promene bioklimatskih indeksa, AVG, WI, HI, CI, DI

II/P11

GEOGRAPHICAL INDICATION VOJVODINA - SPATIAL ANALYSIS OF CHANGES AND CLASSIFICATION OF THE INDICATION ACCORDING TO VITICULTURAL BIOCLIMATIC INDICES

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The Protected Geographical Indication (PGI) Vojvodina is the most recently registered geographical indication for wine in Serbia. In order to create the product specification for the PGI, a scientific study was carried out, which included analysis of climatic parameters (basic climatic elements of *terroir*) for a 30-year climatological period (1988-2017). These parameters were compared with data from the viticulture zoning of wine-growing areas for the period 1961-2010 to determine climate changes within this geographical indication. The spatial data of the basic climatic elements of the *terroir* for the PGI Vojvodina were processed in QGIS v 2.18 and ArcGIS software and finally presented as thematic maps. For a detailed assessment of the climatic conditions of the PGI Vojvodina, a Conceptual Multifactorial Spatial *Terroir* model (CMST model) was applied, classifying the entire area according to modeled suitability classes. This paper presents the obtained attribute and spatial data for some of the most important viticultural bioclimatic indices as basic elements of *terroir* for the PGI Vojvodina, namely: Average Growing Season Temperature (AVG), Winkler Degree Days/Growing Degree Days (WI), Huglin Heliothermal Index (HI), Cool Night Index (CI) and Drought Index (DI) for the climatological periods 1961-2010 and 1988-2017. The values of most of these bioclimatic indices, except for the CI, improved when comparing the more recent climatological period (1988-2017) with the earlier one (period for the viticulture zoning 1961-2010), especially in the case of the WI, which may require changes in national legislation. Based on the CMST modeling and mapping for the period 1988-2017, it was concluded that most of the area of the PGI Vojvodina (62.65 %) can be classified as *very suitable* (value 4) in terms of AVG, while for the earlier period (1961-2010) most of the area (73.33 %) belonged to a *less suitable* class (value 2). Regarding the WI, 54.86 % of the PGI area belongs to the *very suitable* class (value 4), while 18.55 % is classified as the *most suitable* class (value 5) for the climatological period 1988-2017. According to the general WI climate classification, 95.3 % of the PGI Vojvodina falls into III climate class (climate zone C I according to the EU classification). Significant climatic changes are shown by the data from the earlier period 1961-2010, according to which most of the

territory (91.15 %) belonged to the *less suitable* CMST class (value 2) or to II general WI climate class (B climate zone according to the EU classification). The majority (86.05 %) of the PGI Vojvodina falls into the *most suitable* HI class (value 5) in the CMST model for the period 1988-2017, while for the period 1961-2010 this modeled class accounted for 49.37 %. A large proportion (78.60 %) of the PGI has the *most suitable* CI suitability class (value 5) in the CMST model for the period 1988-2017. However, partial deterioration of this climatic basic element of the *terroir* is evident when compared to the earlier climatological period (1961-2010), when as much as 98.99 % of the area had the *most suitable* CMST class. As far as DI is concerned, the majority of the PGI Vojvodina (64.36 %) falls into the *very suitable* CMST class (value 4), while 35.64 % belongs to the *suitable* class (value 3). In the earlier climatological period (1961-2010), as much as 90.54 % of the area belonged to the more humid, *less suitable* CMST class (value 2). The observed and spatially presented changes in the values of the analyzed viticultural bioclimatic indices, as climatic basic elements of the *terroir* for the PGI Vojvodina, indicate the need to adapt viticulture and wine production to these changes, including the introduction of certain adaptation measures, particularly concerning the deterioration of the Cool Night Index (CI).

Keywords: Protected Geographical Indication Vojvodina, CMST model, changes in bioclimatic indices, AVG, WI, HI, CI, DI

II/P12

PROSTORNA I VREMENSKA PROMENLJIVOST PROIZVODNIH OSOBINA VINOGRADA SA SORTOM GRAŠAC

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Proizvodne osobine vinograda se menjaju od godine do godine (vremenska promenljivost), kao i unutar samog vinograda tokom jedne godine (prostorna promenljivost). Vremenska promenljivost je posledica, pre svega, vremenskih prilika tokom godine, dok je prostorna posledica razlika u osobinama zemljišta i topografiji. Tokom četiri uzastopne godine (2020-2023), posmatran je vinograd (1,25 ha) sorte grašac u Sremskim Karlovcima. Čokoti su posađeni 1996. godine, u paru (dva čokota u jednom sadnom mestu - „gnezdu") sa razmakom sadnje 2,8 × 1,6 m i opterećenjem od 6,25 zimskih okaca / m^2. U vinogradu je, u vidu mreže, izabrano 100 tačaka u kojima su čokoti služili za posmatranje. Kao mera promenljivosti visine i kvaliteta prinosa upotrebljen koeficijent varijacije izražen u %. U posmatranom vinogradu nedostaje 19,2% čokota, pri čemu je udeo gnezda sa jednim čokotom bio 28,5%, a onih bez čokota 5%. Prosečane vrednosti prinosa po čokotu, broja grozdova po čokotu i sadržaja kiselina u širi su bile značajno više ako je u paru nedostajao drugi čokot („usamljeni" čokot), dok u pogledu prosečne mase grozda i sadržaja šećera u širi nije bilo značajne razlike. Vremenska promenljivost prosečnog prinosa grožđa po čokotu, broja grozdova po čokotu, mase grozda, sadržaja šećera i kiselina u širi (21%, 17%, 12%, 7% i 14%) je bila manja u odnosu na prostornu promenljivost istih pokazatelja (37%, 35%, 20%, 10% i 17%). Prosečan broj grozdova po čokotu je najznačajniji činilac prinosa. Bolji svetlosni uslovi u kojima žive „usamljeni" čokoti, doveli su do boljeg diferenciranja pupoljaka zimskog okca, a time i većeg broja grozdova na čokotu. Prostorna promenljivost posmatranih pokazatelja je izraženija od vremenske. Podložniji promenljivosti su pokazatelji visine prinosa u odnosu na pokazatelje kvaliteta šire, kao i sadržaj kiselina u odnosu na sadržaj šećera u širi.

Ključne reči: vinograd, promenljivost, prinos, kvalitet, grašac

II/P12

SPATIAL AND TEMPORAL VARIABILITY OF GRAŠAC VINEYARD PRODUCTIVITY

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The production characteristics of the vineyard change from year to year (temporal variability), as well as within the vineyard itself during one year (spatial variability). Temporal variability is a consequence, above all, of the weather conditions during the year, while the spatial is consequence soil properties and topography. During four consecutive years (2020-2023), a vineyard (1.25 ha) planted to grašac variety in Sremski Karlovci was observed. The vines were planted in 1996, in pairs (two vines in one planting place - a "nest") with a planting distance of 2.8 × 1.6 m and a bud load was 6.25 winter buds/m^2. In the vineyard, in the form of a grid, 100 points were chosen in which the vines were used for monitoring. The coefficient of variation expressed in % was used as a measure of the variability of yield and grape quality. In the observed vineyard, 19.2% of vines were missing, where the share of nests with one vine was 28.5%, and those without vines was 5%. The average values of yield per vine, the number of clusters per vine and the content of acids in the must were significantly higher if the second vine missing in the pair ("lone" stem), while there was no significant difference in the average cluster weight and sugar content in the must. The temporal variability of the average yield per vine, number of clusters per vine, cluster weight, sugar and acids content in the must (21%, 17%, 12%, 7% and 14%) was lower compared to the spatial variability of the same indicators (37 %, 35%, 20%, 10% and 17%). The average number of clusters per vine is the most important yield factor. Better light conditions in which the "lonely" vines live, led to a better differentiation of the winter bud, and thus to a greater number of clusters per vine. Spatial variability of the observed indicators is more pronounced than temporal variability. More subject to variability are the indicators of the yield in relation to the must quality indicators, as well as the acid content in relation to the sugar content in must.

Keywords: vineyard, variability, yield, quality, grašac

II/P13

RODNOST I KVALITET GROŽĐA SORTE "TRAMINAC CRVENI" U NIŠKOM VINOGRADARSKOM REJONU

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U radu su prikazani rezultati ispitivanja nekih proizvodnih i tehnoloških osobina sorte Traminac crveni (Savagnin rose) u Niškom vinogradarskom rejonu. Ispitivanja su vršena u kolekcionom vinogradu „Centra za vinogradarstvo i vinarstvo" u Nišu. U periodu ispitivanja vladali su povoljni uslovi za ispoljavanje proizvodnih i tehnoloških osobina sorte Traminac crveni. Visina prinosa i njegovo variranje po godinama ukazuju na visoku i stabilnu rodnost ispitivane sorte. Sadržaj šećera u širi iznosio je 22,51%, a sadržaj ukupnih kiselina 7,86 g/l. Hemijskom analizom vina utvrđeno je da je dobijeno vino od grožđa sorte Traminac crveni dobrog kvaliteta. Vrednosti alkohola u vinu su se kretale od 13,50 do 14,01% vol. Vino od grožđa ove sorte imalo je senzornu ocenu od 76 bodova. Rezultati ispitivanja potvrđuju opravdanost gajenja sorte Traminac crveni u Niškom vinogradarskom rejonu.

Ključne reči: rodni potencijal, prinos grožđa, kvalitet grožđa i vina

YIELD AND GRAPE QUALITY OF RED TRAMINAC GRAPEVINE VARIETY IN THE NIŠ WINE-GROWING REGION

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The paper presents the results of the examination of some production and technological characteristics of the grapevine variety Roter Traminer (Savagnin Rose) in the Niš wine-growing region. The research was conducted at the collection vineyard of the Center for Viticulture and Oenology in Niš. During the study period, the conditions were favorable for the development of the productive and technological characteristics of the Red Traminac grapevine variety. The level of yield and its fluctuations from year to year indicate a high and stable productivity of the studied variety. The sugar content of the grape must was 22.51 % and the total acidity was 7.86 g/l. The chemical analysis showed that the wine made from Red Traminac grapes was of good quality. The alcohol content of the wine was between 13.50 and 14.01 % vol. The wine made from grapes of this variety had a sensory score of 76 points. The test results confirm that the cultivation of the Red Traminac grapevine variety in the Niš wine-growing region is justified.

Keywords: bearing capacity, grape yield, grape and wine quality

II/P14

UTICAJ VELIČINE BOBICE NA UKUPNI SADRŽAJ POLIFENOLA I ANTOCIJANA U GROŽĐU SORTE PROKUPAC (*Vitis vinifera* L.)

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Istraživanja su obavljena u proizvodnom zasadu vinove loze vinarije „Despotika" u Smederevskoj Palanci, lokalitet Vlaški Do i uključivala su ispitivanja uticaja veličine bobice na ukupni sadržaj antocijana i polifenola u pokožici sorte Prokupac. Vinograd je podignut 2010. godine, sa razmakom sadnje 1.2 × 1.2 m. Na ispitivanim čokotima primenjena je kratka rezidba sa ukupnim opterećenjem od 6 okaca po čokotu. Na osnovu veličine, bobice su podeljene u tri kategorije: male veličine, srednji dijametar od 11 mm, srednje veličine, srednji dijametar od 16 mm i velike veličine, srednji dijametar od 20 mm. Hemijaka ispitivanja obavljena su u laboratoriji Hemijskog fakulteta u Beogradu. Sadržaj ukupnih antocijana predstavljen je kao g ekvivalenta malvidin 3-glukozida po kg početnih neliofilizovanih uzoraka grožđa. Sadržaj ukupnih polifenola predstavljen je kao g ekvivalenta galne kiseline po kg početnih neliofilizovanih uzoraka. Ukupni sadržaj antocijana u bobici varirao je u zavisnosti od veličine bobice. U pokožici bobice kategorije velika u proseku sadržaj ukupnih antocijana (TPC) iznosio je 6,84 ± 0,13 g mal 3-glu/kg. U kategoriji bobice srednje veličine u pokožici u proseku sadržaj ukupnih antocijana iznosio je 10,36 ± 0,16 g mal 3-glu/kg, i bio je statistički značajno veći u odnosu na kategoriju sa velikim bobicama. Sadržaj ukupnih antocijana (TPC) u malim bobicama (11,93 ± 0,21 g mal 3-glu/kg) u proseku je bio statistički značajno veći u odnosu na kategoriju sa velikim bobicama. Najveći ukupni sadržaj polifenola u pokožici dobijen je u kategoriji malih bobica (6,92 ± 0,03 g EGK/kg), dok je najmanji sadržaj ukupnih polifenola u pokožici u proseku evidentiran u bobici srednje veličine (3,06 ± 0,26 g EGK/kg).

Ključne reči: bobica, pokožica, antocijani, polifenoli

II/P14

THE INFLUENCE OF BERRY SIZE ON THE TOTAL POLYPHENOL AND ANTHOCYANINS CONTENT IN GRAPES OF PROKUPAC VARIETY (*Vitis vinifera* L.)

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The research was conducted in the production vineyard of the "Despotika" winery in Smederevska Palanka, Vlaški Do locality, and examined the influence of berry size on the total content of anthocyanins and polyphenols in the skin of the Prokupac grape variety. The vineyard was established in 2010 with a planting distance of 1.2 × 1.2 m. Short pruning with a total load of 6 shoots per vine was applied to the examined vines, which were cultivated in a low trellis system with a tree height of 30 cm. Based on size, the berries were divided into three categories: small (mean diameter of 11 mm), medium (mean diameter of 16 mm), and large (mean diameter of 20 mm). Chemical analyses were conducted in the laboratory of the Faculty of Chemistry in Belgrade. The total anthocyanin content is expressed as grams of malvidin-3-glucoside equivalents per kilogram of initial non-lyophilized grape samples. The total polyphenol content is expressed as grams of gallic acid equivalents per kg of initial non-lyophilized samples. The total anthocyanin content varied with berry size. In the skin of large berries, the average total anthocyanin content (TPC) was 6.84 ± 0.13 g mal 3-glu/kg. In medium-sized berries, the average total anthocyanin content was 10.36 ± 0.16 g mal 3-glu/kg, and was statistically significantly higher than in large berries. The total anthocyanin content in small berries (11.93 ± 0.21 g mal 3-glu/kg) was, on average, statistically significantly higher compared to large berries. The highest total polyphenol content in the skin was found in small berries (6.92 ± 0.03 g GAE/kg), while the lowest average total polyphenol content was found in medium-sized berries (3.06 ± 0.26 g GAE/kg).

Keywords: berry, skin, anthocyanins, polyphenols

II/P15

UTICAJ VELIČINE BOBICE NA SADRŽAJ ANTOCIJANA POKOŽICE NEKIH CRNIH VINSKIH SORTI

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Ispitivan je uticaj veličine bobice na sadržaj antocijana pokožice crnih vinskih sorti Kaberne sovinjon (klon 169), Merlo (Klon 348) i Burgundac crni (klon 115). Ispitivanja su sprovedena na Oglednom dobru "Radmilovac" i u laboratoriji Poljoprivrednog fakulteta, Univerziteta u Beogradu. Cilj istraživanja bio je determinacija antocijana malvidin 3-glukozida u pokožici bobice. Za sve tri sorte, bobice su najpre klasirane u tri kategorije: sitne, srednje i krupne. Dobijeni rezultati korišćeni su za poređenje sadržaja antocijana pokožice u zavisnosti od krupnoće bobice. Određivanje koeficijenata rodnosti, indikatora prinosa, analize sastava i strukture grozda i bobice, kao i sadržaja šećera i kiselina su sprovedeni po standardnoj proceduri. Dobijeni rezultati analize antocijana malvidin 3-glukozida su izraženi u mg/g sveže mase pokožice. Sorte Kaberne sovinjon i Burgundac crni su ostvarile očekivane rezultate u smislu da je najveći sadržaj antocijana zabeležen u kategoriji sitnih bobica (dijametar < 7,5 mm). Kod sorte Merlo, najveći sadržaj antocijana zabeležen je kod bobica srednje veličine (diametar 7,6 – 10 mm). Najniži sadržaj antocijana kod sorti Kaberne sovinjon i Merlo je zabeležen kod najkupnijih bobica (diametar > 10,1 mm), dok je kod sorte Burgundac crni najniži sadržaj antocijana zabeležen u srednjoj kategoriji. Sorta Kaberne sovinjon (klon 169) imala je najveći sadržaj antocijana (prosečno 6,87 mg/g sveže mase pokožice), praćena sortom Merlo, klon 348 (prosečno 4,61 mg/g sveže mase pokožice), dok je najniži sadržaj antocijana zabeležen kod sorte Burgundac crni, klon 115 (prosečno 4,05 mg/g sveže mase pokožice).

Ključne reči: sorta, klon, bobica, veličina bobice, antocijani

II/P15

THE INFLUENCE OF THE BERRY SIZE ON THE SKIN ANTHOCYANINS CONTENT OF SOME BLACK WINE VARIETIES

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The influence of berry size on the anthocyanin content in the skin of the black grape varieties Cabernet Sauvignon (clone 169), Merlot (clone 348) and Pinot Noir (clone 115) was investigated. The tests were conducted in the vineyard of the "Radmilovac" experimental estate and in the laboratory of the Faculty of Agriculture of the University of Belgrade. The study aimed to determine an anthocyanin, malvidin-3-glucoside, on the berry skin. For all three varieties, the berries were divided into three categories: small, medium, and large. The results were used to compare the anthocyanin content of the berry skin in the different berry sizes. The determination of the fertility coefficients, the yield indicators, the analysis of the composition and structure of the bunches and berries as well as the content of sugar and total acids were carried out regularly. The results on the anthocyanin content of malvidin-3-glucoside were expressed in mg/g fresh weight of berry skin. For the Cabernet Sauvignon and Pinot Noir varieties, the result was as expected, i.e. the highest anthocyanin content was found in the smallest berries (diameter < 7.5 mm). For the Merlot variety, the highest anthocyanin content was observed in the medium berries (diameter 7.6 – 10 mm). The lowest anthocyanin content in varieties Cabernet sauvignon and Merlot was obtained in the largest berries (diameter > 10.1 mm), while for the Pinot Noir variety, the lowest anthocyanin content was recorded in the medium category (diameter 7.6 – 10 mm). The Cabernet Sauvignon variety (clone 169) had the highest anthocyanin content (average 6.871 mg/g fresh weight), followed by the Merlot variety, clone 348 (average 4.61 mg/g fresh weight), while the lowest anthocyanin content was found in the Pinot Noir variety, clone 115 (average 4.05 mg/g fresh weight).

Keywords: variety, clone, berry, berry skin, anthocyanins

II/P16

UTICAJ KOLIČINE PADAVINA NA PROIZVODNE KARAKTRISTIKE SORTE "TAMJANIKA BELA" GAJENE U POŽAREVAČKOM VINOGORJU

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Cilj ovog rada bio je ispitivanje uticaja povećane količine padavina na proizvodne karakteristike sorte *tamjanika bela* gajene u Požarevačkom vinogorju u okviru Mlavskog rejona. Ogled je sproveden tokom 2022. i 2023. godine na Oglednom dobru Poljoprivredne škole sa domom učenika "Sonja Marinković" u Požarevcu. Meteorološki podaci su dobijenii od RHMZ Srbije, a analiza najvažnijih proizvodnih i kvalitativnih karakteristika grozda obavljena je u laboratorijskim uslovima na Poljoprivrednom fakultetu Univerziteta u Beogradu. Dugotrajni kišni period, praćen padom temperature uslovljava probleme prilikom cvetanja vinove loze, slabiju oplodnju i zametanje bobica. Kao posledica nepovoljnih vremenskih uslova u periodu oprašivanja i oplodnje dolazi do pojave rehuljavosti grozdova. Analizom dobijenih rezultata utvrđeno je da za karakteristike grozda postoje značajne razlike između ove dve godine ispitivanja u odnosu na količinu padavina. Tokom 2022. godine kod osobina grozda utvrđena je vrlo značajna razlika u poređenju sa 2023. godinom. Sorta *tamjanika bela* imala je veću masu grozda od 227,3 g kao i dužinu grozda od 18,2 cm u 2022. godini kada je prosečna količina padavina za maj mesec bila 50,0 mm, dok je u 2023. godini masa grozda iznosila 100,0 g, a dužina grozda 14,0 cm i tada je količina padavina u maju mesecu bila 79,0 mm. U periodu sazrevanja grožđa tokom avgusta meseca prosečna količina padavina je bila 52,3 mm što je rezultiralo kvalitetnim sadržajem šećera u širi kod ispitivane sorte *tamjanika bela* koji je bio isti u toku obe godine ispitivanja i iznosio je 21,4%. Veći sadržaj ukupnih kiselina u širi bio je tokom 2022. godine i iznosio je 7,9 g/l, dok je u 2023. godini bio 6,5 g/l. Na osnovu dobijenih rezultata može se zaključiti da povećana količina padavina u maju mesecu u periodu kada dolazi do cvetanja vinove loze utiče negativno na vrednosti mehaničkog sastava grozda.

Ključne reči: količina padavina, Požarevačko vinogorje, *tamjanika bela,* proizvodne karakteristike

II/P16

INFLUENCE OF RAIN ON THE PRODUCTION CHARACTERISTICS OF 'TAMNJANIKA' VARIETIES GROWN IN POŽAROVAC VINEYARD

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The aim of this work was to examine the impact of increased rainfall on the production characteristics of the 'Tamjanika' variety grown in the Požarevac vineyard within the Mlavski region. The experiment was conducted during 2022 and 2023 at the Agricultural School's Experimental Farm with the home of the student "Sonja Marinković" in Požarevac. Meteorological data were obtained from RHMZ of Serbia, and the analysis of the most important production and qualitative characteristics of the bunch was carried out in laboratory conditions at the Faculty of Agriculture, University of Belgrade. A prolonged rainy period, followed by a drop in temperature, causes problems during the flowering of the vines, weaker fertilization and berry setting. As a result of unfavorable weather conditions during the period of pollination and fertilization, the looseness of the bunches occurs. The analysis of the obtained results revealed that there are significant differences between the two years of the study in relation to the amount of precipitation for the cluster characteristics. In 2022, a very significant difference was found in the characteristics of the grapes compared to 2023. The higher bunch mass of the 'Tamjanika' variety of 227.3 g and the length of the bunch of 18.2 cm was reached in 2022, when the average amount of precipitation for the month of May was 50.0 mm, while in 2023 the mass of the bunch was 100. 0 g, and the length of the bunch was 14.0 cm, and the amount of precipitation in May was 79.0 mm. During the ripening period of the grapes in August, the average amount of precipitation was 52.3 mm, which resulted in a high-quality sugar content in the sugar in the investigated variety 'Tamjanika' which was the same during both years of the investigation and amounted to 21.4%. The higher content of total acids in the must was achieved in 2022 and was 7.9 g/l, while in 2023 it was 6.5 g/l. Based on the results obtained, it can be concluded that the increased amount of precipitation in May, during the flowering period of the vines, has a negative effect on the values of the mechanical composition of the bunch.

Keywords: influence of rain, Požarevacwine growing region, 'Tamnjanika', production characteristics

II/P17

VARIJABILNOST FENOLOŠKIH FAZA RAZVOJA I KVALITETA GROŽĐA U USLOVIMA KLIMATSKIH PROMENA

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Klimatski činioci u značajnoj meri utiču na rast i razvoj vinove loze, fiziološke procese, prinos i kvalitet grožđa. Promene u fenološkim fazama razvoja kod različitih sorti vinove loze zabeležene su u pojedinim vinogorjima u Srbji uslovljavajući značajna pomeranja kod cvetanja, sazrevanja i berbe grožđa. Na primeru sorte Panonia gajene u agroekološkim uslovma Gročanskog vinogorja u Beogradskom rejonu pokazana je varijabilnost fenoloških faza razvoja, kao i uticaj klimatskih promena na prinos i kvalitet grožđa. Sorta Panonia, namenjena za proizvodnju belih vina, gajena je u sertifikovanom organskom vinogradu koji pripada vinariji Plavinci. Rastojanje sadnje je 0,8 × 1,9 m, sa formiranim Smart-Dajson uzgojnim oblikom čokota, odgovarajućim agro i ampelotehničkim merama koje su specifične za organsku proizvodnju. Sistem organskog vinogradarstva predstavlja važan segment mitigacije i adaptacije na klimatske promene. U petogodišnjem periodu (2020-2024) prikazani su početak i dužina trajanja sledećih fenoloških faza razvoja: pupljenje (BBCH 01-03), cvetanje (BBCH 63-64), šarak (BBCH 81) i berba (BBCH 89) kao i broj dana između ovih faza. Takođe su izračunati najvažniji indeksi: WI, HI i BEDD i upoređeni sa uslovima u rejonizaciji vinogradarskih geografskih proizvodnih područja (1961-2010). U momentu berbe određeni su parametri prinosa (prinos po čokotu i jedinici površine) i kvaliteta grožđa (sadržaj šećera i ukupnih kiselina u širi, pH vrednost i gustina šire). Najranije pupljenje i berba grožđa bili su 2024. godine (1.03. i 10.08.). Najkasnije pupljenje je bilo 2021. godine (1.04), a najkasnija berba je obavljena 2023. godine (9.09). Najmanji broj dana između pupljenja i berbe bio je 2021. godine (144), a najveći 2023. godine (170). Prosečno najniži prinos po čokotu utvrđen je 2020. godine (0,59 kg), dok je najviši bio 2022. godine (1,18 kg). Najveći sadržaj šećera i pH vrednost u širi grožđa utvrđen je 2024. godine (23%; 3,29). Promene u ranijem početku određenih fenoloških faza, kao i značajno ranija berba grožđa u Gročanskom vinogorju uslovljavaju primenu različitih mera adaptacije kako bi se očuvale odgovarajuće karakteristike grožđa neophodne za proizvodnju kvalitetnog vina.

Ključne reči: klimatske promene, mitigacija, fenološke faze, prinos, kvalitet grožđa

II/P17

VARIABILITY OF THE PHENOLOGICAL STAGES OF DEVELOPMENT AND QUALITY OF GRAPES IN CONDITIONS OF CLIMATE CHANGES

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Climate factors significantly affect the growth and development of grape vines, physiological processes, yield and quality of grapes. Changes in the phenological stages of development of different varieties of grapevines were recorded in some vineyards in Serbia, causing significant changes in the flowering, ripening and harvesting of grapes. Using the example of the Panonia variety grown in the agroecological conditions of the Grocka vineyard in the Belgrade region, the variability of the phenological stages of development as well as the impact of climate change on the yield and quality of the grapes were demonstrated. The Panonia variety is intended for the production of white wines and is grown in a certified organic vineyard belonging to the Plavinci winery. The planting distance is 0.8 × 1.9 m, with the formed Smart-Dyson growing form of vine, appropriate agro and ampelotechnical measures that are specific for organic production. The system of organic viticulture represents an important segment of mitigation and adaptation to climate changes. In the five-year period (2020-2024), the beginning and duration of the following phenological stages of development are shown: bud burst (BBCH 01-03), flowering (BBCH 63-64), budding (BBCH 81) and harvest (BBCH 89), as well as the number of days between these phases. The most important indices: WI, HI and BEDD were also calculated and compared with the conditions in the rezoning of the winegrowing geographical production areas (1961-2010). At the time of harvest, the yield parameters (yield per plant and unit area) and grape quality (content of sugar and total acids, pH value and density in the must) were determined. The earliest budding and grape harvest were in 2024 (March 1 and August 10). The latest budding was in 2021 (April 1), and the latest harvest was in 2023 (September 9). The shortest number of days between budding and harvest was in 2021 (144), and the longest in 2023 (170). On average, the lowest yield per plant was determined in 2020 (0.59 kg), while the highest was in 2022 (1.18 kg). The highest sugar content and pH value in the grapes was determined in 2024 (23%; 3.29). Changes in the earlier onset of certain phenological phases as well as a significantly earlier grape harvest in Grocka vineyard require the application of various adaptation measures in order to preserve the appropriate grape characteristics, necessary for the production of quality wine.

Keywords: climate change, mitigation, phenological phases, yield, grape quality

II/P18

MULTIPLIKACIJA VINOVE LOZE (*Vitis vinifera* L.) U SVRHU FENOTIPIZACIJE UNUTAR OPLEMENJIVAČKIH PROGRAMA

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Multiplikacija vinove loze u *in vitro* uvjetima klasična je metoda koja daje zadovoljavajuće rezultate s uskim rasponom regeneracije između korištenih hranjivih medija i kultivara. Vrlo često se takav način razmnožavanja koristi u svrhu znanstvenog istraživanja gdje se u kratkom vremenskom periodu može dobiti velik broj biljaka za pokuse. Danas su u svijetu pokrenuti brojni oplemenjivački programi s ciljem stvaranja novih sorti otpornih na bolesti koje će svojom kvalitetom i drugim karakteristikama biti usporedive s tradicionalnim sortama pojedinih područja. U svrhu testiranja sjemenjaka iz preliminarnih pokusa oplemenjivanja vinove loze, postavljen je pokus sa dva genotipa sjemenjaka (GRP-33 i DRP-7) u *in vitro* uvjetima (26 °C, 12 h dan /12 tama), a kao kontrola korištena je sorta Chardonnay. Postavljeno je 20-25 zeljastih pupova u obliku nodalnih segmenata na MS (Murashige i Skoog) mediju sa dodatkom 0,5 mg/L 6-BAP (benzilaminopurin) u periodu od četiri tjedna, a nakon toga je presađeno na MS medij sa dodatkom 1,0 mg/L 6-BAP za naredna četiri tjedna. Nakon 8 tjedana u kulturi tkiva mjereni su visina biljke i broj nodija svakog pojedinog eksplantata. Postotak regeneracije kreće se u rasponu od 85-93%, ovisno o pojedinom genotipu ali upućuje da je ovo učinkovita metoda za dobivanje populacija *in vitro* biljaka na kojima će se raditi ispitivanja utjecaja biotskih i abiotskih faktora, radi fenotipizacije unutar oplemenjivačkih programa za vinovu lozu.

Ključne reči: oplemenjivanje vinove loze, *in vitro*, sjemenjaci, hranjivi medij, regeneracija

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MULTIPLICATION OF GRAPEVINE (*Vitis vinifera* L.) WITH THE AIM OF PHENOTYPING WITHIN THE BREEDING PROGRAMS

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In vitro multiplication of grapevine is a classical method that gives efficient results with the narrow range of regeneration between tested tissue culture media and cultivars. Very often this type of multiplication is used for scientific purposes where is possible, in a short period, to obtain a large number of plants. Nowadays, in a world are initiated numerous breeding programs with the aim of developing new diseases resistant cultivars which can be comparable with the quality and other characteristics with traditional cultivars of certain areas. With the aim of testing the seedlings from preliminary experiment of grapevine breeding, an experiment was set up with two genotypes of seedlings (GRP-33 and DRP-7) in *in vitro* conditions (26 °C, 12h day /12 dark), as control cultivar Chardonnay was used. Nodal segments (20-25) were inoculated to the MS (Murashige and Skoog) medium with addition of 0,5 mg/L 6-BAP (benzylaminopurine) in a period of four weeks, and afterwards they were transferred to the MS medium with addition of 1,0 mg/L 6-BAP for next four weeks. After eight weeks in tissue culture, the height and the number of nodes were measured for each segment. The percentage of regeneration is in the range 85-93%, depending on the particular genotype, but refers to this efficient method for obtaining populations of *in vitro* plants which can be tested for abiotic and biotic factors with the purpose of phenotyping within grapevine breeding programs.

Keywords: breeding of grapevine, *in vitro*, seedlings, plant medium, regeneration

III/PO1

INTENZIVNA TEHNOLOGIJA GAJENJA JABUKE U SISTEMU 3,0 × 0,6 m

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Poslednjih godina se tehnologija gajenje jabuke intenzivirala. U 2018. godini zabeležen je natprosečni rod jabuke u Evropi, što je značajno uticalo na sniženje cene jabuke na tržištu. Voćari sa visokim i kvalitetnim prinosom su više ili manje pokrili troškove proizvodnje u ovoj godini, a ostali su počeli razmišljati o krčenju zasada jabuke. Praktično u svim zemljama Evrope je počeo proces smanjenja površina pod zasadima jabuke. Sa druge strane, počeo je proces intenziviranja gajenja u postojećim i u novim zasadima jabuke. Novi sistemi gajenja jabuke treba da prate opšta dešavanja u društvu u pogledu radne snage, zelene ekologije, i na kraju visokog i kvalitetnog prinosa, koji voćarima omogućuje dobit i dalji razvoj. Zato profesionalni voćari širom sveta na osnovu novih znanja o rastu i razvoju jabuke uvode nove sisteme sadnje i uzgoja 3,0 × 0,6 m. Sistem guste sadnje je jednostavan za gajenje, ne traži obrazovanu radnu snagu, kontrola bolesti i štetočina zbog aplikacije pesticida i uske krune je efikasnija, kontrola rasta i razvoja jabuke je jednostavnija jer je iskorišćena svetlost što omogućava visoke i kvalitetne prinose svake godine. Za ovaj intenzivan sistem možemo koristiti sadnicu staru 9 meseci sa tri do pet prevremenih grana. Takođe, možemo upotrebiti jednogodišnju sadnicu istog kvaliteta. U sistemu 3,0 × 0,6 m je neophodno posaditi sadnicu na banku. Visina banka treba da bude 10–15 cm kada se zemljište slegne nakon sadnje. U vreme sadnje na osnovu hemijske analize zemljišta potrebno je dodati mineralne i organske materije. Na visini od 60 cm od zemlje ostavljaju se 3-4 prevremene grane, koje se skraćuju na 30 cm. Sve ostale grane na provodnici se skraćuju na najviše 10 cm. Ako imamo knip sadnice sa dugim prevremenim granama, isto ih treba skratiti na 30 cm. Provodnice se nikada ne skraćuju. Ako nema prevremenih grana, skratimo prodovodnicu na 1 m i kad krene vegetacija, zaustavlja se rast gornjeg pupoljka i ispod njega se ukloni 4-5 pupoljaka. Na knip sadnici posle sadnje može ostati 10-25 plodova, a na devetomesečnoj i jednogodišnji sadnici 5-15 plodova. Tokom vegetacije provodnica poraste 50-70 cm. Donje prevremene grane se okite sa kratkim rodnim drvetom. Isto se desi i na provodnici. Dobar rod i dobar vegetativni rast zavise od optimalnog snabdevanja vodom i mineralnim elementima u zemljištu i listu. Preporučljivo je da se odmah posle berbe uradi "zimska rezidba". Početkom druge vegetacije predugačke grane skraćuju se na 2-3 pupoljka. Na provodnici se rodne grane reduciraju na 2, izuzetno na 3 rodna pupoljka. Na početku druge vegetacije formira se 12-15 rodnih pupoljaka na donjim skeletnim granima i oko 20-30 rodnih pupoljaka na provodnici, što je minimalno 30-50 rodnih pupoljaka na svakom stablu. To nam omogućuje prinos od 6 do 8 kg/stablu. Na vrhu provodnice se ostavlja vegetativni pupoljak

i ispod njega u dužini od 10 cm uklanjaju se svi rodni pupoljci, što omogućava rast provodnice najmanje 50 cm. Na kraju druge vegetacije stablo dostiže visinu od oko 3,0 m. Posle berbe ovakva stabla možemo rezati mašinski, dok posle mašinske rezidbe sledi i ručna korektivna rezidba. U trećoj godini nakon hemijskog proređivanja na stablu ostane 60-80 plodova, što znači da je prinos u trećoj godini 60-75 t/ha. Uz dobro snabdevanje voćnjaka vodom i mineralima, rast provodnice je najmanje 50 cm. Na kraju vegetacije stablo postiže visinu od 3,6-4,0 m, što je konačna visina stabla. U četrvtoj godini – puna rodnost, svi rodni nosači na provodnici prekraćuju se na dva pupoljka. Na donjim skeletnim granama tada imamo oko 25 pupoljaka, a na provodnici 50-80 pupoljaka. Ako rodni nosač nije adekvatan, režemo ga na čep i tako dobijemo novu granu. Posle četvrte godine možemo svake godine očekivati prosečan prinos od 60-90 t/ha, zavisno od sorte. Posebno treba napomenuti da za postizanje ovih rezultata pre sadnje voćnjaka treba optimalno pripremiti zemljište i kroz svaku vegetaciju optimalno snabdevati biljke sa vodom i mineralima kako putem zemljišta, tako i tokom cele vegetacije preko lista. Takođe je neophodno izvesti optimalno hemijsko proređivanje plodova i po potrebi ručnu korekciju. Zatim, od početka juna treba započeti sa izbalansiranom primenom hormona. Krajem juna neophodno je započeti folijarnu ishranu biljke za diferencijaciju rodnih pupoljaka za sledeću godinu. Pre berbe potrebno je aplicirati sve potrebne minerale za poboljšanje boje, a posle berbe sve potrebne tretmane za kvalitet rodnih pupoljka za sledeću godinu.

Ključne reči: jabuka, *Malus domestica*, prinos, kvalitet, sistem gajenja

III/PO1

INTENSIVE APPLE CULTIVATION TECHNOLOGY IN A 3.0 × 0.6 m SYSTEM

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Apple technology has changed considerably over the last years. In 2018, we witnessed an above-average apple yield, which significantly reduced the price of a kilogram of apples. The fruit growers who achieved large and high-quality yields were more or less able to cover the production costs that year, while other growers seriously began considering ceasing apple production. In practically all European countries, apple orchards have undergone an intensive process of shrinkage, and at the same time, production in existing orchards has been intensified. New apple cultivation systems must accompany changes in society, particularly the workforce and the green ecology, and ultimately achieve large and high-quality yields that allow the grower to earn a normal income and continue their development. For this reason, fruit growers all over the world are introducing new planting and cultivation systems 3.0 × 0.6 m based on new knowledge about apple growth and development. The dense planting system is simple and does not require trained labour. Disease and pest control is more effective due to a narrow crown, which allows a more precise pesticide application. Controlling the growth of apple trees is easier, as higher exposure to light allows high and quality yields every year. For this intensive system, we can use a 9-month-old plant with three to five lateral shoots. In addition, a one-year-old plant of the same quality can also be used. For a system of 3.0 × 0.6 m, it is necessary to plant the plants on a mound. The height of the mound should be 10–15 cm after the soil has settled after planting. When planting, mineral and organic fertilizers should be added on the basis of a chemical soil analysis. At a height of 60 cm above the ground, 3-4 lateral shoots are left and shortened to 30 cm. All other branches on the central leader are shortened to a maximum of 10 cm. If knip plants have long lateral shoots, these should also be shortened to 30 cm. The central leader is never pruned. If there are no lateral shoots, shorten the central leader to 1 m, and when growth starts, the top bud is stopped and 4-5 buds below it are removed. After planting, 10-25 fruits may remain on the knip plant, while 5-15 fruits may remain on the 9 month or one-year-old plants. During the growing season, the central leader grows 50-70 cm. The lower lateral branches develop short, fruit-bearing wood, and the same happens on the central leader. Good fruiting and good vegetative growth depend on an optimal water supply and the availability of minerals in the soil and foliage. It is recommended to carry out "winter pruning" immediately after harvesting. At the beginning of the second growing season, branches that are too long are shortened to 2-3 buds. On the central leader, the fruit-bearing branches are reduced to 2, in some cases 3 buds. At the beginning of the second vegetation period, 12-15 fruit buds form on the lower skeletal branches and around 20-30 fruit buds on the central leader, i.e. a total of at least 30-50 fruit buds per

tree. This enables a yield of 6 to 8 kg per tree. A vegetative bud is left at the top of the central leader, and all fruit buds within 10 cm of it are removed so that the main shoot can grow at least 50 cm. At the end of the second season, the tree reaches a height of approx. 3.0 m. After harvesting, these trees can be pruned mechanically, followed by manual corrective pruning. In the third year, 60-80 fruits remain on the tree after chemical thinning, resulting in a yield of 60-75 t/ha. If the orchard is supplied with sufficient water and minerals, the central leader will grow at least 50 cm. At the end of the vegetation period, the tree reaches a height of 3.6-4.0 m, which corresponds to the final height of the tree. In the fourth year – at full production - all fruit-bearing branches on the central leader are pruned back to two buds. There are about 25 buds on the lower skeletal branches and 50-80 buds on the main shoot. If a fruit-bearing branch is not suitable, it is cut back to a stump to encourage the growth of a new branch. After the fourth year, an average yield of 60-90 t/ha per year can be expected, depending on the variety. To achieve these results, the soil must be optimally prepared before planting and sufficient water and mineral nutrients must be provided throughout the growing season, both through the soil and by foliar fertilization. In addition, optimal chemical thinning and, if necessary, manual thinning of the fruit is essential. A balanced application of hormones should be started at the beginning of June. At the end of June, foliar fertilization is required to differentiate the fruit buds for the following year. Before harvest, all necessary minerals should be administered to improve fruit color, and post-harvest treatments should be applied to improve fruit bud quality for next year.

Keywords: apple, *Malus domestica*, yield, quality, training system

III/PO2

MAĐARSKA INDUSTRIJA ORAHA: ŠTA JE U PITANJU?

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Domaći orah (*Juglans regia* L.) je jedna od tradicionalnih i rasprostranjenih voćnih vrsta orašastih plodova u umerenim zonama, posebno na Mediteranu i severnom Mediteranu. Zbog toga se orašasti plodovi smatraju delom „mediteranske ishrane“ sa različitim zdravstvenim prednostima. Zbog brojnih zdravstvenih prednosti oraha, postoji veliko interesovanje za njegovu proizvodnju u mnogim zemljama. Da bi se zadovoljila sve veća potrošnja oraha, proizvodnja oraha se takođe povećava širom sveta. Svetska proizvodnja oraha je oko 3,5 do 4 miliona tona sušenih oraha sa ljuskom godišnje i pokazuje trend rasta. Svetska proizvodnja se povećavala za 20% do 2000. godine, nakon 2000. godine je rasla 20% godišnje do 2012. Počevši od 2012. postoji trend rasta od 3 do 5 godina, nakon ovog perioda proizvodnja malo opada, i sve se ponovo pokreće. U poslednje dve decenije Kina, SAD, Ukrajina, Čile i Turska su vodeće zemlje u proizvodnji oraha. Uzgajanje oraha ima dugu istoriju u Mađarskoj, počevši od pripitomljavanja francuskih sorti/genotipova, nastavljajući sa selekcionim oplemenjivanjem od lokalnog stanovništva. Trenutno postoji devet registrovanih sorti na Nacionalnoj sortnoj listi. Trenutno ukupna komercijalna površina zasada oraha u Mađarskoj iznosi 9.200 ha, što pokazuje trend rasta poslednjih godina. Trend je u porastu, ali se brzina rasta usporila u odnosu na prethodne godine. Tako industrija može uskoro da krene, jer je otvoren novi poziv za podizanje novih komercijalnih zasada uz podršku države. Prinos nije pratio ovaj trend rasta; ne raste paralelno sa površinom zasađene površine. Prinos je bio između 6.000 i 7.000 tona osušenih oraha sa ljuskom godišnje. Južno prekodunavsko (15%) i severoistočni deo Mađarske (14%) su najvažniji regioni rasta. 10% komercijalnih voćnjaka su ekološki zasadi, još 14% je u procesu prelaska u ekološki. Najviše se uzgaja sorta oraha „Milotai 10” (57%), zatim „Alsoszentivani 117” (23%) i „Tiszacsecsi 83” (2,3%), sve su sorte sa terminalnim rađanjem. Najviše gajene sorte sa lateralnim rađanjem su „Milotai botermo” (3,2%), „Milotai kesei” (2,8%) i „Alsoszentivani kesei” (2,1%). Od inostranih sorti, na najvećoj površini se gaji „Lara” (0,18%). 7% komercijalnih zasada se navodnjava mikroprskalicama. Ova industrija se suočava sa nekim izazovima. Svi izazovi su vezani za temperaturu, koja može da reguliše sve fenološke faze stabala oraha. Na osnovu našeg istraživanja, osnovna temperatura za otvaranje pupoljaka je 5,5°C, 0°C za razvoj resa i 5,5°C za razvoj ženskih cvetova. Ovaj problem znači da se brzina oslobađanja polena i receptivnosti tučkova može promeniti na osnovu temperaturnih vrednosti. Ako je prolećno vreme toplo, rese se mogu razvijati brže od ženskih cvetova, tako da se može uočiti više perioda preklapanja na protoginičnim sortama. Do sada nije primećena promena redosleda cvetanja muških i ženskih cvetova. Više perioda preklapanja može prouzrokovati više abortusa tučkova zbog efekata

autoreregulacije oraha. Vrednosti temperature mogu uticati na stepen oplodnje i apomiksisa. Ako su dnevne maksimalne temperature oko 10 °C, veći stepen apomiksisa i veći rast polenovih cevčica mogu se postići unutar ženskih cvetova, nego u toplijim uslovima. Poslednjih godina orasi su postali fokus interesovanja kao zdrava hrana, zbog svojih izuzetnih hemijskih jedinjenja, pa se orasi nazivaju "superhranom". Jezgro je bogato polifenolima kao što su flavonoidi i fenolna kiselina, polinezasićene masne kiseline, minerali, esencijalne aminokiseline i bioaktivni peptidi. Smatra se da su jedinjenja oraha efikasna protiv nekoliko ozbiljnih bolesti povezanih sa životnim stilom. Važno je napomenuti da sorte, nastale i uzgajane u lokalnim klimatskim uslovima, uvek mogu dostići veću količinu jedinjenja u poređenju sa inostranim uzgojenim. Razlike u količini jedinjenja su značajne. U mađarskoj industriji oraha pojavili su se novi izazovi kao što su orahova muva, novi patogeni, dugotrajna suša, što se može rešiti u bliskoj budućnosti kako bi se uspešno povećala proizvodnja. Što se brže može dobiti odgovor na ove izazove, to se može imati bolja pozicija na tržištu.

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III/PO2

THE HUNGARIAN PERSIAN WALNUT INDUSTRY: WHAT IS AT STAKE?

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Persian or English walnut (*Juglans regia* L.) is one of the traditional and widespread nut fruit species in temperate zones, especially in the Mediterranean and northern Mediterranean regions. Therefore, nuts are considered as a part of the "Mediterranean diet" with different health benefits. Due to the numerous health benefits of the walnut, there is a keen interest in its production in many countries. To satisfy the increasing consumption of walnuts, the production of walnuts is also increasing worldwide. The global walnut production is approx. 3.5 to 4 million tons of dried nuts with shell annually, which shows an increasing trend, The global production used to increase 20% per decide until 2000, after 2000 it increased 20% annually until 2012. Starting from 2012 there is an increasing trend for 3 to 5 years, after this period the production drops a bit, and everything re-start again. In the last two decades, China, the USA, Ukraine, Chile, and Turkey have been the leading walnut-producing countries. The growing of Persian walnuts has a long history in Hungary, starting with the domestication of French varieties/genotypes, continuing with selective breeding from the local population. Currently, there are nine registered varieties on the National Variety List. Currently, the total commercial walnut orchard surface is 9.200 ha in Hungary, which shows an increasing trend in the past years. The trend is increasing, but the speed of the increase slowed up compared to the previous years. Thus industry can get under way soon, because new call for establishing new commercial orchards with state support is open. The harvested yield didn't follow this increasing trend; it is not increasing parallel with the planted area surface. The harvested yield is between 6,000 and 7,000 tons of dried nuts with shell annually. South Transdanubia (15%) and North-Eastern part of Hungary (14%) are the most important growing regions. 10% of the commercial orchards are ecological orchards, further 14% are under changing to ecological. The most grown walnut variety is the 'Milotai 10' (57%), followed by 'Alsószentiváni 117' (23%), and 'Tiszacsécsi 83' (2.3%), all of them is terminal-bearing varieties. The most grown lateral-bearing varieties are 'Milotai bőtermő' (3.2%), 'Milotai kései' (2.8%), and 'Alsószentiváni kései' (2.1%). Among the foreign-bred varieties, the 'Lara' is grown (0,18%) in the largest surface. 7% of the commercial orchards are irrigated with micro-sprinkles. This industry faces with some challenges. All challenges are related to temperature, which can regulate all phenological stages of the walnut trees. Based on our research, the base temperature for bud break is 5.5°C, 0 °C for developing catkins, and 5.5 °C for developing pistillate flowering recovery. This issue means, that rate of pollen shedding and pistillate flowering recovery can be changed based on the temperature values. If the spring weather is warm, the catkins can develop faster, than the female flowers, so more overlapping period can be observed on the protogynic varieties. Until now, changing of male and female flowering wasn't observed. More overlapping period can cause more pistillate flower

abortation due to authoregulation effects of walnut. The temperature values can influence the fertilization and the rate of apomixis as well. If the daily maximum temperature values are around 10 °C, higher apomixis rate and more pollen tube growth can be reached inside the female flowers, than among warmer conditions. In recent years, nuts have become the focus of interest as a healthy food, due to their outstanding chemical compounds, therefore walnuts are also referred to as a superfood. The kernel is rich in polyphenols such as flavonoids and phenolic acid, polyunsaturated fatty acids, minerals, essential amino acids, and bioactive peptides. Compounds of walnuts are considered to be effective against several serious and lifestyle-related diseases. It is important to mention that cultivars, bred and grown under local climate conditions, can reach always the highest amount of the nutrients compared to the foreign-bred ones. The differences in the amount of nutrients are significant. Some new challenges appeared in the Hungarian walnut industry such as the walnut husk fly, new pathogens, prolong drought, which can be solved in the near future to increase the success of production. The faster the answer for these challenges can be found, the better position on the market can be.

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III/PO3

KLIMATSKI SERVISI KAO ALAT ZA RAZVOJ STRATEGIJA ZA PRILAGOĐAVANJE NA KLIMATSKE PROMENE

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Do 2000. godine samo je mali deo evropskih vinogradarskih regiona bio u prilici da iskusi ekstremne vremenske događaje, ali je učestalost ovakvih događaja naglo povećana od tada. Projekcije za period 2020-2080 pokazuju značajan porast broja događaja sa ekstremno visokim temperaturama, pri čemu se očekuje da će otprilike jedna trećina vinogradarskih regiona biti izložena izrazito sušnim uslovima. Pored toga, očekuje se da će porasti broj kombinovanih ekstremnih događaja, naročito u slučaju RCP8.5 scenarija sa intenzivnim emisijama gasova sa efektom staklene bašte. Ova promena klimatske stvarnosti zahteva novi pristup donošenju odluka, u kome će se povećana klimatska varijabilnost i češća pojava vremenskih i klimatskih ekstrema tretirati kao „nova normalnost“ za gajenje grožđa u Evropi. Takva promena mora biti podržana implementacijom biofizičkih, ekonomskih i regulatornih mera prilagođavanja, kako bi se umanjili uticaji klimatskih promena na ove ključne poljoprivredne sektore. Klimatski servisi, dizajnirani i razvijeni u saradnji sa zainteresovanim stranama, kao što su proizvođači grožđa, mogu olakšati praktičnu upotrebu klimatskih podataka na različitim vremenskim skalama, od sezonskih do decenijskih, omogućavajući kreiranje efikasnijih strategija prilagođavanja na izmenjene klimatske uslove.

Ključne reči: klimatske promene, adaptacija, planiranje, donošenje odluka, klimatski servisi

III/PO3

CLIMATE SERVICES AS A TOOL FOR DEVELOPING CLIMATE CHANGE ADAPTATION STRATEGIES

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Prior to 2000, only a small portion of European grape growing regions experienced extreme weather events, but the frequency of these events has risen sharply since then. Projections for 2020 to 2080 show a marked increase in extreme high temperature events, with approximately one-third of grape-growing areas expected to endure severe drought conditions. Moreover, the occurrence of compound extreme events is anticipated to rise, particularly in the Mediterranean, under the high-end emission scenario RCP8.5. This shifting climate reality demands a new approach to decision-making, treating increased climate variability and extremes as the "new normal" for grape cultivation in Europe. Such a shift will have to be supported by the implementation of biophysical, economic, and policy adaptation measures to lessen the impacts of climate change on these critical agricultural sectors. Climate services, co-designed and co-developed with stakeholders like grape producers, can facilitate the practical use of climate data across different time scales, from seasonal to decadal, enabling more effective adaptation strategies.

Keywords: climate change, adaptation, planning, decision making, climate services

III/U1

BIOREGULATORI POSPEŠUJU ZAMETANJE I UTIČU NA KVALITET PLODOVA KRUŠKE SORTE *KARMEN*

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U uslovima Srbije kruška cveta u prvoj polovini aprila, kada su vremenske prilike za oprašivanje i oplodnju često nepovoljne usled niskih temperatura, mraza, vetra, kiše i dr. Bioregulatori se primenjuju za povećanje zametanja i visine prinosa kod sorti kruške koje su sklone slabijem zametanju, u uslovima lošim za oprašivanje i oplodnju, kao i da umanje štete od mrazeva. Cilj istraživanja bio je da se kod kruške sorte *Karmen* primene kombinacije različitih bioregulatora i jednog biostimulatora kako bi se utvrdio njihov uticaj na intenzitet zametanja i kvalitet plodova. U tu svrhu su kod kruške sorte *Karmen* u punom rodu, primenjeni sledeći tretmani na početku i u punom cvetanju: Perlan (a.m. GA_{4+7} 1,8% + 6BA 1,8%) 25 mL/100 L + Perlan 25 mL/100 L; Vellset (a.m. B, Mo, N, aminokiseline) 200 mL/100 L + Perlan 25 mL/100 L; FrutaFija (a.m. NAA 3%) 15 mL/100 L + Perlan 25 mL/100 L; Vellset 200 mL/100 L + GranPera (a.m. GA_3 2%) 50 mL/100 L; Vellset 200 mL/100 L + GranPera 100 mL/100 L; FrutaFija 15 mL/100 L + GranPera 100 mL/100 L; netretirana kontrola. Sve ispitivane kombinacije preparata, doprinele su povećanju zametanja plodova u odnosu na netretiranu kontrolu pri čemu je najefikasnija bila FrutaFija 15 mL/100 L + Perlan 25 mL/100 L. Ova kombinacija preparata doprinela je značajnom povećanju krupnoće, ali i nešto većem udelu deformisanih plodova. Tretman Perlan 25 mL/100 L + Perlan 25 mL/100 L rezultirao je jednakim zametanjem i nešto sitnijim plodovima u odnosu na Fruta Fija + Perlan, ali i većim udelom deformisanih plodova. Tretman FrutaFija 15 mL/100 L + Gran Pera 100 mL/L doprineo je boljem zametanju u odnosu na kontrolu, većoj krupnoći i bolje obojenim plodovima bez deformiteta.

Ključne reči: oplodnja, semenke, 6-benziladenin, giberelini, naftilsirćetna kiselina

Zahvalnica: Istraživanje je finansirano od strane Pokrajinskog sekretarijata za visoko obrazovanje i naučnoistraživačku delatnost u okviru kratkoročnog projekta br. 000855717 2024 09418 003 000 000 001 04 002.

III/U1

BIOREGULATORS IMPROVE FRUIT SET AND IMPACT QUALITY OF PEAR CV. *CARMEN*

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In Serbian conditions, pear typically blooms in the first half of April, when the weather conditions for pollination and fertilization are often unfavorable due to low temperatures, frost, wind, rain, etc. Bioregulators are applied to increase fruit set and yield in pear cultivars that are prone to poor fruit set, in conditions unfavorable for pollination and fertilization, and to minimize frost damage. The aim of the research was to apply combinations of different bioregulators and one biostimulant formulation to the pear cv. *Carmen* to determine their impact on fruit set and fruit quality. For this purpose, the following treatments were applied at the beginning and in full bloom period: Perlan (a.i. GA_{4+7} 1.8% + 6BA 1.8%) 25 mL/100 L + Perlan 25 mL/100 L; Vellset (a.i. B, Mo, N, amino acids) 200 mL/100 L + Perlan 25 mL/100 L; FrutaFija (a.i. NAA 3%) 15 mL/100 L + Perlan 25 mL/100 L; Vellset 200 mL/100 L + GranPera (a.i. GA_3 2%) 50 mL/100 L; Vellset 200 mL/100 L + GranPera 100 mL/100 L; FrutaFija 15 mL/100 L + GranPera 100 mL/100 L; untreated control. All tested combinations of chemicals contributed to increased fruit set compared to the untreated control, with the most effective being FrutaFija 15 mL/100 L + Perlan 25 mL/100 L. This combination resulted in a significant increase in fruit size, but also a slightly higher percentage of deformed fruits. The treatment Perlan 25 mL/100 L + Perlan 25 mL/100 L resulted in similar fruit set but slightly smaller fruits compared to FrutaFija + Perlan, along with a higher percentage of deformed fruits. The treatment of FrutaFija 15 mL/100 L + Gran Pera 100 mL/L contributes to better fruit set compared to the control, larger fruit size, and better-colored fruits without deformities.

Keywords: fertilization, seeds, 6-benzyladenine, gibberellins, naphthaleneacetic acid

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III/U2

RAZVOJ INTENZIVNIH SISTEMA GAJENJA ŠLJIVE U BOSNI I HERCEGOVINI

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Iako je šljiva tradicionalna vrsta sa relativno niskim stepenom intenzivnosti, ona predstavlja najzastupljeniju voćnu kulturu u Bosni i Hercegovini sa trendom daljeg širenja. Ovom trendu doprinosi ne samo činjenica da je šljiva sve traženija zbog prerade u rakiju, već sve izraženijeg trenda izvoza sveže šljive na tržište zapadnoevropskih zemalja. Pravilan izbor uzgojnog oblika u proizvodnji šljive, predstavlja jedan od najvećih izazova za proizvođače u Bosni i Hercegovini. Imajući u vidu da se šljiva uzgaja skoro isključivo na sejancu džanarike, upravljanje visinom i krošnjom stabla, kao i pravovremena zamena rodnog drveta su glavne strategije koje treba sprovesti kod stabala šljive kako bi se obezbedila redovna i profitabilna proizvodnja. Intenzivni sistemi šljive u Bosni i Hercegvini bazirani su na uzgoju šljive u sistemu vretena, što predstavlja standard u intenzivnom uzgoju više od dvadeset godina. Uzgoj šljive u sistemu vretena podrazumeva poznavanje sortnih specifičnosti koje u najvećoj meri opredeljuju pomotehniku u formiranju i održavanju uzgojnog oblika. Poslednjih godina radi se intenzivno na proučavanju mogućnosti uzgoja šljive u dvodimenzionalnim uzgojnim oblicima («UFO» i «Bi-baum»). Dvodimenzionalni uzgojni oblici kod šljive predstavljaju inovativan pristup uzgoju koji omogućava bolje iskorišćenje prostora, efikasnije upravljanje svetlošću i lakšu primenu mehanizacije u voćnjacima. Kod uzgoja šljive oni imaju posebnu ulogu u optimalnom iskorišćavanju bujnosti uslovljene podlogom. Rezultati istraživanja ukazuju na značajne benefite u pogledu produktivnosti, ekonomičnosti i održivosti proizvodnje šljive. U radu su prikazani najznačajniji rezultati u dosadašnjem radu sa intenzivnim sistemima gajenje šljive u Bosni i Hercegovini.

Ključne reči: uzgojni oblik, trodimnezionalni, dvodimenzionalni

DEVELOPMENT OF INTENSIVE PLUM ORCHARD SYSTEMS IN BOSNIA AND HERZEGOVINA

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Although the plum is a traditional species with a relatively low level of intensity in production, it represents the most common fruit crop in Bosnia and Herzegovina, with a trend of further expansion. This trend is contributed to not only by the fact that plums are increasingly in demand for processing into brandy but also by the growing trend of exporting fresh plums to the Western European market. The correct choice of training system in plum production represents one of the greatest challenges for producers in Bosnia and Herzegovina. Considering that plums are grafted almost exclusively on a cherry plum rootstocks, managing the height and the tree canopy, as well as the timely replacement of fruiting wood, are the main strategies to be implemented for plum trees to ensure regular and profitable production. Intensive plum systems in Bosnia and Herzegovina are based on spindle training system, which has been the standard in intensive production for more than twenty years. Plum production in the spindle system requires knowledge of varietal specifics that largely determine the horticultural practices in formation and maintenance of the training system. In recent years, there has been intensive study into the possibilities of training plums in two-dimensional systems ("UFO" and "Bi-baum"). Two-dimensional training systems in plum production represent an innovative approach that allows better use of space, more efficient light management, and easier mechanization application in orchards. They play a crucial role in optimizing the use of vigor induced by the rootstock in plum production. Research results indicate significant benefits in terms of productivity, production efficiency, and sustainability in plum production. This paper presents the most significant findings from research on intensive plum production systems in Bosnia and Herzegovina.

Keywords: training system, three-dimensional, two-dimensional

III/U3

GAJENJE TREŠNJE U SAKSIJI – NOVA METODA PROIZVODNJE U VISOKIM PLASTIČNIM TUNELIMA

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Voćnjaci velike gustine sa kišnim pokrivačima najčešći su sistem za sprečavanje pucanja plodova trešnje u Norveškoj korišćenjem sistema visokih tunela i kišnih pokrivača koji se mogu uvlačiti. Cilj ovog projekta je bio da se razviju nova znanja o uzgoju trešnje u saksijama u visokim tunelima i proizvodnji plodova visokog kvaliteta na ekološki prihvatljiv način. Preliminarni rezultati su pokazali da je potencijal prinosa mnogo veći nego na otvorenim poljima, pri čemu se dobijaju krupniji plodoviTerenska ispitivanja počela su 2020. godine i sprovedena su u NIBIO Ulensvangu, zapadna Norveška, u visokim tunelima za uzgoj trešnje u vodopropusnim posudama od 35 l sa supstratima (treset, kokos i perlit – po 1/3) gde su svi mineralni elementi obezbeđeni fertigacijom i uređaj povezan sa meteorološkom stanicom (Priva) i dve kapaljke po posudi. Od proleća pa do 1. septembra, električna provodljivost (EC) u vodi je bila 1,0 i samo obična voda ostatak sezone. Sorte Tamara, Kordia i Regina su kalemljene na podloge Gisela 5 i 3, i stabla u saksiji na razmaku od 1 m i 2,5 m između redova. Sorta Tamara je dala najveći prinos druge i treće godine posle sadnje, 6 i 8 kg po stablu. Plodovi su bili krupni nezavisno od različitih kombinacija i prosečno su bili 10,5 g druge godine i 12,6 g treće godine. Najveći sadržaj rastvorljivih suvih materija bio je u plodovima sorti Regina/G5 i Tamara/G5 treće godine, 16,7 % i 16,4 %, respektivno. Izazovi su optimizovati snabdevanje vodom i ishranom i prilagoditi temperature kako bi se dobili veliki prinosi visokokvalitetnog voća u različitim periodima sezone.

Ključne reči: *Prunus avium* L., supstrati, fertigacija, prinos, kvalitet ploda, plastični tunel, velika gustina sadnje

MANAGEMENT OF SWEET CHERRY TREES IN POTS – A NEW PRODUCTION METHOD IN HIGH PLASTIC TUNNELS

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High density orchards with rain covers are the most common system for preventing fruit cracking of sweet cherry in Norway using multibay high tunnel systems and retractable rain covers. The aim of this project was to develop new knowledge how to grow sweet cherry trees in pots in high tunnels and produce high fruit quality in an environmentally friendly way. Preliminary results showed that the yield potential is much higher than in the open fields, producing larger fruits. Field trials started in 2020 and were conducted at NIBIO Ullensvang, western Norway in high tunnels growing sweet cherry trees in 35 l water permeable pots with substrates (peat, coconut and perlite – 1/3 each) where all mineral elements were provided through a fertigation device connected to a weather station (Priva) and two drippers per pot. From spring and up to September 1, electric conductivity (EC) of the water was 1.0 and during the rest of the season just plain water was used. The cultivars Tamara, Kordia and Regina were grafted on the rootstocks Gisela 5 and 3 and the potted trees were spaced 1 m apart and 2.5 m between the rows. The cultivar Tamara gave the largest yield second and third year after potting, 6 and 8 kg per tree. Fruits were large regardless of the different combinations averaging 10.5 g in the second year and 12.6 g in the third year. The soluble solids contents were highest in the fruits of the cultivars Regina/G5 and Tamara/G5 in the third year, 16.7 % and 16.4 %, respectively. Challenges are to optimize the water and nutrition supply and adjust the temperatures to obtain large yields of high quality fruits during different periods of the season.

Keywords: *Prunus avium* L., substrates, fertigation, yield, fruit quality, plastic tunnel, high density

III/U4

UTICAJ ĐUBRENJA AZOTOM NA VEGETATIVNI RAST, RODNOST I KVALITET PLODA MALINE (*Rubus idaeus* L.)

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Trogodišnja istraživanja (2021–2023) prikazana u ovom radu su imala za cilj da doprinesu definisanju optimalnih doza i dinamike primene azotnih hraniva u tehnologiji gajenja maline u zemljištu. Vegetativne karakteristike, parametri rodnosti i fizičko-hemijske osobine ploda sorti maline 'Willamette' i 'Meeker' paralelno su proučavane u sledećim tretmanima sa različitim dozama azota: i) tretman sa nižim dozama hraniva (ukupno 31 kg ha^{-1} azota je dodat putem zemljišne aplikacije po 36 kg ha^{-1} đubriva KAN pred početak vegetacije i na početku cvetanja i berbe, kao i kroz dva folijarna tretmana 2% rastvorom đubriva urea posle berbe sa razmakom od 15 dana); ii) tretman sa višim dozama hraniva (ukupno 46,34 kg ha^{-1} azota je dodato putem zemljišne aplikacije po 45 kg ha^{-1} đubriva KAN pred početak vegetacije i na početku cvetanja i berbe i po 15 kg ha^{-1} sredinom berbe i na kraju berbe, kao i kroz dva folijarna tretmana 2% rastvorom đubriva urea posle berbe sa razmakom od 15 dana) i iii) kontrolni tretman (bez primene azotnih hraniva). Najniže vrednosti proučavanih osobina, sa izuzetkom nekih parametara hemijskog sastava ploda, utvrđene su u uslovima gajenja bez primene azotnih hraniva. Najveće vrednosti visine izdanka utvrđene su u tretmanu sa nižim dozama hraniva, dok je primena viših doza hraniva rezultirala najvećom debljinom izdanaka. Proučavani parametri potencijala rodnosti (broj rodnih grančica po izdanku, broj cvetova po rodnoj grančici i cvasti, i broj plodova po reproduktivnom nodusu) se nisu značajno razlikovali između tretmana đubrenja. Značajno veće vrednosti mase i dimenzija ploda, kao i značajno veći prinos utvrđeni su u tretmanu sa nižim dozama hraniva. Prosečne vrednosti mase ploda sorti 'Willamette' i 'Meeker' kretale su se od 2,56 g, odnosno 2,08 g, u kontrolnom tretmanu, preko 3,36 g, odnosno 3,23 g, u tretmanu sa višim dozama hraniva, do 3,88 g, odnosno 3,66 g, u tretmanu sa nižim dozama hraniva. Ista tendencija rezultata uočena je i kod prinosa, pa su najniže prosečne vrednosti prinosa po izdanku utvrđene u kontrolnom tretmanu (352,54 g i 315,56 g), zatim sledi tretman sa višim dozama hraniva (578,23 i 516,55 g), dok su u tretmanu sa nižim dozama hraniva zabeležene najviše vrednosti (652,42 g i 576,14 g). Primena azotnih hraniva nije imala uticaj na sadržaj rastvorljivih suvih materija u plodu proučavanih sorti maline, dok je sadržaj ukupnih i redukujućih šećera, kao i ukupnih fenola i antocijana bio najveći u tretmanu sa nižim dozama azotnih hraniva. Vrednosti sadržaja saharoze, ukupnih kiselina, pH vrednosti soka ploda, kao i odnos sadržaja šećera i kiselina su varirale u zavisnosti od sorte i godine proučavanja.

Ključne reči: 'Willamette', 'Meeker', hraniva, prinos, fizičke i hemijske osobine ploda

Zahvalnica: Ova istraživanja su finansirana sredstvima Ministarstva nauke, tehnološkog razvoja i inovacija RS (ugovor o finansiranju broj 451-03-66/2024-03/200215).

III/U4

EFFECT OF NITROGEN FERTILIZATION ON VEGETATIVE GROWTH, YIELD AND FRUIT QUALITY OF RASPBERRY (*Rubus idaeus* L.)

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The three-year (2021–2023) study presented in this paper aimed to contribute to the definition of optimal doses and dynamics of nitrogen nutrient application in raspberry growing techniques. Parameters of vegetative growth, yielding potential, physical and chemical characteristics of fruit of raspberry cultivars 'Willamette' and 'Meeker' were simultaneously studied in the following treatments with various doses of nitrogen fertilizers: i) treatment with lower doses of nutrients (a total of 31 kg ha^{-1} of nitrogen was added through soil application of 36 kg ha^{-1} KAN fertilizer at the beginning of the growing season, flowering and harvesting and two foliar spraying with a 2% solution of urea fertilizer after harvesting with an interval of 15 days); ii) treatment with higher doses of nutrients (a total of 46.34 kg ha^{-1} of nitrogen was added through soil application of 45 kg ha^{-1} KAN fertilizer at the beginning of the growing season, flowering and harvesting; soil application of 15 kg ha^{-1} at the middle of the harvesting and at the end of the harvesting, and two foliar spraying with a 2% solution of urea fertilizer after harvesting with an interval of 15 days); and iii) control treatment (without fertilizers application). The lowest values of the studied properties, with the exception of some parameters of the chemical composition of the fruit, were determined in control treatment. The highest shoot height values were determined in the treatment with lower doses of nutrients, while the application of higher doses of nutrients resulted in the highest shoot thickness. The number of fruiting laterals, the number of flowers in the umbel and fruiting lateral, and the number of fruits per fruiting node did not differ significantly between fertilization treatments. Significantly higher values of weight and dimensions of the fruit and a significantly higher yield were determined in the treatment with lower doses of nutrients. The average fruit weight of the cultivars 'Willamette' and 'Meeker' ranged from 2.56 g and 2.08 g, respectively, in the control treatment, over 3.36 g and 3.23 g, respectively, in the treatment with higher doses of nutrients, up to 3.88 g, i.e., 3.66 g, in the treatment with lower doses of nutrients. The same tendency of the results was observed in the yield, so the lowest yield values per floricane were found in the control treatment (352.54 g and 315.56 g), followed by the treatment with higher doses of nutrients (578.23 g and 516.55 g), while the highest values were recorded in the treatment with lower doses of nutrients (652.42 g and 576.14 g).The application of nitrogen nutrients had no effect on the content of soluble solids in the fruits of the studied raspberry cultivars, while the content of total and reducing sugars and total phenols and anthocyanins was the highest in the treatment with lower doses of nitrogen nutrients. The values of sucrose content, total acid content, pH value of the fruit juice, and ratio of sugar and acid content varied depending on the cultivar and year of study.

Keywords: Willamette, Meeker, dose of nutrients, yield, physical and chemical fruit traits

III/U5

FOTOSELEKTIVNE MREŽE KAO NOVI TEHNOLOŠKI PRISTUP ZA POBOLJŠANJE PROIZVODNIH PERFORMANSI I KVALITETA PLODA BOROVNICE GAJENE U SUPSTRATU

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Rad predstavlja rezultate komparativnog ispitivanja uticaja različito obojenih fotoselektivnih protivgradnih mreža (plava, crvena i žuta mreža) i neutralnih mreža (biserna i crna mreža) na vegetativni rast, produktivnost i kvalitet ploda sorte borovnice 'Duke' gajene u supstratu. Ispitivanja su izvedena u zasadu borovnice koji se nalazi u Gruži (opština Knić) tokom perioda 2022-2023. godina. Zasad je zasnovan u proleće 2017. godine sadnjom dvogodišnjih biljaka u saksije zapremine 113 l, koje su ispunjene mešavinom strugotine i belog treseta (50:50) i postavljene na rastojanje od 0,8 m u redu i 3,0 m između redova (4.170 biljaka/ha). Crvena fotoselektivna mreža je stimulativno uticala na vegetativni rast (visinu i širinu žbuna, i ukupan broj grana u žbunu) i doprinela je značajnom povećanju broja plodova i prinosa po žbunu (2642,2 i 5,8 kg/žbunu, po redosledu) u poređenju sa ostalim ispitivanim mrežama. Uticaj godine je bio značajan sa registrovanim povećanjem ukupnog broja grana u žbunu, širine žbuna, broja plodova i prinosa po žbunu u 2023. godini, dok su masa i dimenzije ploda, čvrstoća, kao i sadržaj rastvorljive suve materije bili značajno veći u 2022. godini. Prosečna masa ploda kretala se u rasponu od 2,01 g (crna mreža) do 2,47 g (crvena mreža). Biserna mreža je ispoljila pozitivan uticaj na čvrstoću ploda (16,18 N), dok kod kohezivnosti i elastičnosti pokožice ploda nisu uočene značajne razlike između boja mreža. Plava mreža je pozitivno uticala na sadržaj rastvorljive suve materije u plodu (12,2%), kao i na značajno smanjenje sadržaja ukupnih kiselina (0,43%). Crvena mreža je doprinela većoj sintezi ukupnih fenola i ukupnih antocijanina u plodu (1,62 mg galne kis. ekv/g sv.m.pl. i 50,07 mg malvidin-3-glukozid ekv/100 g sv.m.pl., po redosledu), dok je crna mreža uticala na značajno smanjenje sadržaja fenolnih komponenti. Sličan trend se zapaža i u pogledu ukupnog antioksidativnog kapaciteta ploda, koji je bio značajno povećan pod uticajem crvene mreže (1,13 mg askorb. kis. ekv/g sv.m.pl.). Dobijeni rezultati ukazuju na značajan potencijal primene crvene fotoselektivne mreže u poboljšanju proizvodnih performansi i povećanju sadržaja fenolnih jedinjenja, kao i antioksidativne aktivnosti ploda borovnice gajene u supstratu.

Ključne reči: *Vaccinium corymbosum* L., prinos, teksturna analiza ploda, bioaktivne komponente, antioksidativni kapacitet

Zahvalnica: Ova istraživanja su finansirana Ugovorom o realizaciji naučnoistraživačkog rada u 2024. godini između Ministarstva za nauku, tehnološki razvoj i inovacije Republike Srbije i Univerziteta u Beogradu, Poljoprivrednog fakulteta (Ugovor br. 451-03-65). /2024-03/200116) i Univerziteta u Beogradu, Instituta za multidisciplinarna istraživanja (Ugovor br. 451-03-66/2024-03/200053).

III/U5

PHOTOSELECTIVE NETS AS A NEW TECHNOLOGICAL APPROACH TO IMPROVE FIELD PERFORMANCE AND FRUIT QUALITY OF SOILLESS-GROWN BLUEBERRY

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This work presents the results of a comparative study of the impact of photoselective anti-hail nets of different colors (blue, red and yellow) and neutral photoselective nets (pearl and black net) on vegetative growth, productivity and fruit quality of blueberry cultivar 'Duke' grown in the substrate. The field study was conducted in the blueberry plantation in the village of Gruža (the municipality of Knić) during 2022-2023. The plantation was established in the spring of 2017 by planting two-year-old plants of cultivar 'Duke' in pots with a volume of 113 L, filled with a substrate mixture of pine sawdust and white peat (50:50 ratio). The pots were spaced 0.8 m apart in a row and 3.0 m between rows (4,170 plants/ha). The red photoselective net had a stimulating effect on vegetative growth (height and width of the bush, and the total number of canes in the bush) and contributed to a significant increase in the number of fruits and yield per bush (2642.2 and 5.8 kg/bush, respectively) in comparison with other nets tested. A significant effect of the year with a registered increase in the total number of canes in the bush, the width of the bush, the number of fruits and the yield per bush was observed in 2023, while the weight and dimensions of the fruit, hardness 1 and 2, as well as the content of soluble solids were significantly higher in 2022. The average fruit weight ranged from 2.01 g (black net) to 2.47 g (red net). The pearl net had a positive effect on the fruit hardness (16.18 g), while no significant differences were observed between the colors of the nets in cohesiveness and elasticity of the fruit skin. The blue net increased the content of soluble solids (12.2%) and contributed to a significant reduction of total acids (0.43%). Red net contributed to the higher synthesis of total phenols and total anthocyanins in the fruit (1.62 mg GA eq/g FW and 50.07 mg malvidin-3-glucoside eq/100 g FW, respectively), while black net significantly reduced the content of total phenolic compounds. A similar trend was observed in terms of the total antioxidant capacity of the fruit, which was significantly increased under the red net (1.13 mg AsA eq/g FW). The obtained results indicate the significant potential of the application of the red photoselective net in improving the production performance and increasing the content of phenolic compounds, as well as the antioxidant activity of blueberries grown in the substrate.

Keywords: *Vaccinium corymbosum* L., yield, fruit color, textural analysis, bioactive compounds, antioxidant capacity

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III/U6

UTICAJ DEZINFEKCIJE PLEMKI EKOLOŠKI PRIHVATLJIVIM METODAMA NA PRINOS KALEMOVA I METABOLIZAM FENOLA U KALUSU LOZNIH KALEMOVA

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Tokom proteklih 30 godina, Esca je postala jedna od najrazornijih bolesti u vinogradima širom sveta, koja utiče na kalemljenje vinove loze do zrele loze. Učešće brojnih gljivičnih patogena i nenamerno širenje zaraženog materijala za razmnožavanje kroz asimptomatske matične loze doprinose njegovoj ozbiljnosti. Dezinfekcija materijala za razmnožavanje je neophodna, ali nedostaju efikasni ekološki prihvatljivi tretmani i njihov uticaj na formiranje kalusa je nejasan. Ova studija je istraživala fenolnu reakciju i srodne enzime svežeg kalusa vinove loze kalemljenih sa plemkama različitog zdravstvenog stanja u vezi sa bolešću Esca, dezinfikovanih ekološkim sredstvima (Beltanol, Beltanol sa tretmanom toplom vodom, Serenade® ASO, BioAction ES, Remedier i natrijum bikarbonat). Takođe je procenjen prinos kalemova. U kalusu preovlađuju flavanoli, stilbeni i kondenzovani tanini. Rezultati pokazuju da zdravstveno stanje plemki i njihova dezinfekcija pre kalemljenja utiču na sadržaj fenola, ali ne i na fenolni sastav. BioAction ES je pokazao snažan elicitorski efekat, značajno povećavajući aktivnost fenilalanin amonijak lijaze (PAL) za 3,4 puta u kalusu kalemova okalemljenim zdravim plemkama, i posledično povećanje ukupnog sadržaja fenola u proseku za 38% u poređenju sa kalusom kalemova okalemljenih plemkama tretiranim Beltanolom. Ovo povećanje je moglo biti povezano sa većim prinosom kalemova okalemljenih zdravim plemkama, koje su prethodno dezinfikovane sa sredstvom BioAction ES. U tretmanu sa sredstvom BioAction ES utvrđen je prinos kalemova od 79%, praćen tretmanom sredstvom Serenade (75%). BioAction ES je takođe uticao na aktivnost flavanon 3 β - hidroksilaze (FHT) u kalusima kalemova okalemljenih inficiranim plamkama za 4,9 puta (asimptomatski) i 6,9 puta (simptomatski) u poređenju sa kalemovima tretiranim sredstvom Beltanol. Ovo je izazvalo prosečno povećanje za 2,0 puta sadržaja fenola u kalemovima sa simptomatskom reakcijom dezinfikovanim sredstvom BioAction ES u poređenju sa kalemovima tretiranim Beltanolom. Ovi rezultati ukazuju na potencijal primene sredstva BioAction ES u modulaciji sadržaja fenola.

Ključne reči: ESCA, kalemljenje, BioAction ES, Beltanol, fenolni sastav, fenilpropanoidi

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III/U6

THE INFLUENCE OF SCION DISINFECTION USING ECOLOGICALLY ACCEPTABLE METHODS ON VINE GRAFT YIELD AND PHENOL METABOLISM IN THE CALLUS OF VINE GRAFTS

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Over the past 30 years, Esca has become one of the most devastating diseases in vineyards worldwide, affecting vine grafts to mature vines. The involvement of numerous fungal pathogens and the inadvertent spread of infected propagation material through asymptomatic mother vines contribute to its severity. Disinfection of propagation material is essential, but effective eco-friendly treatments are lacking and their effects on callus formation are unclear. This study investigated the phenolic response and related enzymes of fresh grapevine callus grafted with scions of different health status regarding Esca disease, disinfected with eco-friendly methods (Beltanol, Beltanol with hot water treatment, Serenade® ASO, BioAction ES, Remedier and sodium bicarbonate). Graft yield was also evaluated. Flavanols, stilbenes and condensed tannins predominated in the graft callus. The results indicate that the health status of the scions and their disinfection prior to grafting affect the phenolic content, but not its composition. BioAction ES showed a strong elicitor effect, significantly increasing phenylalanine ammonia lyase (PAL) activity by 3.4-fold in callus from grafts with healthy scions, and consequently increasing total phenolic content by an average of 38% compared to callus from grafts with Beltanol-treated healthy scions. This increase was could be associated with a higher grafting yield in grafts with healthy scions previously disinfected with BioAction ES, which had beside Serenade (75%), the highest grafting yield (79%). BioAction ES also affected flavanone 3β-hydroxylase (FHT) activity in callus from grafts with infected scions by 4.9-fold (asymptomatic) and 6.9-fold (symptomatic) compared to callus from grafts with Beltanol-treated scions. This probably caused an average 2.0-fold increase in phenolic content in grafts with symptomatic scions disinfected with BioAction ES compared to those treated with Beltanol. These results indicate the potential of BioAction ES in modulating phenolic content.

Keywords: ESCA, grafting, BioAction ES, Beltanol, phenolic composition, phenylpropanoids

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III/U7

KVALITET GROŽĐA BESJEMENIH STONIH SORTI VINOVE LOZE (*Vitis vinifera* L.) GAJENIH NA PODRUČJU ISTOČNE HERCEGOVINE

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U svijetu je posljednjih godina konstatovan trend porasta proizvodnje i potrošnje grožđa za konzumnu upotrebu, posebno grožđa besjemenih sorti. Promjene u strukturi proizvodnje grožđa su prisutne i u Bosni i Hercegovini, a dijelom se odnose na introdukciju stonih sorti grožđa koje do sada nisu bile dio sortimenta. S obzirom na nedovoljno poznavanje karakteristika ovih sorti, cilj ovog rada je bilo ispitivanje kvaliteta grožđa besjemenih stonih sorti: Crimson, Autumn Royal, Flame, Sugraone i Perlon, gajenih u istočnoj Hercegovini. Predmet istraživanja su bila fizička i strukturna svojstva grozda i bobica (masa, dužina i širina, veličina, broj bobica u grozdu, odnosno relativni udio peteljkovine i bobica u grozdu, te mesa i pokožice u bobicama). Fizičko-hemijska svojstva grožđanog soka su ocjenjena na osnovu analize sadržaja rastvorljive suve materije – šećera (%Brix), sadržaja ukupnih kiselina (g/l) i pH vrijednosti. Organoleptička svojstva ispitivanih sorti su determinisana na osnovu ocjene (1-5) spoljašnjih karakteristika grozda i bobica (opšti izgled, veličina i rastresitost grozda, uniformnost, veličina, boja i lakoća odvajanja bobice od peteljke) i konzumnih karakteristika bobica (ukus, čvrstoća, sočnost i aroma). Prema rezultatima ispitivanja, sorta Autumn Royal je imala najveću prosječnu masu grozda (508,02 g) i bobica (4,77 g), kao i najveću prosječnu dužinu bobica (21,77 mm). Ista sorta je imala neznatno manju širinu bobica (17,66 mm) u odnosu na najveću utvrđenu vrijednost kod sorte Sugraone (17,74 mm). Najmanja prosječna masa bobice konstatovana je u slučaju sorte Perlon (2,21 g), koja je s druge strane imala najveću prosječnu dužinu grozda (23,90 cm), najveći broj bobica u grozdu (175,5) i najviši nivo šećera i ukupnih kiselina u grožđanom soku (22,4 %Brix, odnosno 6,31 g/l). Najvišu ocjenu (5) za spoljašnje karakteristike grozda i bobica dobila je sorta Autumn Royal, a za konzumne karakteristike sorta Sugraone, a potom Crimson.

Ključne riječi: besjemene stone sorte, grožđe, kvalitet

THE QUALITY OF GRAPES SEEDLESS TABLE VARIETIES (*Vitis vinifera* L.) GROWN IN THE AREA OF EASTERN HERZEGOVINA

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The growing trend of production and consumption of grapes for fresh consumption, is noted worldwide in a last few years, especially seedless types of grapes. The alterations in the structure of grape production are also present in Bosnia and Herzegovina and are partly related to the introduction of table grape varieties which, until now, haven't been a part of the assortment. Considering not being sufficiently familiar with these grape varieties characteristics, the main aim of this paper was the quality assessment of the seedless table grape varieties: Crimson, Autumn Royal, Flame, Sugraone and Perlon, grown in Eastern Herzegovina. The research subject were physical and structural characteristics of the cluster and berries (mass, length and width, size, number of berries in the cluster, relative share of rachis and berries in the cluster and of the flesh and skin of a berry). Physical and chemical characteristics of the grape juice were assessed based on the analysis of the content of solublesolids – sugar (%Brix), the content of total acids (g/l) and pH values. Organoleptic characteristics of tested varieties were determined based on grade (1-5) of external characteristics of cluster and berries (general look, size and compactness of the cluster, uniformity, size, colour of berries and the easiness of berry separation) and consumption characteristics of the berries (taste, hardness, juiciness and aroma). According to the examination results, Autumn Royal had the biggest average cluster mass (508.02g) and berry mass (4.77g), as well as the biggest average berry length (21.77mm). The same variety had slightly smaller berry width (17.66mm) comparing to the largest value determined at Sugraone (17.74mm). The smallest average berry mass was determined at Perlon (2.21g) which, on the other hand, had the biggest average cluster length (23.9 cm), the biggest number of berries in the cluster (175.5) and the highest sugar and total acid content in the grape juice (22.4 %Brix, 6.31 g/l). Autumn Royal received the highest score (5) for the external characteristics of the cluster and berries, Sugraone for the consumption characteristics, and Crimson followed.

Key words: seedless table grapes, quality

III/PO4

IZAZOVI U ZAŠTITI VOĆAKA I VINOVE LOZE OD PROUZROKOVAČA EKONOMSKI NAJZNAČAJNIJIH BILJNIH BOLESTI I ŠTETOČINA

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Proizvodnja hrane predstavlja globalni izazov u aktivnosti čovečanstva. Na ovom putu susrećemo se sa mnogobrojnim ograničavajućim faktorima. Jedan od limitirajućih faktora je prisustvo prouzrokovača biljnih bolesti i štetočina, što je posebno izraženo u voćarskoj proizvodnji. U zaštiti voćaka i vinove loze najprihvaljiviji je sistem proizvodnje u skladu sa principima dobre poljoprivredne prakse. Za upešnu zaštitu bilja neophodno je dati odgovor na tri pitanja: kada izvršiti tretiranje pesticidima (optimalno vreme primene pesticida), kojim pesticidima tretirati (pravilan izbor preparata) i kakav treba da bude kvalitetet tretiranja (pravilan izbor mehanizacije).Na nivou zakonske regulative Evropske Unije dostupan je spisak dozvoljenih i zabranjenih jedinjenja koja se koriste u zaštiti voćaka i vinove loze. Naša zakonska regulativa usklađena je sa ovim pravilima.

Venturia inaequalis, prouzrokovač čađave pegavosti lista i krastavosti plodova predstavlja ekonomski najznačajnije oboljenje jabuke. Osnovni princip u suzbijanju *V. inaequalis* je suzbijanje primarnih zaraza. U periodu kada se one ostvaruju, neophodno je da se pre ostvarivanja pogodnih uslova odradi tretiranje fungicidima. Od fungicida u ovom periodu može se koristiti kombinacija *SDHI* fungicida (fluksapiroksad, fluopiram, pentiopirad) sa kaptanom ili ditianonom. Kasnije u periodu sekundarnih zaraza koriste se kaptan, ditianon, fluazinam ili dodin. Kada je reč o pepenici jabuke, *Podosphaera leucotricha* program suzbijanja *V. inaequalis* uglavnom obuhvata i suzbijanje ovog oboljenja. Za suzbijanje prouzrokovača bolesti u skladištu (*Coletotrichum* spp., *Botrytis cinerea* i dr.) treba obaviti dva tretiranja tokom letnjeg perioda. Od fungicida mogu se koristiti: boskalid, piralokstrobin, trifloksistrobin i fludioksonil. *Cydia pomonella,* prouzrokovač crvljivosti plodova jabuke predstavlja ekonomski najznačajniju štetočinu jabuke. Usled globalnih klimatskih promena (više temperature) postaje sve veći problem, jer u ovakvim uslovima ima više generacija godišnje. Osnovna strategija suzbijanja *C. pomonella* je efikasno suzbijanje prve generacije. Suzbijanje ove generacije treba obaviti pre ubušivanja gusenica u plodove. Od insekticida mogu se koristiti: hlorantranilprol, cijantranilprol, spinetoram, acetamiprid, piretroidi i emamektin benzoat. Ovi inskekticidi se koriste i za suzbijanje smotavaca šljive i breskve. Pored *C. pomonella* u poslednje vreme sve veći problem u proizvodnji jabuke predstavlja *Eriosoma lanigerum*, krvava vaš. Osnovni razlog jače pojave krvave vaši je ukidanje organofosfornih insekticida. Od insekticida najbolju efikasnost ispoljavaju flupiradifuron i spirotetramat.

Osnovni problem u zaštiti kruške predstavlja štetočina *Cacopsylla pyri*, obična kruškina buva. Suzbijanje *C. pyri* je veoma kompleksno i zahteva dobru kombinaciju hemijskih i agrotehničkih mera kojima treba optimalno izbalansirati bujnost biljaka. U okviru hemijskog suzbijanja kruškine buve osnovna strategija je suzbijanje prezimljujuće forme (zimski imago) i sprečavanje polaganja zimskih jaja. Za ove namene koriste se mineralna ulja ili kaolin. Tokom vegetacije mogu se koristiti: acetamiprid, spirotetramat i spinetoram.

III/PO4

Poslednjih godina posebno kod nektarine *Thrips* spp. postaje sve značajnija štetočina breskve. Za suzbijanje tripsa mogu se primenjivati: acetamiprid, piretroidi, spinosad, spinetoram i cijantraniliprol.

Najznačajnije vrste grinja koje se javljaju na jabuci su: *Panonychus ulmi*, crvena voćna grinja i *Tetranychus urticae*, obična koprivina grinja. Za njihovo suzbijanje najčešće se koriste: mineralna ulja, acekvinocil i spirotetramat. *Halyomorpha halys*, braon mramorasta stenica postaje sve veći problem u proizvodnji voćaka. Pored nje prisutne su i druge vrste stenica. Od insekticida za suzbijanje ovih štetnih insekata koriste se: piretroidi, sulfoksaflor i acetamiprid.

Plasmopara viticola, prouzrokovač plamenjače vinove loze u kišovitim godinama predstalja ekonomski značajno oboljenje. Prvi preduslov za njegovu uspešnu kontrolu je suzbijanje primarne zaraze. Od fungicida mogu se koristiti preventivni: neorganska jedinjenja bakra, ditianon + kalijum-fosfonat, ali i sistemični: fosetil-Al, metalaksil, dimetomorf, mandipropamid, iprovalikarb, ametokradin i dr. *Erysiphe necator*, prouzrokovač pepelnice vinove loze predstavlja ekonomski značajno oboljenje vinove loze. Novija saznanja ukazuju da se i pepelnica intenzivnije razvija u kišovitim godinama, zato što su hazmotecije glavni izvor inokuluma. Sve ovo ukazuje da su ključna tretiranja ona koja se izvode od kretanja vegetacije do početka cvetanja. Od fungicida mogu se koristiti: *SDHI* fungicidi, revisol, difenokonazol, metrafenon u kombinaciji sa sumporom. Važno je pomenuti i *ESCA*, kompleks gljiva koji izaziva sušenje vinove loze. Osnovu zaštite vinove loze od od ovog oboljenja čini primena fungicida odmah posle rezidbe, a pre prve kiše. Za ove namene potrebno je koristiti kombinaciju neorganskih jedinjenja bakra sa boskalidom. U budućnosti cikade mogu predstavljati sve veći problem u proizvodnji grožđa zbog globalnog povećanja temperatura vazduha.

Ključne reči: jabuka, kruška, breskva, vinova loza, bolesti, štetočine, pesticidi

III/PO4

CHALLENGES IN FRUITS AND GRAPEVINE PROTECTION AGAINST THE MOST ECONOMICALLY IMPORTANT PLANT DISEASES AND PESTS

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Food production is a global challenge in human activities. On this path, we encounter numerous limiting factors. One of the limiting factors is the presence of plant diseases and pests, which is especially pronounced in fruit production. In the protection of fruit trees and grapevines, the most acceptable production system is in accordance with the principles of good agricultural practice. For the successful protection of plants, it is necessary to answer three questions: when to carry out the treatment with pesticides (optimal time of pesticide application), which pesticides to treat (correct choice of preparation) and what should be the quality of treatment (correct choice of mechanization). At the level of European Union legislation, a list of permitted and prohibited compounds used in the protection of fruit trees and grapevines is available. Our legislation is aligned with these rules.

Venturia inaequalis, the cause of apple scab, is the most economically significant apple disease. The basic principle in the control of *V. inaequalis* is the control of primary infections. In the period when they are realized, it is necessary to carry out treatment with fungicides before the realization of favorable conditions. A combination of *SDHI* fungicides (fluxapiroxad, fluopyram, penthiopyrad) with captan or dithianone can be used in this period. Later in the period of secondary infections, captan, dithianone, fluazinam or dodine are used. When it comes to apple powdery mildew, the *Podosphaera leucotricha* control program of *V. inaequalis* mainly includes the control of this disease. To control disease-causing agents in storage (*Coletotrichum* spp., *Botrytis cinerea*, etc.), two treatments should be carried out during the summer period. The following fungicides can be used: boscalid, pyralostrobin, trifloxystrobin and fludioxonil. *Cydia pomonella*, codling moth, represents the most economically significant apple pest. Due to global climate changes (higher temperatures) it is already becoming a problem, because in these conditions there are more generations per year. The basic control strategy of *C. pomonella* is effective control of the first generation. Suppression of this generation should be done before the caterpillars bore into the fruit. The following insecticides can be used: chlorantranilprole, cyantranilprole, spinetoram, acetamiprid, pyrethroids and emamectin benzoate. These insecticides are also used to control plum and peach moths. In addition to *C. pomonella*, *Eriosoma lanigerum*, the woolly apple aphid, has recently become a growing problem in apple production. The main reason for the stronger occurrence of *E. lanigerum* is the abolition of organophosphorus insecticides. Of the insecticides, flupyradifuron and spirotetramat show the best effectiveness.

The main problem in pear protection is the pest *Cacopsylla pyri*, pear psylla. Suppression of *C. pyri* is very complex and requires a good combination of chemical and agrotechnical measures that should optimally balance the lushness of the plants. Within the framework of chemical control

of the pear psylla, the basic strategy is to control the overwintering form (winter imago) and prevent the laying of winter eggs. Mineral oils or kaolin are used for these purposes. During the growing season, the following can be used: acetamiprid, spirotetramat and spinetoram.

In recent years, especially in nectarine *Thrips* spp. is becoming an increasingly important peach pest. The following can be used to control thrips: acetamiprid, pyrethroids, spinosad, spinetoram and cyantraniliprole.

The most important mite species that occur on apple are: *Panonychus ulmi* and *Tetranychus urticae*. For their suppression, the following acaricides are most often used: mineral oils, acequinocil and spirotetramat. *Halyomorpha halys* is becoming an increasing problem in fruit production. In addition to it, other types of bed bugs are also present. The following insecticides are used to control these harmful insects: pyrethroids, sulfoxaflor and acetamiprid.

Plasmopara viticola, the causative agent of grapegrapevine downy mildew in rainy years, represents an economically significant disease. The first prerequisite for its successful control is the suppression of the primary infection. Preventive fungicides can be used: inorganic compounds of copper, dithianone + potassium phosphonate, but also systemic: fosetyl-Al, metalaxyl, dimethomorph, mandipropamide, iprovalicarb, ametocradin, etc. *Erysiphe necator*, the causative agent of grapevine powdery mildew, is an economically significant grapevine disease. Recent findings indicate that powdery mildew also develops more intensively in rainy years, because chasmothecia are the main source of inoculum. All this indicates that the key treatments are those carried out from the movement of vegetation to the beginning of flowering. Fungicides that can be used are: SDHI fungicides, Revisol, difenoconazole, metrafenone in combination with sulfur. It is important to mention ESCA, a complex of fungi that causes dieback of the grapevines. The basis of the protection of the grapevines from this disease is the application of fungicides immediately after pruning and before the first rain. For these purposes, it is necessary to use a combination of inorganic copper compounds with boscalid. In the future, leafhoppers may represent an increasing problem in grape production due to the global increase in air temperatures.

Keywords: apple, pear, peach, grapevine, diseases, pests, pesticides

III/U8

UTICAJ ORGANSKIH PREPARATA NA MEHANIČKI SASTAV GROZDA SORTE GAME CRNI

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Organsko vinogradarstvo sve češće pronalazi svoju primenu u savremenoj i održivoj proizvodnji, pri čemu se teži inovativnosti, ekonomskoj dobiti, očuvanju zdravlja i životne sredine. Sorta vinove loze *game crni* gajena je u sistemu organske proizvodnje u agroekološkim uslovima Požarevačkog vinogorja u Mlavskom rejonu. Ogled je sproveden tokom 2022 i 2023. godine na Oglednom dobru Poljoprivredne škole sa domom učenika „Sonja Marinković" u Požarevcu. Zaštita eksperimentalnih čokota obavljena je sa preparatima specifičnim za organsku proizvodnju *„TMB Diamond"*, dok su kontrolni čokoti bili bez zaštite. U ogledu su korišćeni proizvodi FitoCal Ultra i Fito Bor 10, FitoSupreme, Fitoaminoflash, Fitomil L60, Fitobotryfun koji su imali za cilj rešavanje problema ishrane i zaštite na najefikasniji način. U oglednom vinogradu razmak sadnje bio je 3,5 × 1 m, formiran je Gijov jednogubi uzgojni oblik, zimskom rezidbom je ostavljeno 10 okaca po čokotu i primenjene sve standardne agro i ampelotehničke mere. Laboratorijska ispitivanja su sprovedena u Laboratoriji za hortikulturu, Poljoprivrednog fakulteta Univerziteta u Beogradu i Laboratorijama Poljoprivredne škole sa domom učenika „Sonja Marinković" u Požarevcu. Statistička analiza je izvršena metodom analize varijanse (ANOVA). U ovom radu su prikazani rezultati uticaja organskih preparata na osnovne parametre mehaničkog sastava grozda sorte *game crni.* Na osnovu dobijenih rezultata utvrđeno je da kod dužine grozda i broja bobica u grozdu postoje statistički značajne razlike između organskih preparata i kontrole. Prosečna dužina grozda u varijanti sa primenom organskih preparata iznosila je 17,6 cm, dok je kod kontrole ona bila 16,85 cm, broj bobica kod grozdova tretiranih organskim preparatima bio je 155, a kod kontrole 111. Primena organskih preparata nije imala statistički značajan uticaj na masu grozda i masu bobice. Gajenje sorte *game crni* po principima organske proizvodnje uz primenu organskih preparata *„TMB Diamond"* može biti preporuka i za širenje organskih vinograda u drugim vinogorjima.

Ključne reči: organsko vinogradarstvo, Požarevačko vinogorje, *game crni*, sastav grozda

INFLUENCE OF ORGANIC PREPARATIONS ON THE MECHANICAL COMPOSITION OF 'GAME' GRAPE VARIETY

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Organic viticulture is increasingly finding its application in modern and sustainable production, where innovation, economic profit, preservation of health and the environment are sought. The 'Game' grape variety was grown in the agro-ecological conditions of the Požarevac vineyard in the Mlavski region. The experiment was carried out during 2022 and 2023 at the Agricultural School's Experimental Farm with the home of the students "Sonja Marinković" in Požarevac. The protection of the experimental vines was carried out with preparations specific for organic production "TMB Diamond", while the control vines were without protection. In the study, the products FitoCal Ultra and Fito Bor 10, FitoSupreme, Fitoaminoflash, Fitomil L60, Fitobotryfun were used, which aimed to solve the problems of nutrition and protection in the most effective way. In the experimental vineyard, the planting distance was 3.5 × 1 m, single Guyot training system was formed, 10 shoots per vine were left with winter pruning and all standard agro and ampelotechnical measures were applied. The laboratory tests were carried out in the Horticulture Laboratory, Faculty of Agriculture, University of Belgrade, and the Laboratories of the Agricultural School with a student dormitory "Sonja Marinković" in Požarevac. Statistical analysis was performed by the method of variance analysis (ANOVA). This stady presents the results of the influence of organic preparations on the basic parameters of the mechanical composition of grapes of the 'Game' grape variety. Based on the obtained results, it was determined that there are statistically significant differences between the organic preparations and the control in the length of the bunch and the number of berries in the bunch. The average length of bunches with the use of organic preparations was 17.6 cm, while in the control it was 16.85 cm, the number of berries in the bunches treated with organic preparations was 155, and in the control 111. Application of organic preparations did not have a statistically significant effect on bunch mass and berry mass. Cultivation of the 'Game' grape variety according to the principles of organic production with the use of organic preparations "TMB Diamond" can be a recommendation for the establishment of organic vineyards in other vineyards.

Keywords: organic preparations, Požarevac wine-growing region, 'Game' grape variety, bunch composition

III/U9

UTICAJ ORAHOVE MUVE NA METABOLIZAM PLODA

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Orahova muva (*Rhagoletis completa*) uzrokuje ozbiljnu štetu u proizvodnji oraha, stvarajući nekrotične crne mrlje na klapini ploda, koje kasnije utiču na ceo plod. Analizirali smo koordinaciju sistema odbrane biljke između oštećenog i okolnog tkiva, kao i između različitih delova ploda (klapina, peteljka, pokožica jezgre, meso jezgre). Procenjivali smo morfološke promene na plodu, uključujući boju, veličinu i čvrstinu. Na metaboličkom nivou, uključili smo analizu fenolnih jedinjenja korišćenjem HPLC-MS/MS, masnih kiselina korišćenjem GC-MS, i enzimskih aktivnosti (polifenol oksidaza i peroksidaza). Rezultati pokazuju da nisu zahvaćene samo morfološke karakteristike, već i sadržaj fenola i aktivnost antioksidativnih enzima u različitim tkivima ploda, kao i sadržaj masnih kiselina u jezgri. Takođe, čini se da je odbrambeni odgovor biljke lokalizovan na direktno pogođeno mesto, i ne širi se sistemski na druge delove ploda. Efekat prisustva štetočine se takođe intenzivira tokom vremena. Duboko razumevanje interakcije biljka-štetočina je od izuzetne važnosti jer pomaže da se shvati obim štete u pogledu kvaliteta i razvoja ploda, i predlože nova rešenja za smanjenje ekonomskih gubitaka izazvanih prisustvom ove štetočine.

Ključne reči: morfologija, metabolizam, fenolna jedinjenja, enzimi, masne kiseline

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III/U9

EFFECT OF WALNUT HUSK FLY ON THE FRUIT METABOLISM

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Walnut husk fly (*Rhagoletis completa*) causes severe damage in walnut production, producing necrotic black spots on the fruit husk, which later affect the whole fruit. We analyzed the coordination of the plant defense system between the affected spot and the surrounding tissue, as well as between different parts of the fruit (husk, stalk, kernel skin, kernel flesh). We assessed morphological changes in the fruit, including color, size, and firmness. At the metabolic level, we included analysis of phenolic compounds using HPLC-MS/MS, fatty acid using GC-MS, and enzymes activity assays (polyphenol oxidase and peroxidase). The results show that not only morphological features are affected, but also the phenolic content and antioxidant enzymes activity in different tissues of the fruit, as well as the fatty acid content in the kernel. Also, the plant defense response seems to be local to the directly affected spot, and it does not get systemic to other parts of the fruit. Also, the effect of the pest presence intensifies with time. Deep comprehension of the plant-pest interaction is of the utmost importance as it helps to understand the extent of the damage on the fruit quality and development, and propose new solutions to mitigate economic loss due to the presence of this pest.

Keywords: morphology, metabolism, phenolic compounds, enzymes, fatty acids

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III/U10

KORIŠĆENJE EKSTRAKATA I ULJA SEMENA *Koelreuteria paniculata* ZA EKOLOŠKO UPRAVLJANJE KRVAVOM VAŠI

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Krvava vaš, *Eriosoma lanigerum* (Hausmann, 1802), predstavlja veliku pretnju za intenzivnu proizvodnju jabuke. Uvažavajući sve veća ograničenja u korišćenju konvencionalnih sintetičkih pesticida, uslovljen je razvoj efikasnih i održivih strategija za kontrolu štetočina. Biološka kontrola, korišćenjem prirodnih predatora i parazitoida pokazuje obećavajuće rezultate u suzbijanju krvave vaši. S tim u vezi, ovo istraživanje imalo je za cilj ispitivanje aficidnog potencijala etanolnog ekstrakta i ulja semena invazivne ukrasne vrste *Koelreuteria paniculata* u suzbijanju krvave vaši. U oba slučaja dokazana su jaka insekticidna svojstva, postižući potpunu (100% sa uljem) ili značajnu (86-100% sa etanolnim ekstraktom) stopu smrtnosti krvave vaši. Preovlađujuća fenolna jedinjenja u etanolnom ekstraktu — galna i protokatehuinska kiselina i njihovi derivati, kao što su p-kumarinska, kvercetin i luteolinska kiselina — čine preko 90% ukupnog fenolnog sadržaja. Nasuprot tome, fenolna jedinjenja nisu detektovana u ulju, što ukazuje na prisustvo različitih aktivnih materija. Na taj način, pored stvaranja održive proizvodnje jabuke, postiže se usklađenost sa širim socio-ekonomskim i ekološkim ciljevima. Osim toga uvođenjem biljnih ekstrakata, posebno poreklom od invazivnih vrsta, u tekuće prakse upravljanja štetočinama stvara se ekološka ravnoteža, promovišući zdraviju životnu sredinu i održivu poljoprivredu.

Ključne reči: zaštita jabuke, razvoj biopesticida, cirkularna ekonomija, zelena ekonomija, smanjenje invazivnosti, rešenja zasnovana na prirodi

UTILIZING *Koelreuteria paniculata* SEED EXTRACTS AND OIL FOR ECO-FRIENDLY WOOLLY APPLE APHID MANAGEMENT

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The woolly apple aphid (WAA), *Eriosoma lanigerum* (Hausmann, 1802), is a major threat to intensive apple cultivation, especially with the growing restrictions on conventional synthetic pesticides, necessitating the development of effective and sustainable pest control strategies. Biological control, utilizing natural predators and parasitoids, has shown promise in managing these pests. This study explores the aphicidal potential of *Koelreuteria paniculata* seed ethanolic extract and oil. Both treatments demonstrated strong insecticidal properties, achieving complete (100% with oil) or significant (86-100% with ethanolic extract) mortality rates. The predominant phenolic compounds in the ethanolic extract — gallic and protocatechuic acids and their derivatives, such as p-coumaric, quercetin, and luteolin — constitute over 90% of the total phenolic content. In contrast, phenolic compounds were absent in the oil, indicating the presence of different active compounds. This approach not only enhances the sustainability of apple production. but also aligns with broader environmental and socio-economic objectives. Incorporating botanical extracts from invasive species into pest management practices supports ecological balance and sustainable agriculture, promoting a healthier environment and more resilient farming systems.

Keywords: apple pest management, biopesticide development, circular economy, green economy, invasiveness reduction, nature-based solutions

III/U11

ŠTA ČINI LISTOVE KRUŠKE OTPORNIM NA *Psylla sp*.? MORFOLOGIJA NASPRAM HEMIJE

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Kruškina buva (*Cacopsylla pyri* L.), insekt koji se hrani sokom floema, predstavlja jednu od najdestruktivnijih štetočina kruške u Evropi i ako se ne suzbija i ne prati na pravi način može ozbiljno da ugrozi proizvodnju. Cilj našeg istraživanja bio je da ispitamo anatomsku strukturu i profil šećera u listovima 21 sorte kruške različitiog porekla (*Pyrus communis*, *Pyrus pyrifolia* i *Pyrus pyrifolia* × *Pyrus communis*) i različite otpornosti na kruškinu buvu, kako bismo identifikovali osobine koje bi mogle ukazati na uzrok osetljivosti kruške prema ovoj štetočini. Dublje razumevanje odnosa između anatomije lista, profila rastvorljivih šećera u listovima i otpornosti kruške na kruškinu buvu može nam pomoći u selekciji i oplemenjivanju novih sorti kruške koje će omogućiti lakše upravljanje ovom štetočinom. Parametri koji su mereni uključivali su osobine centralnog nerva, primarnog nerva i liske lista, zajedno sa profilom šećera potpuno razvijenih listova, prikupljenih sa središnjeg dela mladara početkom jula. Rezultati su pokazali da postoje značajne razlike između ispitivanih sorti za sve merene parametre centralnog nerva, primarnog nerva i liske. Parametri centralnog nerva (dužina, širina, površina floema i ksilema) pokazali su jasnu razliku između sorti azijske i evropske kruške, pri čemu su najveće vrednosti izmerene kod rezistentnih (*P. pyrifolia*) sorti, a najniže kod sorti 'Jeribasma' i 'Packhams Triumph', dok merenja primarnog nerva i liske, iako se razlikuju između sorti, nisu u korelaciji sa njihovim poreklom i otpornošću. Rezultati analize šećera pokazali su da orijentalne sorte kruške imaju niži sadržaj svih kvantifikovanih šećera u poređenju sa sortama evropske kruške, pri čemu 'Niitaka' i 'Kumoi' imaju najniže vrednosti. Međuvrsni hibrid 'Kieffer seedling' imao je slične vrednosti kao azijske sorte. Ovi rezultati sugerišu da debljina centralnog nerva kod azijskih sorti može predstavljati značajnu barijeru prilikom ishrane *C. pyri* na listovima kruške i zajedno sa niskim sadržajem šećera, posebno sorbitola, fruktoze, glukoze i saharoze, predstavlja jedan od ključnih faktora u otpornosti ovih sorti.

Ključne reči: kruškina buva, *Pyrus communis*, *Pyrus pyrifolia*, anatomija lista, sastav šećera

III/U11

WHAT MAKES PEAR LEAVES RESISTANT TO *Psylla sp.*? MORPHOLOGY VERSUS CHEMISTRY

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The European pear psylla (*Cacopsylla pyri* L.) is a phloem sap-sucking insect that represents one of the most harmful pests of pear in Europe and if it's not suppressed and monitored correctly it can seriously hamper the production. The aim of our study was to examine the anatomical structure and sugar profile in leaves of 21 pear cultivars of diverse origin (*Pyrus communis*, *Pyrus pyrifolia*, and *Pyrus pyrifolia* × *Pyrus communis*) and different resistance to psylla, to identify traits that could indicate the cause of susceptibility to this pest. A deeper understanding of the relationship between leaf anatomy and soluble sugar profile in the leaves and pear psylla resistance can help us in the selection and breeding of new pear cultivars with easier pest management. Parameters that were measured included the traits of the midrib, primary vein and lamina, together with sugar profile of fully developed leaves collected from the middle part of the extension shoots in early July. The results demonstrated that there were significant differences between the tested cultivars for all measured parameters of the midrib, primary veins and lamina. Midrib parameters (length, width, phloem and xylem area) showed clear difference between cultivars of Asian and European pear, with measurements being the highest in resistant (*P. pyrifolia*) cultivars, and the lowest in 'Jeribasma' and 'Packhams Triumph', while measurements of the primary vein and lamina, although different between cultivars, show no correlation with it's origin and resistance. The results of sugar analysis revealed that Oriental pears had a lower content of all quantified sugars compared to cultivars of European pear, with 'Niitaka' and 'Kumoi' exhibiting the lowest values. *Interspecies* hybrid 'Kieffer seedling' had similar values to the Asian cultivars. These results suggest that the thickness of the midrib in Asian cultivars may pose a significant barrier to *C. pyri* probing on pear leaves, and combined with the low sugar content, especially sorbitol, fructose, glucose and sucrose, represents one of the key factors in the resistance of these cultivars.

Keywords: pear psylla, *Pyrus communis*, *Pyrus pyrifolia*, leaf anatomy, sugar composition

III/P1

UTICAJ RASTOJANJA SADNJE NA VISINU PRINOSA JABUKE

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Poljski ogled je osmišljen da se kod dve sorte jabuke utvrdi optimalno rastojanje sadnje između stabala u redu u cilju dobijanja redovnih i visokih prinosa sa visokim učešćem krupnih plodova u ukupnom prinosu. Istraživanje je realizovano u devetogodišnjem periodu (2015-2023) na stablima dve sorte jabuke Greni Smit i Zlatni delišes u komercijalnom zasadu (Jazak, Fruska Gora) zasnovanom 2014. godine. Rastojanje između redova u svim tretmanima iznosi 3,2 m dok su unutar reda primenjena tri rastojanja sadnje: 60 cm (5.208 stabala/ha), 80 cm (3.906 stabala/ha) i 100 cm (3.125 stabala/ha). Kod sorte Greni Smit značajno najmanje sitnih plodova sa prečnikom ispod 70 mm dobijeno je u tretmanu sa rastojanjem sadnje 100 cm (52,3 t/ha). Prinos srednje krupnih plodova (prečnik 70-85 mm) i veoma krupnih plodova sa prečnikom većim od 85 mm nije se značajno razlikovao između ispitivanih tretmana. Najveći ukupan prinos je bio u tretmanu sa rastojanjem sadnje 60 cm (512,8 t/ha), a najmanji u tretmanu sa rastojanjem sadnje 100 cm (445,0 t/ha), ali razlika nije bila statistički značajna. Kod sorte Zlatni delišes prinos sitnih plodova nije se značajno razlikovao između ispitivanih tretmana. Prinos srednje krupnih plodova prečnika 70-85 mm bio je značajno veći u tretmanu sa rastojanjem sadnje 60 cm (491,1 t/ha) u odnosu na tretman sa rastojanjem sadnje 100 cm (365,7 t/ha). Prinos veoma krupnih plodova sa prečnikom >85 mm nije se značajno razlikovao između ispitivanih tretmana. Ukupan prinos je u tretmanima sa rastojanjem sadnje 60 cm (655,7 t/ha) i 80 cm (629,8 t/ha) bio značajno veći u odnosu na tretman sa rasatojanjem sadnje 100 cm (499,9 t/ha)

Ključne reči: *Malus domestica*, gustina sadnje, rodnost, kvalitet ploda

Zahvalnica: Rad je nastao kao rezultat istraživanja u okviru "Ugovora o prenosu sredstava za finansiranje naučnoistraživačkog rada zaposlenih u nastavi na akreditovanim visokoškolskim ustanovama u 2024. godini, evidencioni broj ugovora: 451-03-65/2024-03/200116".

INFLUENCE OF ROW SPACING ON THE YIELD OF APPLES

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The aim of the field trial was to determine the optimum planting distance between the trees in a row for two apple varieties in order to achieve regular and high yields with a high proportion of large fruit in the total yield. The study was conducted over a period of nine years (2015-2023) on trees of two apple varieties, Granny Smith and Golden Delicious, in a commercial orchard (Jazak, Fruska Gora) established in 2014. The inter-row spacing was 3.2 m in all treatments, while three planting distances were applied within the row: 60 cm (5,208 trees/ha), 80 cm (3,906 trees/ha) and 100 cm (3,125 trees/ha). The Granny Smith variety with a planting distance of 100 cm produced significantly the fewest fruits with a diameter of less than 70 mm (52.3 t/ha). The yield of medium-sized fruit (70-85 mm) and very large fruit (>85 mm) did not differ significantly between the treatments studied. The highest total yield was obtained in the treatment with a planting distance of 60 cm (512.8 t/ha) and the lowest in the treatment with a planting distance of 100 cm (445.0 t/ha), but the difference was not statistically significant. In the Golden Delicious variety, the yield of small fruit did not differ significantly between the treatments tested. The yield of medium-sized fruit with a diameter of 70-85 mm was significantly higher in the treatment with a planting distance of 60 cm (491.1 t/ha) than in the treatment with a planting distance of 100 cm (365.7 t/ha). The yield of very large fruits with a diameter of >85 mm did not differ significantly between the treatments studied. The total yield was significantly higher in the treatments with a planting distance of 60 cm (655.7 t/ha) and 80 cm (629.8 t/ha) than in the treatment with a planting distance of 100 cm (499.9 t/ha).

Keywords: *Malus domestica*, planting density, productivity, fruit quality

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III/P2

PRIMJENA REFLEKTIRAJUĆE FOLIJE U NASADU JABUKE I NJEN UTJECAJ NA KVALITETU PLODA

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U intenzivnom uzgoju jabuke javljaju se sve veći izazovi s obzirom na neuobičajene vremenske prilike tijekom vegetacije, a posebno pred samu berbu. Posljednjih godina u vrijeme dozrijevanja ploda javljaju se ekstremno visoke temperature koje ubrzavaju dozrijevanje, smanjuju kvalitetu, skladišnu sposobnost i tržišnu vrijednost plodova jabuke. Za ublažavanje navedenih problema, traže se tehnološka rješenja, a jedna je mogućnost postavljanje reflektirajuće folije u nasade. Cilj istraživanja bio je utvrditi utjecaj reflektirajuće folije Lumilys™ na kvalitetu ploda jabuke sorti 'Fuji Kiku 8' i 'Jonagold Novajo®' u berbi i nakon 18 tjedana čuvanja u rashladnoj komori (normalna atmosfera, 1 °C, 85% r.v.z.). Pokus s reflektirajućom folijom postavljen je u nasadu jabuke (pokušalište 'Tovaljač' Poljoprivrednog instituta u Osijeku) između redova četiri do šest tjedana prije berbe, a kontrolu su činili redovi bez folije. Plodovi su ubrani u optimalnom roku berbe i potom su standardnim metodama utvrđene boja, masa, tvrdoća, indeks razgradnje škroba, udio topljive suhe tvari i ukupnih kiselina u berbi, te gubitak mase plodova (kalo), tvrdoća, topljiva suha tvar i ukupne kiseline nakon čuvanja. Analizom kromatskih vrijednosti kod sorte 'Jonagold Novajo®' utvrđene su više vrijednosti crvene boje (a), a manji intenzitet zelene boje prema CIE L*a*b sustavu boja, kao i veća masa te manja tvrdoća plodova pokusa u odnosu na kontrolu u berbi. Kod plodova 'Fuji Kiku 8' nije utvrđena razlika u intenzitetu boje između plodova pokusa i kontrole, ali je utvrđen najmanji indeks razgradnje škroba i najveći indeks zrelosti. Nakon čuvanja došlo je do značajnog smanjenja tvrdoće ploda kod sorte 'Jonagold Novajo®, ali su plodovi zadržali najvišu vrijednost kiselina, dok je kod plodova sorte 'Fuji Kiku 8' utvrđena najviša vrijednost topljive suhe tvari. Reflektirajuća folija Lumilys™ pokazala je pozitivan utjecaj na pojedina svojstva plodova istraživanih sorata što upućuje na njen potencijal u postizanju standarda kvalitete plodova jabuka te je u budućnosti potrebno provoditi daljnja istraživanja.

Ključne riječi: *Malus domestica* Borkh., sorta, skladišna sposobnost, Lumilys™

THE USE OF REFLECTIVE GROUNDCOVER IN APPLE ORCHARDS AND ITS INFLUENCE ON FRUIT QUALITY

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In the intensive cultivation of apples, unusual weather conditions during the vegetation period and especially before the actual harvest pose an increasing challenge. In recent years, extremely high temperatures have occurred at the time of fruit ripening, which accelerate ripening, reduce the quality, storability and market value of apple fruit. Technological solutions are being sought to alleviate these problems, and one possibility is the installation of reflective groundcover in the plantations. The aim of the study was to determine the influence of the reflective groundcover Lumilys™ on the quality of apple fruit of the cultivars 'Fuji Kiku 8' and 'Jonagold Novajo®' at harvest and after 18 weeks of storage in a cold store (normal atmosphere, 1 °C, 85 % RH). In an apple orchard (experimental station 'Tovaljač' of the Agricultural Institute in Osijek), a trial with reflective groundcover between the rows was set up four to six weeks before harvest, and the control consisted of rows without foil. The fruits were harvested at the optimal harvest time, and then color, fruit weight, firmness, starch degradation index, soluble solids content and total acids at harvest as well as the loss of fruit weight, firmness, soluble solids content and total acids after harvest were determined using standard methods. The analysis of the color values of the 'Jonagold Novajo®' cultivar revealed higher values of red color (a) and a lower intensity of green color according to the CIE L*a*b color system, as well as a higher weight and a lower firmness of the test fruits compared to the control at harvest. No difference in color intensity was observed between the experimental and control fruits of 'Fuji Kiku 8', but the lowest starch degradation index and the highest ripeness index were recorded. After storage, the firmness of 'Jonagold Novajo®' fruits decreased significantly, but the fruits retained the highest acidity value, while the highest soluble solids value was found in the 'Fuji Kiku 8' trial fruits. The reflective groundcover Lumilys™ showed a positive influence on certain characteristics of the fruit of the tested cultivars, indicating its potential to achieve quality standards in apple fruit, and further research is needed in the future.

Keywords: *Malus domestica* Borkh., cultivar, storage capacity, Lumilys™

III/P3

UTICAJ ISPRAVNOSTI RASPRSKIVAČA OROŠIVAČA NA VERTIKALNU DISTRUBUCIJU ZAŠTITNE TEČNOSTI U PROIZVODNJI JABUKE

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Visoka efikasnost hemijske zaštite u voćarskoj i vinogradarskoj proizvodnji je pored ostalih kriterijuma ostvariva uz primenu tehnički ispravnih orošivača. U ovom radu prikazani su rezultati ispitivanja tehničke ispravnosti tri različita modela orošivača koji se primenjuju u intenzivnoj proizvodnji jabuke, a pre svega uticaj ispravnosti rasprskivača na vertikalnu distribuciju zaštitne tečnosti. Geometrija mlaza i protok orošivača su veoma važni i uticajni parametari na kvalitet izvedene hemijske zaštite. Definisanje geometrije mlaza i protoka rasprskivača u skladu sa optimalnom geometrijom krošnje voćaka jeste završni čin u procesu kalibracije orošivača. Podešavanje geometrije mlaza moguće je izvršiti samo uz pomoć vertikalnog spraj skenera (*patternator*-a). Relativna distribucija rasprskivača (R_d) služi za volumetrijsku ocenu zaštitne tečnosti koja se distribuira po visini zasada, a prema definisanom uzgojnom obliku. Izmerene vrednosti vertikalne distribucije nam omogućavaju korektivne mere u procesu kalibracije rada orošivača. Kod orošivača M-1, na levoj strani su izmerene vrednosti vertikalne distribucije Rd-D/Rd-M/Rd-T (u %) po redosledu: 40,1/50/9,9; dok su vrednosti na desnoj strani 31,9/51,3/16,8; u odnosu na optimalnu distribuciju 20/50/30. Kod orošivača M-2, vrednosti vertikalne distribucije na levoj strani su Rd-D/Rd-M/Rd-T, po redosledu: 34,8/59,7/5,5; a na desnoj 18/67,5/14,5. Kod orošivača M-3, vrednosti vertikalne distribucije na levoj strani su Rd-D/Rd-M/Rd-T, po redosledu: 26/55,4/18,6; a na desnoj 24,9/59/16,1. Uticaj ispravnosti rasprskivača i jačina vazdušnog strujanja ventilatora u visokoj meri utiču na vertikalnu distribuciju zaštitne tečnosti.

Ključne reči: tehnička ispravnost, mlaz rasprskivača, geometrija mlaza, geometrija krošnje, relativna distribucija, brzina vazdušng strujanja

III/P3

THE INFLUENCE OF THE PERFORMANCE OF SPRAYERS ON THE VERTICAL DISTRIBUTION OF PROTECTIVE LIQUID IN APPLE PRODUCTION

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High efficiency of chemical protection in fruit and viticulture production is, in addition to other criteria, achievable with the use of technically correct of orchard sprayers. This paper presents the results of testing the technical correctness of three different models of orchard sprayer that are used in intensive apple production, and above all the influence of the correctness of the sprinkler on the vertical distribution of the protective liquid. Jet geometry and sprinkler flow are very important and influential parameters on the quality of the performed chemical protection. Defining the geometry of the jet and flow of the sprinkler in accordance with the optimal geometry of the tree canopy is the final act in the sprinkler calibration process. Adjusting the jet geometry can only be done with the help of a vertical spray scanner (patternator). The relative distribution of the sprinkler (Rd) is used for the volumetric evaluation of the protective liquid that is distributed according to the height of the plants and according to the defined breeding system. The measured values of the vertical distribution allow us to take corrective activity in the process of orchard sprayers calibrating. In the case of orchard sprayer M-1, the values of the vertical distribution of Rd-D/Rd-M/Rd-T (in %) were measured on the left side in the following order: 40.1/50/9.9; while the values on the right side are 31.9/51.3/16.8; relative to the optimal 20/50/30 distribution. For orchard sprayer M-2, the vertical distribution values on the left side are Rd-D/Rd-M/Rd-T, in order: 34.8/59.7/5.5; and on the right 18/67.5/14.5. In the orchard sprayer M-3, the vertical distribution values on the left side are Rd-D/Rd-M/Rd-T, in order: 26/55.4/18.6; and on the right 24.9/59/16.1. The influence of the correctness of the sprinkler and the value of the air flow of the sprayer fan greatly affect the vertical distribution of the protective liquid.

Key words: technical correctness, spray jet, jet geometry, canopy geometry, relative distribution, air flow velocity

III/P4

UTICAJ METAMITRONA NA HEMIJSKO PROREĐIVANJE PLODOVA SORTE KRUŠKE VILIJAMOVKA

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Za veoma rodne sorte kruške, kao što je Viljamovka, neophodna je dodatna kontrola rodnosti nakon primenjene rezidbe u vidu redukovanja prekobrojnih plodova, najčešće primenom hemijskih sredstava za njihovo proređivanje. Cilj rada je bio da se utvrdi uticaj metamitrona (MM) primenjenog u dve koncentracije na hemijsko proređivanje plodova kruške sorte Viljamovka. Ispitivanje je realizovano tokom 2023. godine u komercijalnom zasadu (Bogatić) koji je podignut 2019. godine na rastojanju 3,5m × 1m na podlozi dunja Ba 29. Uzgojni oblik je vitko vreteno. Metamitron je primenjen u dve koncetracije: 250 mg/l (MM250) i 330 mg/l (MM330), dok su netretirana stabla korišćena kao kontrolni tretman. Treiranje je izvršeno 04. maja kada je prosečna veličina najvećeg ploda u gronji bila 13,4 mm. Dobijeni rezultati pokazuju da je MM u obe ispitivane koncentracije značajno redukovao ukupan broj plodova po stablu u odnosu na kontrolni tretman. Najviše je bio redukovan broj plodova sa pričnikom <60 mm i to 57% u tretmanu MM250, odnosno 73% u tretmanu MM330, dok je broj plodovi prečnika 60-65 mm u tretmanu MM250 smanjen 41% a u tretmanu MM330 43%. Broj plodova ostalih kvalitetnih kategorija (65-70 mm, 70-75 mm i >75 mm) nije se značajno razlikovao između primenjenih tretmana. Zbog smanjenja ukupnog broja plodova, odnosno zbog značajnog smanjenja prinosa plodova koji su sitniji od 60 mm, ukupan prinos po stablu je bio značajno smanjen u tretamanima sa MM. Prinos plodova krupnijih od 60 mm nije se značajno razlikovao između primenjenih tretmana. Prosečna masa ploda je bila značajno veća samo u tretmanu MM330 u odnosu na kontrolni tretman. Primenjeni tretmani nisu ispoljili bilo kakav uticaj na sadržaj ukupne rastvorljive suve materije i ukupnih kiselina, kao i na čvrstoću plodova. Ukupan broj diferenciranih generativnih pupoljaka za rod u sledećoj godini je bio veći u tretmanima sa metamitronom, međutim razlika nije bila statistički značajna u odnosu na kontrolni tretman.

Ključne reči: *Pyrus communis*, hemijsko proređivanje plodova, rodnost, kvalitet ploda

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THE INFLUENCE OF METAMITRON ON CHEMICAL THINNING OF FRUITS OF THE PEAR VARIETY WILLIAMS

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For very fertile pear varieties such as Williams, additional productivity control is required after pruning in the form of a reduction of excess fruit, usually by applying chemicals for fruit thinning. The aim of this work was to determine the influence of metamitron (MM) in two concentrations on the chemical thinning of the fruit of the Williams pear. The experiment was conducted in 2023 in a commercial pear orchard (Bogatić) planted in 2019 at a distance of 3.5 m × 1 m on a quince rootstock Ba 29. The tree shape is a slender spindle. Metamitron was applied in two concentrations: 250 mg/l (MM250) and 330 mg/l (MM330), while untreated trees were used as control treatment. Chemical thinner was applied on May 4, when the average size of the largest fruit in the cluster was 13.4 mm. The results show that MM significantly reduced the total number of fruits per tree in both studied concentrations compared to the control treatment. The number of fruits with a diameter of <60 mm was reduced the most by 57% in the MM250 treatment and 73% in the MM330 treatment, while the number of fruits with a diameter of 60-65 mm in the MM250 treatment was reduced by 41% and in the MM330 treatment by 43%. The number of fruits of other quality categories (65-70 mm, 70-75 mm and >75 mm) did not differ significantly between the treatments applied. Due to the decrease in the total number of fruits and the significant decrease in the yield of fruits with a diameter of less than 60 mm, the total yield per tree was significantly lower in both treatments with MM. The yield of fruits larger than 60 mm did not differ significantly between the applied treatments. The average fruit weight was only significantly higher in the MM330 treatment compared to the control treatment. The applied treatments had no effect on soluble solids and total acid content, as well as on the fruit firmness. The total number of formatted floral buds for the following year's yield was higher in the Metamitron treatments, but the difference was not statistically significant compared to the control treatment.

Keywords: *Pyrus communis*, fruit chemical thinning, productivity, fruit quality

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III/P5

UTICAJ INTENZITETA PREKRAĆIVANJA NOSAČA RODNOG DRVETA NA POMOLOŠKE KARAKTERISTIKE ŠLJIVE

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Rad ima za cilj da ispita uticaj intenziteta prekraćivanja nosača rodnog drveta na pomološke karakteristike šljive. Istraživanje je obavljeno 2021. godine na sortama Stenli i Čačanska rodna u proizvodnom zasadu kompanije "Agro-voće" u opštini Laktaši (Bosna i Hercegovina). Isptivane sorte su kalemljene na podlozi sejanac džanarike (*Prunus cerasifera* Ehrh.). Gustina sadnje za isptivane sorte je 4,0 × 1,8 m, a uzgojni oblik vreteno šljive. Prekraćivanje nosača rodnog drveta, izvršeno je sa dva različita intenziteta t_1 (prekraćivanje 30% dužine nosača rodnog drveta) i t_2 (prekraćivanje 50% nosača rodnog drveta). Kontrolni nosači nisu prekraćivani. Eksperiment je sproveden na osnovu potpuno nasumičnog blok dizajna, sa deset ponavljanja za svaku od ispitivanih kombinacija. Prekraćivanje je izvršeno krajem maja meseca (BBCH 73 - 75), tokom realizacije redovne zelene rezidbe. Na terenu je izvršena analiza karakteristika nosača rodnog drveta i novoformiranih prirasta. Plodovi za pomološku analizu su ubrani u momentu optimalne zrelosti. Laboratorijska analiza je obuhvatila osnovne karakteristike ploda i koštice. Dvofaktorska analiza varijanse (ANOVA) korišćena je kako bi se istražio uticaj sorte i intenziteta prekraćivanja na pomološke karakteristike. Primenjeni tretman je imao statistički značajan uticaj na masu i randman ploda, kao i sadržaj rastvorljivih suvih materija u plodu. Masa ploda sorte Čačanska rodna kretala se u rasponu od 22,2 g (kontrola) do 25,4 g (tretman 2), a masa ploda sorte Stenli od 30,8g (kontrola) do 36,4 g (tretman 2). Primenjeni tretman je imao pozitivan uticaj na sadržaj rastvorljivih suvih materija kod sorte Čačnska rodna i negativan kod sorte Stenli. Prekraćivanje nosača rodnog drveta, kao pomotehnička mera može biti od značaja i u kontroli nivoa plodonošenja, kako bi se izbegla alternativnost, posebno kod sorti sa visokim rodnim potencijalom (Čačanska rodna).

Ključne reči: sorta, letnja rezidba, plod

IMPACT OF INTENSITY OF CUTTING BACK THE FRUITING WOOD ON POMOLOGICAL CHARACTERISTICS OF PLUM

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The aim of this paper is to examine the impact of the intensity of cutting back the fruiting wood on the pomological characteristics of plums. The research was conducted in 2021 on the Stanley and Čačanska Rodna varieties in a production orchard owned by the company "Agro-voće" in the municipality of Laktaši (Bosnia and Herzegovina). The analyzed varieties were grafted onto the *Prunus cerasifera* Ehrh. rootstock. The planting density for the analyzed varieties was 4.0 × 1.8 m, and the training system was plum spindle. The cutting back of the fruiting wood was performed with two different intensities: t_1 (cutting back 30% of the fruiting wood length) and t_2 (cutting back 50% of the fruiting wood). The control fruiting wood was not cut back. The conducted experiment was based on a completely randomized block design, with ten repetitions for each of the examined combinations. The cutting back was carried out at the end of May (BBCH 73 - 75), during the regular summer pruning. Analysis of the fruiting wood characteristics and the newly formed growths was conducted in the field. The fruits for pomological analysis were harvested at the time of optimal ripeness. Laboratory analysis included the basic characteristics of the fruit and the stone. A two-factor analysis of variance (ANOVA) was used to analyze the impact of plum variety and cutting back intensity on the pomological characteristics. The applied treatment had a statistically significant impact on fruit weight and yield, as well as soluble solids content in the fruit. The fruit weight of the Čačanska Rodna variety ranged from 22.2 g (control) to 25.4 g (treatment 2), while the fruit weight of the Stanley variety ranged from 30.8 g (control) to 36.4 g (treatment 2). The applied treatment had a positive impact on the of soluble solids content in the Čačanska Rodna variety and a negative impact on the Stanley variety. Cutting back the fruiting wood, as a pomotechnical measure, can be significant in controlling the level of fruiting to avoid alternate bearing, especially in varieties with high fruit-bearing potential (Čačanska Rodna).

Keywords: variety, summer pruning, fruit

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UPRAVLJANJE BILJNIM POKRIVAČEM VOĆNJAKA U ŽUPI (ALEKSANDROVAC)

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Sve veći značaj očuvanja zemljišnih resursa, kao neobnovljive baze za gajenje i korišćenje u poljoprivredi, te mere adaptacije u okviru odgovora na klimatske promene, zahtevaju multidisciplinarni pristup. Kao mera konzervisanja vodno-zemljišnih resursa se sve više primenjuje setva travnog pokrivača, odnosno zatravljivanje međurednog prostora u voćnjacima, prilagođeno agroekološkim uslovima područja i karakteristikama gajene voćne vrste. Jedna od najvažnijih dobrobiti ove agrotehničke mere je bolja infiltracija i zadržavanje padavina, naročito na nagnutim terenima. Zatravljivanje doprinosi povoljnijoj klimi u voćnjaku, olakšan je pristup i rad čak i posle obilnih padavina. Takođe, borba protiv korova je svedena na minimum, smanjen je broj prohoda u voćnjaku, upotreba pesticida, potrošnja goriva, što je veoma značajno sa ekološkog aspekta. U cilju određivanja adekvatne smeše za zatravljivanje zasada šljive i ispitivanja uticaja na rodnost i kvalitet plodova sorte stenlej, u okolini župskog Aleksandrovca (selo Raklje) je u jesen 2023. postavljen dvofaktorijelni ogled sa travnom (A1) i travno leguminoznom smešom (A2), sa dve setvene norme od 40 (B1) i 80 kg ha^{-1} (B2). Travna smeša se sastojala od sledećih travnih vrsta: visoki vijuk, engleski ljulj, crveni vijuk i prava livadarka. U sastavu travno-leguminozne smeše se pored navedenih travnih vrsta nalazila i bela detelina. Ogled je postavljen po slučajnom blok sistemu, sa ponavljanjima veličine 16 m^2 (4 × 4 m). Tokom 2024. godine su obavljena dva otkosa i praćeni su sledeći parametri: ocena pokrovnosti useva u vegetativnoj fazi 40 dana pre prvog otkosa, visina biljaka u prvom otkosu, produkcija biomase u prvom i drugom otkosu. Od hemijskih i fizičkih osobina plodova šljive praćeni su sledeći parametri: masa i veličina ploda, sadržaj rastvorljive suve materije, ukupne kiseline i ukupni šećeri. Preliminarni rezultati u prvoj godini ogleda ukazuju da bi adekvatna smeša za dato područje i sklop šljivika bila travna smeša, koja je u datim uslovima pokazala bolji odnos pokrovnosti i produkcije biomase. Veća dužina, širina i masa ploda šljive (47,1 mm, 35,4 mm i 32,7 g, redom) zabeležena je kod travne smeše, a gustina setve nije značajno uticala na parametre ploda šljive u prvoj godini istraživanja.

Ključne reči: smeša, šljivik, setvena norma, pokrovnost, produkcija biomase

Zahvalnica: Istraživanja su finansirana od strane Ministarstva nauke, tehnološkog razvoja i inovacija, broj ugovora 451-03-66/2024-03/200217, 451-03-66/2024-01/200019 i 451-03-65/2024-01/200116.

III/P6

MANAGEMENT OF GROUND-COVERING FRUIT TREES IN THE ŽUPA REGION (ALEKSANDROVAC)

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The increasing importance of conserving soil resources as a non-renewable basis for cultivation and utilisation in agriculture as well as adaptation measures in response to climate change require a multidisciplinary approach. One of the increasingly applied measures to conserve water and soil resources is the sowing of grass or inter-row cover in orchards adapted to the agro-ecological conditions of the area and the characteristics of the fruit species grown. One of the main advantages of this agronomic measure is the improved infiltration and retention of rainfall, especially on sloping land. The greening contributes to a more favourable climate in the orchard and facilitates access and work even after heavy rainfall. In addition, weed control is minimised, the number of passes in the orchard is reduced, as is the use of pesticides and fuel consumption, which is of great importance from an ecological point of view. In order to determine a suitable mixture for the greening of plum orchards and to investigate its effects on the yield and quality of the fruit of the 'Stanley' variety, a two-factor trial with a grass mixture (A1) and a grass-legume mixture (A2) with two sowing rates of 40 (B1) and 80 kg ha^{-1} (B2) was established in autumn 2023 near Aleksandrovac (Raklje village). The grass mixture consisted of the following grass species: tall fescue, perennial ryegrass, red fescue and bluegrass. In addition to the above-mentioned grass species, the grass-legume mixture also contained white clover. The trial was set up in a randomised block system with replicates of 16 m² (4 × 4 m) in size. Two cuts were carried out in 2024 and the following parameters were monitored: assessment of plant cover in the vegetative phase 40 days before the first cut, plant height at the first cut and biomass production at the first and second cut. The following chemical and physical properties of the plum fruit were monitored: fruit mass and size, soluble solids content, total acids and total sugars.The preliminary results of the first year of the trial indicate that the most suitable mixture for the given area and structure of the plum orchard is the grass mixture, which has a better ratio of cover to biomass production under the given conditions. The grass mixture had a greater length, width and mass of plum fruit (47.1 mm, 35.4 mm and 32.7 g respectively), while the sowing density did not significantly affect the parameters of the plum fruit in the first year of the trial.

Keywords: mixture, plum orchard, seeding rate, ground cover, biomass production

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III/P7

UTICAJ UZGOJNOG OBLIKA I PROREĐIVANJA PLODOVA NA PRINOS I KVALITET PLODA TREŠNJE

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Uticaj uzgojnog oblika i proređivanja plodova na prinos i kvalitet trešnje ispitivano je tokom 2024. godine u Eksperimentalno edukativnom centru (EECT) Poljoprivrednog fakulteta, Univerziteta u Banjoj Luci. Zasad trešnje u sklopu EECT se nalazi u Aleksandrovcu, opština Laktaši. Zasad je podignut 2019. godine. Ispitivane su sorte Ferovija i Sabrina kalemljene na podlozi "GiSelA 6". Razmak sadnje je 4 × 2m. Istraživanjem su obuhvaćeni "KGB" i "UFO" uzgojni oblici. Ručna proreda plodova obavljena je u fazi intenzivnog porasta ploda (BBCH 75). Proređivanje ploda je obavljeno na po tri stabla svake od analiziranih kombinacija ručnim uklanjanjem približno 20-25% zametnutih plodova. Kontrolna stabla nisu proređivana. Berba plodova sorte Sabrina izvršena je u trećoj dekadi maja meseca, a sorte Ferovija u prvoj dekadi juna. Izračunati su prinos po stablu (kg), po jedinici površine (t ha^{-1}) i koeficijent rodnosti (kg cm^{-2}). Pomološka analiza ploda je urađena na po 30 plodova. Uzgojni oblik je imao značajan uticaj na keficijent rodnosti. Kod sorte Ferovija značajno veći prinos je utvrđen na uzgojnom obliku UFO kod stabala koja nisu proređivana. Na istoj sorti kod uzgojnog oblika KGB nije konstatovana značajna razlika u koeficijentu rodnosti. Kod sorte Sabrina uzgojni oblik i primenjeni tretman nisu imali uticaja na koeficijent rodnosti. Kod sorte Ferovija krupniji plod je utvrđen kod uzgojnog oblika UFO kod stabala koja su proređivana, dok je kod sorte Sabrina to bio slučaj na uzgojnom obliku KGB. Proređivanje plodova je poželjna mera u proizvodnji trešnje u cilju postizanja optimalnih prinosa visokog kvaliteta. Sistem gajenja u velikoj meri utiče na efikasnost primene ovog tretmana.

Ključne reči: sorta, sistem gajenja, masa ploda, koeficijent rodnosti

INFLUENCE OF TRAINING SISTEM AND FRUIT THINNING ON CHERRY YIELD AND FRUIT QUALITY

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The influence of the training system and fruit thinning on the yield and quality of cherries has been studied in 2024 season at the Experimental Educational Center (EEC) of the Faculty of Agriculture, University of Banja Luka. Cherry trees as a part of EECT are located at Aleksandrovac, municipality of Laktaši. The orchard was planted in 2019. Varieties Ferrovia and Sabrina grafted on 'GiSelA 6' rootstock were studied. The planting distance was 4 × 2 meters. The research included Kym Green Bush - 'KGB' and Upright Fruiting Offshoots - 'UFO' training systems. Manual fruit thinning was done in the phase of intensive fruit growth (BBCH scale 75). Fruit thinning was performed on three trees of each of the analysed combinations by manual removal of approximately 20-25% of set fruits. Control trees were not thinned. The fruits of the Sabrina variety were harvested in the third decade of May, and of the Ferrovia variety in the first decade of June. Yield per tree (kg), per unit area (t ha^{-1}) and yield efficiency (kg cm^{-2}) were calculated. Pomological fruit analysis was done on 30 fruits for each combination. Training systems had a significant influence on the yield efficiency. In the case of the Ferrovia variety, a significantly higher yield was determined on the training system UFO in trees that were not thinned. On the same variety, no significant difference in the fertility coefficient was noted in the training system KGB. In the case of the Sabrina variety, the training systems and applied treatment had no effect on the yield efficiency. In the case of the Ferrovia variety, a larger fruit was found in the UFO training system in trees that were thinned, while in the Sabrina variety it was the case in the KGB training system. Fruit thinning is a desirable measure in cherry production in order to achieve optimal yields of high quality. The training system greatly affects the effectiveness of the application of this treatment.

Key words: variety, training sistem, fruit weight, yield efficiency

III/P8

PRIMENA BIOREGULATORA U CILJU SMANJENJA BUJNOSTI I POVEĆANJA PRODUKTIVNOSTI VIŠNJE

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U savremenim zasadima sve više su zastupljene manje bujne podloge, sa ciljem da se smanji bujnost stabala i poveća produktivnost ove voćne vrste. Zbog sve zastupljenije mehanizovane berbe poslednjih godina, javlja se neophodnost regulisanja bujnosti stabala, kako bi dimenzije krošnje omogućile nesmetano obavljanje berbe ovakvog tipa. Istraživanje je rađeno na sorti Oblačinska višnja, gajenoj na podlozi magriva (*Prunus mahaleb*) i sopstvenom korenu (*Prunuscerasus*). Cilj ovog istraživanja bio je da se ispita uticaj bioregulatora na kontrolu bujnosti stabala. Ogled je sproveden 2023. godine na dva lokaliteta (Manđelos i Gladnoš), a primenjeni su sledeći tretmani: paklobutrazol preko korena (PBZ-R) u tri koncentracije (0,4, 0,7 i 1,0 l/ha); paklobutrazol folijarno (PBZ-F) u tri koncentracije (1,0, 1,5 i 2,0 l/ha) i prokesadion-kalcijum (Pro-Ca-F) takođe u tri koncentracije (1,0, 1,25 i 1,5 kg/ha). Primena paklobutrazola preko korena pokazala je statistički značajne razlike kada je reč o vegetativnom porastu kao ispitivanom parametru, dok primena proheksadion-kalcijuma, nije pokazala statistički značajne razlike. Pomološke osobine (masa i dimenzije ploda, sadržaj ukupnih rastvorljivih suvih materija i ukupnih kiselina) u berbi 2023. godine, nisu značajno varirale između primenjenih tretmana. U 2024. godini zabeleženo je da je folijarna primena paklobutrazola u prethodnoj godini uticala na veći broj, dok je primena proheksadion-kalcijuma uticala na manji broj cvetova u cvetnom pupoljku.

Ključne reči: paklobutrazol, proheksadion-kalcijum, vegetativni porast, cvetni pupoljak, masa ploda

III/P8

APPLICATION OF BIOREGULATORS TO CONTROLVIGOR AND INCREASE SOUR CHERRY PRODUCTIVITY

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In contemporary orchards, there is an increasing use of dwarfing rootstocks aimed at reducing tree vigor and enhancing productivity of these fruit species. Due to the increasing mechanization of harvesting in recent years, there is a need to manage tree vigor to ensure canopy dimensions facilitate efficient harvesting methods. The research was conducted on the Oblačinska cherry variety grafted onto Mahaleb rootstock (*Prunus mahaleb*) and its own root (*Prunuscerasus*). The objective of the study was to investigate the impact of bioregulators on controlling tree vigor. The trial was carried out in 2023 at two locations (Manđelos and Gladnoš), using the following treatments: root application of paclobutrazol (PBZ-R) at three concentrations (0.4, 0.7, and 1.0 l/ha); foliar application of paclobutrazol (PBZ-F) at three concentrations (1.0, 1.5, and 2.0 l/ha); and foliar application of prohexadione-calcium (Pro-Ca-F) also at three concentrations (1.0, 1.25, and 1.5 kg/ha). Root application of paclobutrazol showed statistically significant differences in vegetative growth as the evaluated parameter, whereas the application of prohexadione-calcium did not demonstrate statistically significant differences. Pomological characteristics (fruit weight and dimensions, total soluble solids content, and total acids) at harvest in 2023 did not significantly vary among the applied treatments. In 2024, it was observed that foliar application of paclobutrazol in the previous year resulted in a higher number of flowers, while the application of prohexadione-calcium led to a lower number of flowers in the floral buds.

Key words: pacobutrazol, prohexadione-calcium, vegetative growth, floral bud, fruit weight

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UTICAJ BIOREGULATORA NA ZAMETANJE I KVALITET PLODOVA VIŠNJE SORTE *ERDI BOTERMO*

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U poslednjih deset godina, Srbija se po proizvodnji višnje nalazi na petom mestu u svetu sa količinom od 117.595 tona u proseku godišnje. Dominantna sorta višnje je Oblačinska, namenjena za preradu, uglavnom zamrzavanje. Plodovi manjeg broja sorti namenjeni su svežoj potrošnji s obzirom na krupnoću ploda, čvrstoću, balansirani odnos šećera i kiselina i aromu. Primena bioregulatora ispoljava pozitivne efekte na masu, veličinu i unutrašnji kvalitet plodova trešnje, dok kod višnje njihova primena nije dovoljno istražena tako da nije uobičajena u praksi. Cilj istraživanja bio je da se utvrdi da li primena različitih koncentracija bioregulatora kod višnje sorte Erdi Botermo utiče na zametanje i kvalitet ploda. U tu svrhu su primenjeni sledeći tretmani: OroGib (a.m. GA_3 1,6 % + BA 1,6 %) u koncentracijama od 10 i 20 ppm.; GranPera (a.m. GA_3 2%) u koncentracijama od 10 i 20 ppm, oba preparata primenjena dva puta, u fazi I i II razvoja ploda; FrutaFija (a.m. NAA 3%) u koncentraciji od 20 ppm primenjen jednom u fazi I razvoja ploda. Svi tretmani bioregulatorima, doveli su do povećanja mase i dimenzija ploda, i dužine peteljke. Najveća masa ploda (7,4 g) zabeležena je u tretmanu preparatom FrutaFija. Sa druge strane, primena ovog preparata smanjila je sadržaj rastvorljive suve materije (RSM) i kiselina, kao i čvrstoću ploda u odnosu na kontrolni tretman. Takođe, najveći udeo ispucalih plodova zabeležen je u ovom tretmanu, kao i smanjen stepen zametanja plodova. Tretmani preparatima OroGib i GranPera su nezavisno od koncentracije doveli do povećanog sadržaja RSM i kiselina u plodovima u odnosu na kontrolu. Pored toga, u tretmanu OroGib-om zametanje plodova višnje bilo je povećano, a pucanje plodova na nivou kontrole.

Ključne reči: rastvorljive suve materije, kiseline, 6-benziladenin, giberelini, naftilsirćetna kiselina

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THE EFFECTS OF BIOREGULATORS ON FRUIT SET AND QUALITY OF SOUR CHERRY CV. *ERDI BOTERMO*

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In the last ten years, the production of sour cherries in Serbia has been ranked fifth in the world and amounts to an average of 117,595 t. The dominant sour cherry is Oblačinska, a cultivar intended for processing, predominantly freezing. Only a small amount of cultivars is intended for fresh consumption regarding their fruit size, firmness, balanced sugar-acid ratio and flavor. The application of bioregulators exhibit positive effects on weight, size and internal quality of sweet cherry fruits at harvest, while for sour cherries, it is neither common practice nor sufficiently studied. The aim of the research was to apply the different concentrations of bioregulators to sour cherry cv. Erdi Botermo to determine their impact on fruit set and quality. For this purpose, the following treatments were applied: OroGibb (a.i. GA_3 1,6 % + BA 1,6 %) at 10 and 20 ppm of each a.i.; GranPera (a.i. GA_3 2%) at 10 and 20 ppm a.i., both compounds were applied twice, at stage I and II of fruit development; FrutaFija (a.i. NAA 3%) at 20 ppm a.i. applied once at stage I of fruit development. All treatments with bioregulators led to an increase in fruit weight and dimensions, as well as the length of fruit stems. The highest fruit mass (7.4 g) was recorded in the treatment with FrutaFija. The application of FrutaFija also had negative effects, as the fruits had slightly lower soluble solids content (SSC) and acids and were softer compared to the control. The highest proportion of cracked fruits was recorded in this treatment, along with reduced fruit set. Treatments with OroGib and GranPera, regardless of concentration, resulted in increased SSC and acid content in the fruits compared to the control. Additionally, in the treatment with OroGib, fruit set was increased, and fruit cracking was at the control level.

Keywords: soluble solids, acids, 6-benzyladenine, gibberellins, naphthaleneacetic acid

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UTICAJ BILJNIH REGULATORA RASTENJA NA PRINOS ULJA LEŠNIKA I SADRŽAJ MASNIH KISELINA

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Lešnik, koji se godišnje proizvodi oko milion tona širom sveta, koristi se u industriji čokolade, pekarskih proizvoda, grickalica i jestivog ulja. Najvažnije hranljive materije u lešniku su lipidi, proteini, ugljeni hidrati, fitosteroli, vitamini i minerali. Najkoncentrovaniji sadržaj ovih komponenti je ulje (50–70%). U 2023. godini isipitvani su efekti dva biljna inhibitora rastenja proheksadion-kalcijum (P-Ca) i paklobutrazola (PB) na tri sorte leske (Tonda di Giffoni, Tonda Gentile Romana i Nocchione). Tretmani su se sastojali od netretirane kontrole, dve folijarne aplikacije sa P-Ca (125 g hL^{-1}) i jedne folijarne aplikacije sa PB (250 mL hL^{-1}). U ovom radu je ispitan uticaj regulatora rastenja na ukupan prinos ulja i sadržaj masnih kiselina. Najmanji prinos ulja bio kod sorte Nocchione (57,83%) u tretmanu sa PB, dok je najveći prinos ulja bio kod sorte Tonda Gentile Romana (63,17%) u kontrolnom tretmanu. Samo kod sorte Tonda Romana postojala je statistički značajna razlika između tretmana sa regulatorima rastenja i kontrolnih žbunova, gde je najveći prinos ulja bio kod kontrolnih žbunova (63,17%), dok kod P-Ca (60,44%) i PB (60,21%) nije bilo statistički značajnih razlika. Najzastupljenije masne kiseline su palmitinska, stearinska, oleinska i linolna. U sadržaju masnih kiselina između sorti postojala je statistički značajna razlika, gde je sadržaj palmitinske kiseline bio najveći kod sorte Nocchione (7,18%); sadržaj stearinske kiseline kod sorte Tonda di Đifoni (2,54%); oleinske kiseline kod sorte Nocchione (82,93%) i linolne kod sorte Tonda Gentile Romana (7,05%). Primenom regulatora rastenja sadržaj oleinske kiseline se smanjio kod sve tri ispitane sorte, dok se sadržaj linolne kiseline povećao. P-Ca i PB su uticali na povećanje sadržaja palmitinske kiseline i kod sorte Nocchione, palmitinske i stearinske kiseline kod sorte Tonda Gentile Romana, dok je kod sorte Tonda di Đifoni njihov sadržaj smanjen.

Ključne reči: lešnik, sorta, prinos ulja, paklobutrazol, proheksadion-kalcijum

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INFLUENCE OF PLANT GROWTH REGULATORS ON HAZELNUT OIL YIELD AND FATTY ACID COMPOSITION

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Hazelnuts, which are produced annually around one million tons worldwide, are used in the chocolate, bakery, snack and edible oil industries. The most important nutrients in hazelnuts are lipids, proteins, carbohydrates, phytosterols, vitamins and minerals. The most concentrated content of these components is oil (50–70%). In 2023, the effects of two plant growth inhibitors prohexadione-calcium (P-Ca) and paclobutrazol (PB) on three hazelnut varieties (Tonda di Giffoni, Tonda Gentile Romana and Nocchione) were tested. Treatments consisted of an untreated control, two foliar applications with P-Ca (125 g hL^{-1}) and one foliar application with PB (250 mL hL^{-1}). In this paper, the influence of growth regulators on the total yield of oil and fatty acid composition were examined. The lowest oil yield was in the Nocchione variety (57.83%) in the treatment with PB, while the highest oil yield was in the Tonda Gentile Romana variety (63.17%) in the control treatment. Only in the Tonda Gentile Romana variety, there was a statistically significant difference between the treatment with plant growth regulators and the control trees, where the highest oil yield was in the control trees (63.17%), while in P-Ca (60.44%) and PB (60.21%) there were no statistically significant differences. The most abundant fatty acids are palmitic, stearic, oleic and linoleic. There was a statistically significant difference in the content of fatty acids between the varieties, where the content of palmitic acid was the highest in the Nocchione variety (7.18%); content of stearic acid in the Tonda di Giffoni variety (2.54%); oleic acid in Nocchione variety (82.93%) and linoleic acid in Tonda Gentile Romana variety (7.05%). With the application of plant growth regulators, the content of oleic acid decreased in all three tested varieties, while the content of linoleic acid increased. P-Ca and PB influenced the increase of palmitic acid content in the Nocchione variety, palmitic and stearic acid content in the Tonda Gentile Romana variety, while their content was reduced in the Tonda di Giffoni variety.

Keywords: hazelnut, variety, oil yield, paclobutrazol, prohexadione-calcium

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UKORENJAVANJE I AKLIMATIZACIJA SADNICA KUPINE DOBIJENIH MIKROPROPAGACIJOM

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Razmnožavanjem mikropropagacijom dobija se veliki broj biljaka u kratkom vremenskom periodu, a ako je inicijalni materijal čist garantovan je bezvirusni status sadnica. Zbog ovih i mnogih drugih prednosti ovaj način proizvodnje sadnog materijala je sve više zastupljen u svetu i kod nas. Aklimatizacija tako dobijenih biljaka je kritičan momenat u kome dolazi do gubitka dela sadnog materijala. U ogledu su korišćene sorte tripl kraun, blek satin i tajberi (međuvrsni hibrid maline i kupine). Sve biljke su bile sa dva do četiri lista, bez korena, posađene u supstrat sačinjen od 60% crnog i 40% belog treseta. Deo biljaka je postavljen u klima komoru sa strogo kontrolisanim uslovima (21 °C, 2.000 lux, dan/noć 16/8 h), dok je deo biljaka bio u plastičnim posudama pokrivenim staklom i uslovi nisu bili strogo kontrolisani (sobni uslovi). Tokom 6 nedelja su praćeni različiti parametri na biljkama. Procenat biljaka koje su uginule je bio najveći kod tajberija (19,44% i 12,50%, redom soba i klima komora) dok se sorta blek saten najbolje aklimatizovala (5,23% i 2,62% propadanja, redom soba i klima komora). Kod sorti tripl kraun i blek saten broj listova je bio najveći (8,3 i 8,5, po redosledu), dok je kod tajberija taj broj bio 7,9 i 8,0 u zavisnosti od uslova aklimatizacije. Kod sve tri sorte, list na biljkama iz komore bio je širi (18,8; 28,0 i 13,8 mm po redosledu) i duži (22,2; 32,6 i 14,5 mm) u odnosu na list iz sobnih uslova. Biljke koje su se aklimatizovale u komori su imale veću ukupnu dužinu (151,7; 178,2 i 110,1 mm) i dužinu korena (77,8; 70,2 i 58,3 mm), kao i ukupnu masu (2,67; 2,85 i 1,16 g) i masu korena (0,56; 0,58 i 0,11 g) od biljaka aklimatizovanih u sobnim uslovima. Razlike u masi korena nisu registrovane kod hibrida tajberi. Razvijeniji početni materijal sa više listova vodi ka uspešnijem ukorenjavanju i aklimatizaciji biljaka kupine dobijenih mikropropagacijom.

Ključne reči: *Rubus fruticosus*, *Rubus fruticosus* × *R. ideaus*, *in vitro*, masa biljke, broj listova, klima komora

ROOTING AND ACCLIMATIZATION OF MICROPROPAGETED BLACKBERRY PLANTS

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Propagation by micropropagation produces a large amount of plants in a short time, and since the initial material is clean, virus-free status of plants is guaranteed. Because of these, as well as many other advantages, this method of production of planting material is being used more and more frequently both in the world and in our country. Acclimatization of plants produced in this way is a critical moment in which the loss of planting material happens. Blackberry cultivars Black Satin, Triple Crown and Tayberry (interspecies hybrid) were used in the experiment. All plants had two to fourleaves, without roots, and were planted in a substrate consisting of 60% of black and 40% of white sphagnum moss. A part of the plants was put in a climate control chamber with strictly controlled conditions (21 °C, 2.000 lux, day/night 16/8 h), while the other part of the plants was in plastic containers covered with glass and with no strict control of conditions (room conditions). Different parameters were monitored on the plants during 6 weeks. The percentage of plants that died was highest in Tayberry (19.44% and 12.50%, room and climate chamber, respectively), while Black Satin acclimatized best (5.23% and 2.62% died out, room and climate chamber, respectively). The cultivars Triple Crown and Black Satin had the highest number of leaves was (8.3 and 8.5, respectively), while Tayberry had 7.9 and 8.0, depending on the acclimatization conditions. The leaf on the plants from the chamber was wider (18.8, 28.0 and 13.8 mm, respectively) and longer (22.2, 32.6 and 14.5 mm) compared to the leaf from room conditions. Plants of all three cultivars acclimatized in the chamber had greater total length (151.7, 178.2 and 110.1 mm) and root length (77.8; 70.2 and 58.3 mm) as well as greater total mass (2.67, 2.85 and 1.16 g) and root mass (0.56, 0.58 and 0.11 g), than plants acclimatized under room conditions. No significant differences in root mass were observed in Tayberry. More developed starting material with more leaves leads to more successful rooting and acclimatization of blackberry plants produced by micropropagation.

Key words: *Rubus fruticosus*, *Rubus fruticosus* × *R. ideaus*, *in vitro*, plant mass, number of leaves, climate control chamber

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UTICAJ BILJNIH REGULATORA RASTA NA HEMIJSKI SASTAV PLODOVA BOROVNICE

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Severnoamerička visokožbunasta borovnica (*Vaccinium corymbosum* L.) je voćna vrsta koja beleži značajan rast kako u proizvodnji, tako i u potrošnji na globalnom nivou, uključujući i našu zemlju. Zahvaljujući njenom hemijskom sastavu, prepoznata je širom sveta kao važan izvor nutrijenata. Biljni regulatori rasta koriste se u proizvodnji voća sa ciljem povećanja prinosa i poboljšanja fizičkih karakteristika plodova, dok je malo podataka o njihovom uticaju na hemijski sastav plodova. U ovom radu predstavljen je uticaj biljnih regulatora rasta na hemijski sastav plodova borovnice sorte 'Bluecrop'. Ogled je postavljen 2016. godine u komercijalnom zasadu u Mačvi, podignutom 2014. godine. Nakon precvetavanja primenjeni su sledeći tretmani: 200 mg L^{-1} giberelinske kiseline (GA_3), 10 mg L^{-1} α-naftilsirćetne kiseline (NAA), 20 mg L^{-1} NAA, 50 mg L^{-1} 6-benziladenina (BA), 100 mg L^{-1} BA i netretirana kontrola. Plodovi za uzorkovanje uzeti su u prvoj, srednjoj i poslednjoj probirnoj berbi. Sadržaj kalijuma, kalcijuma i magnezijuma u plodovima bio je najmanji u prvoj, a najveći u poslednjoj berbi. U plodovima tretiranim sa GA_3 i BA 50 mg L^{-1} zabeležen je veći sadržaj kalijuma u poređenju sa kontrolom, u svim berbama. U prvoj berbi, u svim tretmanima izmeren je manji sadržaj kalcijuma u plodovima u odnosu na netretiranu kontrolu. Sadržaj hlorofila a i b u plodovima se povećavao, pa je najmanji sadržaj izmeren u prvoj probirnoj berbi, a najveći u poslednjoj. Sadržaj polifenola u plodovima u prvoj i srednjoj berbi bio je značajno veći u svim tretmanima sa BA u odnosu na kontrolu, a najveće povećanje uočeno je u drugoj berbi u tretmanu sa BA 100 mg L^{-1} i iznosilo je 21,8%. U zavisnosti od vremena berbe, bioregulatori nisu isto uticali na sve ispitivane hemijske parametre u plodovima borovnice sorte 'Bluecrop', što zahteva dalja istraživanja.

Ključne reči: giberelinska kiselina, α-naftilsirćetna kiselina, 6-benziladenin, probirna berba, polifenoli

Zahvalnica: Istraživanje je finansiralo Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije, na osnovu ugovora o realizaciji i finansiranju naučno-istraživačkog rada u 2024. godini, Poljoprivredni fakultet, Univerzitet u Novom Sadu, broj 451-03-66/2024-03/200117.

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EFFECT OF PLANT GROWTH REGULATORS ON THE CHEMICAL COMPOSITION OF BLUEBERRY FRUITS

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The North American highbush blueberry (*Vaccinium corymbosum* L.) is a fruit species experiencing significant growth both in production and consumption globally, including in our country. Thanks to its chemical composition, it is recognized worldwide as an important source of nutrients. Plant growth regulators are used in fruit production aiming to increase yield and improve the physical characteristics of fruits, while there is limited data on their impact on the chemical composition of fruits. The present research presents the influence of plant growth regulators on the chemical composition of blueberry fruits of the cultivar 'Bluecrop'. The experiment was conducted in 2016 on a commercial plantation located in Mačva, established in 2014. After the corolla drop, the following treatments were applied: 200 mg L^{-1} gibberellic acid (GA_3), 10 mg L^{-1} α-naphthaleneacetic acid (NAA), 20 mg L^{-1} NAA, 50 mg L^{-1} 6-benzyladenine (BA), 100 mg L^{-1} BA, and an untreated control. Fruit samples for the analysis were taken during the first, middle, and last selective harvest. The potassium, calcium, and magnesium content in the fruits were lowest in the first harvest and highest in the last harvest. Fruits treated with GA_3 and BA 50 mg L^{-1} showed higher potassium content compared to the control in all harvests. In the first harvest, lower calcium content was measured in fruits in all treatments compared to the untreated control. The content of chlorophyll a and b in the fruits increased, with the lowest content measured in the first harvest and the highest in the last harvest. The polyphenol content in fruits during the first and second harvest was significantly higher in all treatments with BA compared to the control, with the highest increase observed during the second harvest in the BA 100 mg L−1 treatment, reaching 21.8%. Depending on the harvest time, plant growth regulators did not uniformly affect all examined chemical parameters in the fruits of 'Bluecrop' blueberry cultivar, necessitating further research.

Keywords: gibberellic acid, α-naphthaleneacetic acid, 6-benzyladenine, selective harvest, polyphenols

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III/P13

UTICAJ NAVODNJAVANJA I PRIHRANE AZOTOM NA VEGETATIVNI PRIRAST VINOVE LOZE U PRVOJ GODINI POSLE SADNJE

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Vinogradarska proizvodnja u Srbiji se odvija u uslovima umerene klime (Dfa), koja pruža veoma povoljne uslove za gajenje vinove loze. Međutim, zbog evidentnih klimatskih promena koje dovode do izraženih vremenskih ekstrema, česta je pojava toplih i suvih prolećnih meseci koji mogu dovesti u pitanje uspeh sadnje. Stoga se postavlja pitanje neophodnosti navodnjavanja vinove loze tokom sušnog perioda u vegetaciji posle sadnje. Cilj ovog istraživanja bio je da se ispita uticaj navodnjavanja i prihrane azotnim đubrivom (KAN) na vegetativno razviće sorte Petra (*Vitis vinifera* L.) tokom vegetacije 2022. godine. Elementi korišćeni za procenu vegetativnog razvića bili su prosečna dužina lastara, prečnik osnove i masa zrelih lastara, koji su mereni na kraju vegetacije. Tretman navodnjavanja (T1) se sastojao od zalivanja sa 10 l vode po čokotu, (5. i 20. u mesecu) tokom juna, jula i avgusta. Drugi tretman (T2) je predstavljao primenu 10 g kalijum amonijum nitrata (KAN) po čokotu (5. i 20. u mesecu) tokom marta, aprila i maja, bez dodavanja vode. Kontrolu su predstavljali čokoti bez navodnjavanja i dodavanja N đubriva. Tretmani T1 i T2 su povoljno uticali na vegetativni rast, pa su utvrđene statistički značajne razlike u prosečnoj dužini lastara, prečniku osnove i masi lastara u odnosu na kontrolu. U T1 i T2 prosečna dužina lastara bila je 42%, odnosno 24,3% veća nego u kontrolnoj varijanti. U poređenju sa kontrolom, prečnik osnove lastara bio je veći za 29% u T1 i 22,9% u T2, a prosečna masa lastara je bila veća za 137% u T1 i 122% u T2. Između T1 i T2, osim prosečne dužine lastara nisu utvrđene statistički značajne razlike u prečniku osnove i masi lastara.

Ključne reči: klima, navodnjavanje, azotno đubrivo, vegetativno razviće

III/P13

EFFECT OF IRRIGATION AND NITROGEN FERTILIZATION ON THE VEGETATIVE GROWTH OF GRAPEVINE IN THE FIRST GROWING SEASON

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Viticulture production in Serbia takes place in the conditions of a Dfa - humid continental climate, which provides very favourable conditions for grapevine growing. However, due to pronounced climate changes that lead to prominent weather extremes, we have frequent conditions of warm and dry spring months that can call into question the planting success. Therefore, the question arises of the necessity of applying vine irrigation throughout the growing season after planting. The objective of this research was to examine the influence of irrigation treatment and nitrogen fertilizers on the vegetative development of cv. Petra (*Vitis vinifera* L.) in 2022, which was the first growing season. The elements used to evaluate vegetative development were average shoot length, basal diameter and shoot weight, which were measured at the end of the growing season. The irrigation treatment (T1) consisted of one irrigation with 10 l of water per plant, (on the 5th and 20th of the month) during June, July, and August. The second treatment (T2) was the application of 10 g of potassium ammonium nitrate (KAN) per vine, (5th and 20th of the month) during March, April, and May, without irrigation. The control consisted of vines without irrigation and N supplementation. Treatments T1 and T2 had a favourable influence on vegetative growth, so statistically significant differences were determined in the average shoot length, basal diameter, and shoot weight compared to the control. In T1 and T2, the average shoot length was 42% and 24.3%, respectively, longer than in the control vines. In comparison to the control vines, the basal shoot diameter was 29% larger in T1 and 22.9% in T2, and the average shoot weight was 137% greater in T1 and 122% in T2. There were no statistically significant differences in the basal shoot diameter or shoot weight between T1 and T2, with the exception of the average shoot length.

Keywords: climate, watering, nitrogen fertilizers, vegetative development

III/P14

ULOGA TRAVNOG POKRIVAČA U KONZERVISANJU ZEMLJIŠTA U VINOGRADU

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Travni pokrivač kao biološki sistem i način očuvanja zemljišta koristi se u vinogradarskim regionima sa većim osmotrenim količinama padavina ali i polusušnim i aridnim geografskim područjima. Ima široku primenu u vinogradarstvu Srbije, jedan je od načina održavanja zemljišta i od velikog je značaja s obzirom na prognoze koje predviđaju promenu klimatskih uslova u narednim decenijama u vidu pojave češćih kišnih proleća i toplije i produžene vegetacije praćenom većom akumulacijom toplote i dužim bezmraznim periodom. Očekuje se da će ovakve promene imati značajnog uticaja na enološki potencijal aktuelnog sortimenta vinove loze. Pri zasnivanju travnog pokrivača smesom trava potrebna je nega biljaka uz specifične agrotehničke mere karakteristične za binomni sistem gajenja (vinograd-travnjak), te iznaći odgovarajuće mere za agroekološke uslove mikrolokaliteta. U tom cilju je sproveden trogodišnji ogled (2020-2022) na zasnovanom travnjaku u vinogradu sa sortom Kaberne sovinjon u Krnjevu. Dvofaktorijelni ogled po slučajnom blok sistemu je obuhvatio četiri klona sorte Kaberne sovinjon (15, 169, 191 i 412) i tri načina tretiranja travnjaka azotom u prolećnoj prihrani (0, 50 i 100 kg/ha N). Elementarna ogledna parcela po tretmanu bila je površine 10 m^2. Azot je neophodan u održavanju travnjaka, jer pospešuje vegetativno razviće i pokrovnost zemljišta, a nesimetričnim košenjem (dva puta u humidnoj godini ispitivanja, jednom u aridnoj) se prilagođavalo promenljivim meteorološkim prilikama tokom vegetacije. Prihrana travnog pokrivača azotom je nosila potencijalni rizik uticaja na ampelografska svojstva vinove loze, pa su sprovedene analize osobina travnog pokrivača, ali i ampelografskih i enoloških svojstava grozda i bobica. Rezultati istraživanja ukazuju da je travnjak značajno reagovao na primenjeni azot, kako prinosom sveže i suve biomase, pokrovnošću, tako i količinom usvojenog azota. S druge strane, primenjene doze azota nisu značajno uticale na ampelografske karakteristike grozda i bobice. Može se zaključiti da u ovom slučaju održavanje jednog sistema (travnjaka) i mere popravke, nemaju uticaja na drugi sistem (vinograd) i proizvodnju.

Ključne reči: zatravljivanje, smeša trava, Kaberne sovinjon, prihrana azotom, grozd i bobica

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III/P14

THE ROLE OF GRASS COVER IN SOIL CONSERVATION IN VINEYARDS

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Grass cover as a biological system and method of soil conservation is used in wine-growing regions with higher rainfall and in semi-arid and arid geographical areas. It is widely used in Serbian viticulture as a means of soil conservation, which is of great importance in view of the forecasts predicting climate changes in the coming decades, such as more frequent rainy springs and warmer, longer vegetation periods associated with higher heat retention and longer frost-free periods. These changes are expected to have a significant impact on the oenological potential of current growing grapevine varieties. When establishing a grass cover with a grass mixture, it is necessary to manage the plants with agrotechnical measures specific to the binomial cropping system (vineyard-grass cover) and to identify specific measures for the agroecological conditions of the microsite. For this purpose, a three-year trial (2020-2022) was conducted with an established grass cover in a vineyard with the Cabernet Sauvignon variety in Krnjevo. The two-factor trial with a randomised block system included 4 clones of the Cabernet Sauvignon variety (15, 169, 191 and 412) and three methods of nitrogen treatment of the sward during spring fertilisation (0, 50 and 100 kg/ha N). The elementary trial plot per treatment had an area of 10 m². Nitrogen is essential for the maintenance of the sward as it promotes vegetative growth and ground cover. Asymmetric mowing (twice in a wet year, once in a dry year) was adapted to the changing meteorological conditions during the growing season. Fertilising the sward with nitrogen carried the risk of affecting the ampelographic characteristics of the vine. Therefore, analyses of the characteristics of the sward and the ampelographic and oenological properties of the grapes and berries were carried out. The research results show that the grass reacted significantly to the applied nitrogen in terms of the yield of fresh and dry biomass, the degree of cover and the amount of nitrogen absorbed. On the other hand, the doses of nitrogen applied did not have a significant effect on the ampelographic characteristics of the grapes and berries. It can therefore be concluded that in this case the maintenance of one system (grass cover) and the measures taken to improve it do not affect the other system (vineyard) and production.

Keywords: grass cover, grass mixture, Cabernet Sauvignon, nitrogen fertilisation, grape, berry

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III/P15

PRIMENA MIKROBIOLOŠKOG ĐUBRIVA BIOFOR AKTIV U ORGANSKOJ PROIZVODNJI GROŽĐA

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Cilj ovog rada bio je ispitivanje delovanja mikrobiološkog đubriva Biofor Aktiv u organskoj proizvodnji kod sorti vinove loze Panonia i Regent, koje su namenjene za dobijanje belih i crvenih vina, u agroekološkim uslovima proizvodnog zasada organske vinarije „Plavinci“ u Gročanskom vinogorju. Mikrobiološko đubrivo Biofor kao aktivnu komponentu sadrži različite populacije mikroorganizama, koji su značajni za biljku, jer je snadbevaju potrebnim hranivima kao što su azot, fosfor i kalijum. Ogled je postavljen tako da su izdvojena po dva reda od obe sorte na kojima je primenjivano mikrobiološko đubrivo kao i po dva reda koja su poslužila kao kontrola bez primene đubriva. Uzgojni oblik čokota u eksperimentalnim vinogradima bio je Smart-Dajson uz primenu agro i ampelotehničkih mera koje su specifične i dozvoljene u organskoj proizvodnji. Agrohemijskom analizom zemljšta kod obe sorte i obe varijante ogleda odrađeni su sledeći parametri: sadržaj lakopristupačnog N (%), sadržaj $CaCO_3$ (%), sadržaj K_2O i P_2O_5 (mg/100 g/v.s.z.), sadržaj humusa (%), pH (u H_2O i KCl), sadržaj C, ukupni N, kao i odnos C:N. U periodu berbe grožđa određeni su parametri prinosa (kg/čokotu i kg/hektaru), a laboratorijskim analizama dobijeni su podaci za mehanički sastav grozda i bobice, sadržaj šećera, ukupnih kiselina i pH vrednost u grožđanom soku. Rezultati analize zemljišta pokazali su različite vrednosti najvažnijih parametara. Kod obe sorte, zemljište na kome je primenjen Biofor Aktiv imalo je višu prosečnu vrednost pH vrednost u KCl (6,98 - Panonia; 6,82 - Regent) u odnosu na pH vrednost zemljišta koje je bilo kontrola (6,45 - Panonia; 6,30 - Regent). U vinogradu sa sortom Regent uz primenu Biofor Aktiv prosečni sadržaj humusa bio je 1,67% dok je kod kontrole iznosio 1,31%. Primena Biofor Aktiv đubriva je imala uticaja na prinos samo kod sorte Regent (1,24 kg/čokotu - Biofor Aktiv; kontrola - 1,04 kg/čokot). Kod obe ispitivane sorte masa grozda je bila veća na oglednim područjima (108,5 g - Panonia; 67,8 g - Regent) od one na kontrolnim (103,0 g - Panonia; 53,0 g - Regent). Kod sorte Panonia primena ovog mikrobiološkog đubriva uslovila je veći sadržaj šećera u širi (24%) u odnosu na kontrolu (23%) dok kod sorte Regent nije imala značajnijeg uticaja. Sadržaj kiselina u širi nije se razlikovao u odnosu na tretman sa Biofor Aktivom. Upotreba mikrobiološkog đubriva u organskom vinogradarstvu ima značajnu ekološku opravdanost jer obezbeđuje zdravo zemljište za rast i razvoj vinove loze kao i poboljšanje određenih parametara i karakteristika grozda.

Ključne reči: organska proizvodnja, Panonia, Regent, mikrobiološko đubrivo, kvalitet grožđa

III/P15

APPLICATION OF MICROBIOLOGICAL FERTILIZER BIOFOR AKTIV IN ORGANIC GRAPES PRODUCTION

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The aim of this research was to examine the action of the microbiological fertilizer Biofor Aktiv in organic production with grape varieties Panonia and Regent, which are intended of the production of white and red wines, in the agroecological conditions of the production plantation of the organic winery "Plavinci" in Grocka vineyard. Microbiological fertilizer Biofor as an active component contains different populations of microorganisms, which are important for the plant, because they supply it with the necessary nutrients such as nitrogen, phosphorus and potassium. The experiment was set up in such a way that two rows were separated from both varieties on which microbiological fertilizer was applied, as well as two rows each that served as a control without fertilizer application. The cultivation form of the vines in the experimental vineyards was Smart-Dyson with the application of agro and ampelotechnical measures that are specific and permitted in organic production. The agrochemical analysis of the soil for both cultivars and both variants of the experiment determined the following parameters: the content of readily available N (%), the content of $CaCO_3$ (%), the content of K_2O and P_2O_5 (mg/100 g/a.d.s.), the content of humus (%), pH value (in H_2O and KCl), C content, total N, as well as the C:N ratio. During the grape harvest period, yield parameters were determined (kg/bunch and kg/hectare), and laboratory analyzes obtained data on the mechanical composition of grapes and berries, sugar content, total acid and pH value in the must. The results of the soil analysis showed different values of the most important parameters. In both varieties, the soil on which Biofor Aktiv was applied had a higher average value of pH in KCl (6.98 - Panonia; 6.82 - Regent) compared to the pH value of the control soil (6.45 - Panonia; 6, 3 - Regent). In the vineyard with the Regent variety with the Biofor Aktiv fertilizer, the average humus content was 1.67%, while it was 1.31% in the control. The application of Biofor Aktiv fertilizer had effect on the yield only in the variety Regent (1.24 kg/vine - Biofor Aktiv; control - 1.04 kg/vine). In both examined cultivars, the cluster weight was higher in the experimental areas (108.5 g - Panonia; 67.8 g - Regent) than in the control areas (103.0 g - Panonia; 53.0 g - Regent). In the case of the Panonia variety, the application of this microbiological fertilizer caused a higher sugar content in the must (24%) compared to the control (23%), while in the Regent variety it had no significant effect. The content of acids in the must did not vary in relation to the treatment with Biofor Aktiv. The use of microbiological fertilizers in organic viticulture has significant environmental justification because it provides healthy soil for the growth and development of the grape vine as well as the improvement of certain parameters and characteristics of the bunch.

Key words: organic production, Pannonia, Regent, microbiological fertilizer, grape quality

III/P16

UTICAJ ETARSKIH ULJA NA ANTIOKSIDATIVNU AKTIVNOST PLODOVA JABUKE U USLOVIMA VEŠTAČKE INOKULACIJE SA *Neofabraea alba*

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Proteklih godina, istraživanja u tehnologiji čuvanja plodova jabuke nakon berbe obuhvataju i mogućnost primene etarskih ulja kao potencijalnih bioagenasa za suzbijanje prouzrokovača truleži tokom skladištenja. *Neofabraea alba*, prouzrokovač truleži tipa „bikovo oko“, jedan je od najvažnijih patogena ploda koji ostvaruje infekciju tokom vegetacije, a simptomi postaju uočljivi tek nakon nekoliko meseci posle berbe. S obzirom na značaj oboljenja neophodno je istražiti načine kontrole patogena i umanjiti njihov uticaj na fiziološko stanje ploda. Cilj ovog istraživanja je bio da se ispita delovanje etarskih ulja na antioksidativnu aktivnost plodova jabuke prethodno veštački inokulisanih sa *N. alba.* Inokulisani plodovi jabuke sorte zlatni delišes bili su izloženi etarskim uljima timijana i divljeg origana u koncentracijama od 0,08 i 0,16 µl/ml vazduha, u zatvorenim plastičnim kutijama. Kontrolu su činili inokulisani plodovi u identičnim uslovima bez primene tretmana. Antioksidativna vrednost je izmerena nakon 78 dana skladištenja u hladnjači sa normalnom atmosferom i nakon dodatne inkubacije od 7 dana na sobnoj temperaturi Pokožica inokulisanih plodova ekstrahovana je sa 70% metanolom, a antioksidativna aktivnost određena pomoću ABTS testa. U većini tretmana etarskim uljima zabeleženo je statistički značajno povećanje antioksidativne aktivnosti zaraženih plodova u poređenju sa kontrolom. Najveća vrednost zabeležena je u tretmanu sa etarskim uljem timijana više koncentracije. Povećanje koncentracije ulja timijana je dovelo do povećanja antioksidativne aktivnosti ploda. Suprotan ishod registrovan je povećanjem koncentracije ulja divljeg origana gde je zabeleženo smanjenje antioksidativne aktivnosti u inokulisanim plodovima. Rezultati ukazuju na značajan uticaj etarskih ulja na antioksidativnu aktivnost vestački inokulisanih plodova jabuke, pri čemu aktivnost zavisi od vrste etarskog ulja, koncentracije i uslova skladištenja. Ovi rezultati mogu doprineti razumevanju mehanizama odbrane biljaka od patogena i poboljšanju kvaliteta ploda jabuke tokom skladištenja.

Ključne reči: *Neofabraea alba*, plod jabuke, timijan, divlji origano, ABTS

III/P16

THE IMPACT OF ESSENTIAL OILS ON APPLE FRUIT ANTIOXIDANT ACTIVITY UNDER ARTIFICIAL *Neofabraea alba* INOCULATION

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In recent years, research in apple fruit storage technology includes the possibility of using essential oils as potential bioagents for the control of postharvest diseases. *Neofabraea alba*, the cause of "bull's eye" rot, is one of the most important fruit pathogens that establishes quiescent infection during the growing season, while symptoms become noticeable a few months after harvest. Given the importance of the disease, it is necessary to improve the effectiveness of the pathogen's control and to reduce its impact on the fruit physiology. The aim of this research was to examine the effect of essential oils on the antioxidant activity of apple fruits previously infected with the *N. alba* isolate. Inoculated apple fruits cv. 'Golden Delicious' were exposed to thyme and wild oregano essential oils at concentrations of 0.08 and 0.16 µl/ml of air, in closed plastic boxes. Inoculated fruits under identical conditions without any treatment were used as a control. The antioxidant activity was determined after 78 days of storage in a cold storage with a normal atmosphere and after an additional incubation of 7 days at room temperature. The skin of the inoculated fruits was extracted with 70% methanol, and the antioxidant activity was determined using the ABTS test. In most treatments with essential oils, a statistically significant increase in the antioxidant activity of the infected fruits was recorded, compared to the control. The highest value was recorded in the treatment with thyme essential oil at higher concentration. An increase in the concentration of thyme oil led to an increase in the antioxidant activity of the fruit. The opposite outcome was observed with an increase in the concentration of wild oregano oil, wherein a reduction in antioxidant activity was recorded in the inoculated fruits. The results indicate a significant influence of essential oils on the antioxidant activity of infected apple fruits, where the activity depends on the type of essential oil, concentration and storage conditions. These results contribute to the understanding of plant defence mechanisms against pathogens and the improvement of apple fruit quality during storage.

Keywords: *Neofabraea alba*, apple fruit, thyme, wild oregano, ABTS

III/P17

IDENTIFIKACIJA I KARAKTERIZACIJA *Bacillus* spp. IZOLATA SA POTENCIJALOM BIOKONTROLE TRULEŽI I POBOLjŠANjA KVALITETA PLODA ŠLjIVE

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Gubici u u proizvodnji svežeg voća mogu dostići značajan nivo nakon berbe usled delovanja različitih faktora, uključujući genotip, način berbe, uslove skladištenja i transport. U savremenoj poljoprivrednoj proizvodnji, sintetički fungicidi su najefikasniji metod za smanjenje gubitaka uzrokovanih gljivičnim oboljenjima nakon berbe, međutim, njihova strogo ograničena upotreba u Evropi nalaže potrebu za primenom alternativnih mera. Jedan od perspektivnih pristupa uključuje upotrebu vrsta roda *Bacillus* koje pokazuju antagonistička svojstva prema *Monilinia laxa*. Ovaj rad obuhvata izolaciju, karakterizaciju i odabir odgovarajućih vrsta roda *Bacillus* na osnovu njihovih fizioloških (rast pri različitim temperaturama, nivoima pH, koncentracijama NaCl, i otpornosti prema Cd i Pb) i biohemijskih svojstava (produkcija lipaze, amilaze, pektinaze i celulaze), kao i njihovih PGPR karakteristika (produkcija indol-sirćetne kiseline, siderofora i cijanovodonika, solubilizacija fosfora). Najperspektivniji izolat (*BI*) odabran je za dalju evaluaciju u kontekstu biokontrole truleži ploda šljive i uticaja na poboljšanje kvaliteta njenog ploda. Eksperiment je izveden u zasadu šljive sorte 'Čačanska lepotica', u uslovima veštačke inokulacije sa *M. laxa*. Pored *BI* izolata, primenjena su i dva komercijalna preparata ('Neon' i 'Aleox'), kao i kontrolni tretman (destilovana voda). Tretmani su primenjeni i kao preventivna i kao kurativna mera, radi ispitivanja njihovog uticaja na pojavu i širenje infekcije. Rezultati istraživanja pokazuju da je primena *BI* izolata kao preventivne mere smanjila pojavu truleži uzrokovane *M. laxa* za 10-30%, dok je njegova primena kao kurativne mere smanjila pojavu truleži za 29-55%. Dodatno, primena *BI* izolata u kurativne svrhe značajno je uticala na poboljšanje antioksidativnog kapaciteta ploda (0,18 mmol TE/100 g sveže mase), dok je njegova primena u preventivne svrhe uticala na povećanje i antioksidativnog kapaciteta ploda (0,21 mmol TE/100 g sveže mase) i sadržaja ukupnih fenola (234,51 mg GA/100 g sveže mase). Ovi rezultati ističu potencijal komercijalizacije ovog izolata u cilju smanjenja upotrebe fungicida u komercijalnoj proizvodnji i unapređenja kvaliteta ploda šljive.

Ključne reči: biokontrola, *Bacillus* spp, *Monilinia* spp, trulež, stepen zaraze, kvalitet ploda, šljiva

III/P17

IDENTIFICATION AND CHARACTERIZATION OF *Bacillus* spp. ISOLATES WITH POTENTIAL FOR BIOCONTROL OF POSTHARVEST PLUM FRUIT ROT AND QUALITY IMPROVEMENT

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Postharvest losses of fresh fruits can reach significant levels due to various factors, including genotype, harvesting methods, storage conditions, and transportation. Although synthetic fungicides remain the most effective method for preventing yield losses caused by postharvest fungal diseases, their use after harvest is heavily restricted in Europe, making the search for alternative postharvest decay control methods imperative in modern agriculture. One promising strategy involves using *Bacillus* species, which have shown antagonistic properties against *Monilinia laxa*. This study involved the isolation and characterization of *Bacillus* spp. based on their physiological (growth at different temperatures, pH levels, NaCl concentrations, and resistance to Cd and Pb) and biochemical (production of lipase, amylase, pectinase, cellulase) properties, alongside their plant-growth-promoting activities. The most promising *Bacillus* isolate (*BI*) was selected for further evaluation regarding its impact on the quality and storability of plum fruits. The experiment was conducted in an orchard with 'Čačanska Lepotica' plum cultivar, artificially inoculated with *M. laxa*. In addition to the *BI*, two commercial products (Neon and Aleox) and a control (distilled water) were applied using both preventive and curative spraying. The study assessed the reduction in postharvest rot of plums by *M. laxa* when the *BI* strain was applied pre-harvest under field conditions. The pre-harvest application of the selected strain reduced postharvest rot incidence by 10%, while curative treatment reduced it by 30%. The curative application of *BI* positively affected the antioxidant capacity (0.18 mmol TE/100 g fw), and the preventive *BI* treatment enhanced both the antioxidant capacity (0.21 mmol TE/100 g fw) and total phenolic content (234.51 mg GA/100 g fw). These results highlight the potential for commercialization of this strain in order to reduce reliance on fungicides in commercial production and improve plum fruit quality.

Keywords: biocontrol, *Bacillus* spp, *Monilinia* spp, post-harvest rot, stone fruit, plum, fruit quality

III/P18

BRAON MRAMORASTA STENICA (*Halyomorpha halys*) U ZASADIMA LESKE, MONITORING I POTENCIJAL BIOLOŠKE KONTROLE

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Braon mramorsta stenica (*Halyomorpha halys* Stål; Hemiptera: Pentatomidae) je jedna od navažnijih štetnih vrsta stenica u svetu, pa i u Srbiji. Ova izuzetno polifagna vrsta hrani se na preko 170 biljnih vrsta i može napraviti štetu na mnogim gajenim biljkama. Osim štete koju nanosi poljoprivrednim kulturama, ova vrsta je i uznemiravajuća vrsta u urbanim i semi urbanim sredinama u kojima nalazi sklonište za prezimljavanje. Tokom kasnog leta i jeseni ulazi u razne zidane objekte i često izaziva paniku među ljudima. Zbog značaja koji ova stenica ima u poljoprivrednoj proizvodnji, od 2018. godine u Srbiji se sprovodi monitoring uz pomoć piramidalnih feromonskih klopki, a tokom 2022. i 2023. godine u zasadima leske redovno se sprovodio i metod otresanja jedinki sa grana (tzv. „frappage"). Na osnovu monitoringa klopkama pokazalo se da je ukupna brojnost stenica pomenute vrste na teritoriji Srbije u blagom opadanju, ali da se opadanje brojnosti ne uočava na svim pregledanim lokalitetima. Tokom 2023. godine broj stenica u klopkama porastao je u odnosu na prethodnu godinu na lokalitetima: Kraljevo, Novi Sad, Sopot, Šabac i Aleksa Šantić, dok je na lokalitetima Velika Plana, Čelarevo, Bački Petrovac, Bela Crkva i Leskovac zabeležan pad ukupne brojnosti stenica. Zajedno sa praćenjem stenica u zasadima leske praćeno je i stanje preimaginalnih stadijuma razvića tj. jaja i larvi. Uzorkovanjem jajnih legala ustanovljeno je prisustvo jajnih parazitoida koji mogu redukovati brojnost stenica. U ukupno šest zasada leske, u kojim su sprovođeni redovni hemijski tretmani tokom vegetacije, utvrđeno je prisustvo šest vrsta parazitioida, što pokazuje solidan potencijal za biološku kontrolu brojnosti braon mramoraste stenice na teritoriji Srbije. Parazitioidi su, osim u urbanoj sredini Novog Sada, u toku 2023. godine registrovani u zasadima leske na lokalitetima: Ilinci, Ribari, Miokus, Bački Petrovac, Ljukovo i Nova Crvenka.

Ključne reči: stenice, monitoring, Srbija, jajni parazitioidi, biološka kontrola

Zahvalnica: Autori se nesebično zahvaljuju svim tehničarima koji su vredno uzorkovali stenice, larve i jaja u zasadima leske.

BROWN MARMORATED STINK BUG (*Halyomorpha halys*) IN HAZELNUTS, MONITORING AND BIOLOGICAL CONTROL POTENTIAL

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The brown marmorated stink bug (*Halyomorpha halys* Stål; Hemiptera: Pentatomidae) is a highly destructive stink bug species found worldwide, including Serbia. This insect is known for its wide-ranging diet, feeding on over 170 plant species and causing damage to crops. It is also a nuisance in urban and semi-urban areas, seeking shelter in buildings during late summer and autumn, often causing panic among people. Due to the importance of this pest in agricultural production, since 2018, monitoring has been carried out in Serbia using the pyramidal pheromone dead-inn traps. In addition to the traps, hazelnut orchards were examined using a method of shaking off specimens from branches, so called "frappage" method, during 2022 and 2023. The monitoring has shown that the total number of this species in Serbia is slightly decreasing, but not in all areas. In 2023, the number of adults in traps increased in Kraljevo, Novi Sad, Sopot, Šabac, and Aleksa Šantić, while the number decreased in Velika Plana, Čelarevo, Bački Petrovac, Bela Crkva, and Leskovac. In addition to monitoring adult stinkbugs in hazelnut orchards, we also monitored the development stages of the bugs, including eggs and larvae. We found egg parasitoids that can help reduce the stinkbug population by sampling egg masses in six hazelnut orchards, where regular chemical treatments were carried out during the growing season. We identified six parasitoid species in these orchards, indicating a solid potential for biological control of the brown marmorated stink bug population in Serbia. In 2023, parasitoids were found in hazelnut orchards in the following locations: Ilinci, Ribari, Miokus, Bački Petrovac, Ljukovo, and Nova Crvenka, beside the urban area of Novi Sad.

Keywords: stink bugs, monitoring, Serbia, egg parasitoids, biological control

Acknowledgement: The authors would like to express their gratitude to all the technicians who diligently collected samples of the bugs, larvae, and eggs in the hazelnut orchards.

III/P19

INFESTACIJA BRAON MRAMORASTE STENICE (*Halyomorpha halys* Stål.): UTICAJ NA FENOLNI ODGOVOR I KVALITET PLODOVA MASLINE (*Olea europaea* L.)

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Jedan od najvećih problema za maslinare je najezda insekata, kao što je braon mramorasta stenica (*H. halis*), koja utiče na kvalitet ploda masline i njenih proizvoda. Masline su dobar izvor hranljivih materija za *H. halis*, jer sazrevaju kada su ostali plodovi ubrani. U ovoj studiji je prikazan efekat infestacije *H. halis* na odgovor pojedinačnih i ukupnih fenolnih jedinjenja (TPC), antioksidativni kapacitet (AC) i kvalitet ploda masline u oštećenom tkivu oštećenih plodova (PD) i u neoštećenom tkivu oštećenih plodova (NPD) u poređenju sa neoštećenim tkivom neoštećenog ploda – kontrola (C) sorti 'Istrska belica' i 'Pendolino'. U vreme berbe primećen je neprijatan miris, plutasto tkivo i gubitak težine i čvrstine kod zaraženih plodova. Naše istraživanje je pokazalo da različite sorte na različite načine reaguju na infestaciju *H. halis*. U plodovima sorte 'Istrska belica' sadržaj TPC je u PD povećan za 10,7 %, dok je sadržaj AC u NPD povećan za 7,11 % i u PD za 6,1 % u poređenju sa kontrolom. Kod sorte 'Pendolino' je zabeležen najveći porast ukupnog sadržaja flavonoida, sa povećanjem za 80,2 % u PD i povećanjem za 57,4 % u NPD u odnosu na kontrolu. Kod sorte 'Istrska belica' najveći fenolni odgovor zabeležen je kod ukupnih sekoiridoida, gde je njihov sadržaj u PD povećan za 17,2 %, i u NPD za 43,4 % u odnosu na kontrolu. Naši nalazi će značajno doprineti boljem razumevanju odgovora biljaka na napad štetočina i poboljšati strategije zaštite bilja.

Ključne reči: štetočine, metabolički odgovor, Pentatomidae, oštećenje plodova

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BROWN MARMORATED STINK BUG (*Halyomorpha halys* Stål.) INFESTATION: EFFECTS ON PHENOLIC RESPONSE AND QUALITY OF OLIVE FRUITS (*Olea europaea* L.)

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One of the major problems for olive growers is insect infestation, such as the case of the brown marmorated stink bug (*H. halys*), which affects the quality of the olive fruit and its products. Olives are a good source of nutrients for *H. halys*, because they ripen when other fruits have already been harvested. This study presents the effect of *H. halys* infestation on the response of individual and total phenolic compounds (TPC), antioxidant capacity (AC) and olive fruit quality in the pierced tissue of damaged fruits (PD) and in the non-pierced tissue of damaged fruits (NPD) compared to the undamaged tissue of undamaged fruit - control (C) of 'Istrska belica' and 'Pendolino' cultivars. At harvest time, an unpleasant odour, corky tissue and loss of weight and firmness were noted in the infested fruits. Our research showed that different cultivars respond to *H. halys* infestation in different ways. In 'Istrska belica', the content of TPC in the PD increased by 10.7 %, while the content of AC in the NPD increased by 7.11 % and in the PD fruits by 6.1 % compared to the control. In 'Pendolino', the highest increase in total flavonoid content was observed, with an 80.2 % increase in the PD and a 57.4 % increase in the NPD compared to the control. In the cultivar 'Istrska belica', the greatest phenolic increase was observed in total secoiridoids, where its content in the PD increased by 17.2 % and in the NPD by 43.4 % compared to the control. Our findings will contribute significantly to a better understanding of the plant response to pest infestation and improve the plants protection strategies.

Keywords: pests, metabolic response, Pentatomidae, fruit damage

III/P20

BIOLOŠKI RAZVOJ *Grapholita funebrana* TREITSCHKE, 1835, (FAM. TORTRICIDAE, LEPIDOPTERA) U SEVERNOJ MAKEDONIJI

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Grapholita funebrana Treitschke, 1835 (fam. Tortricidae, Lepidoptera) je ekonomski značajna štetočina koštičavih voćaka u Severnoj Makedoniji. Praćenje ove štetočine je sprovedeno tokom tri uzastopne godine (2021-2023). Cilj je bio da se identifikuje najkritičniji period njegove pojave u dva regiona u zemlji (selo Čelopek, severoistok i selo Sirkovo, Vardarski region), u voćnjacima sa mešanim koštičavim voćem (šljiva, breskva, kajsija). Proučavana štetočina je praćena feromonskim mamcima. Istraživanja su potvrdila prisustvo proučavane štetočine u mešovitim zasadima koštičavog voća u oba proizvodna regiona u Severnoj Makedoniji uz nanošenje povreda na šljivi, breskvi, nektarini i kajsiji. Rezultati istraživanja su zasnovani na ukupno 2.916 uhvaćenih jedinki, u dva proizvodna regiona u Severnoj Makedoniji tokom istraživanog perioda. Dobijeni podaci daju nove uvide u period leta i biološki razvoj *G. funebrana* u specifičnim klimatskim i geografskim uslovima. Tokom 2021. godine, *G. funebrana* je imala ukupan period leta od 188 dana (30.3-3.10.2021) u Čelopeku naspram 208 dana (31.3-24.10.2021) u Sirkovu. U 2022. godini imao je ukupan period leta od 209 dana (20.3-15.10.2022) u Čelopeku naspram 229 dana (31.3-14.11.2022) u Sirkovu. *G. funebrana* je imala ukupan period leta od 204 dana (20.3-10.10.2023) u Čelopeku u odnosu na 234 dana (7.3-26.10.2023.) u Sirkovu tokom 2023. godine. U pogledu lokacija nije bilo statistički značajnih razlika za *G. funebrana*. Kontinuirano praćenje ove štetočine će pomoći u uspostavljanju Integralnog upravljanja štetočinama u zasadima koštičavog voća u cilju poboljšanja standarda bezbednosti hrane i zaštite životne sredine od zagađenja insekticidima.

Ključne reči: *G. funebrana*, Tortricidae, koštičavo voće, Severna Makedonija, integralno upravljanje štetočinama

III/P20

BIOLOGICAL DEVELOPMENT OF *Grapholita funebrana* TREITSCHKE, 1835, (FAM. TORTRICIDAE, LEPIDOPTERA) IN NORTH MACEDONIA

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Grapholita funebrana Treitschke, 1835 (fam. Tortricidae, Lepidoptera) is economically important pest on stone fruit in North Macedonia. Monitoring of this pest was conducted during three consecutive years (2021-2023). The goal was to identify the most critical period of it's appearance in two regions in the country (vilage Chelopek, Northeast and vilage Sirkovo, Vardar region), in orchards with mixed stone fruits (plum, peach, apricot). The studied pest was monitored with pheromone lures. The researches confirmed the presence of the studied pest in the mixed stone fruit plantations in both productive regions in North Macedonia and make injuries on plum, peach, nectarine and apricot. The research results are based on a total of 2,916 caught individuals, in the two production regions in North Macedonia during the researched period. The obtained data gives new insights of the flight period and biological development of *G. funebrana* in the specific climatic and geographical conditions. During 2021 *G. funebrana* had total flight period of 188 days (30.3-3.10.2021) in Chelopek versus 208 days (31.3-24.10.2021) in Sirkovo. In 2022 it had total flight period of 209 days (20.3-15.10.2022) in Chelopek versus 229 days (31.3-14.11.2022) in Sirkovo. *G. funebrana* had total flight period of 204 days (20.3-10.10.2023) in Chelopek versus 234 days (7.3-26.10.2023) in Sirkovo during 2023. Concerning the locations there was no statistically significant differences for *G. funebrana.* Continuous monitoring of this pest will help in establishing Integral Pest Management in stone fruit orchards in order to improve food safety standards and to keep environment from insecticide pollution.

Keywords: *G. funebrana*, Tortricidae, stone fruit, North Macedonia, Integral Pest Management

IV/U1

UTICAJ PRIMENE 1-MCP PRE BERBE JABUKE NA OSNOVNU I DOPUNSKU BOJU PLODOVA

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S obzirom na evidentnu promenu klime i negativan uticaj spoljnih faktora na intenzitet sazrevanja jabuke usled stresom indukovane produkcije etilena još u voćnjaku, ukazala se potreba za odlaganjem berbe. Putem usporavanja sazrevanja se direktno utiče na produkciju i usvajanje etilena blokiranjem receptora istog. Etilen, intenzivirajući sazrevanje otežava berbu u optimalnim parametrima za dugo čuvanje. Kod sorte Gala, jedan od ključnih razloga primene 1-MCP pred berbu je da se kroz usporavanje sazrevanja i odlaganje berbe za dve do tri nedelje omogući dobijanje intenzivnije dopunske crvene boje i očuvanje osnovne zelene. Tokom avgusta 2023. godine pred berbu, postavljen je ogled na sorti Gala u Titelu (Ćirić Agro). Izvršena su tri tretmana biljnim regulatorom 1- MCP (preparat Harvista), istom dozom (8,75 l/ha), na svakih sedam dana pri različitim nivoima razgradnje skroba u plodu jabuke i produkcije etilena. Cilj ovako postavljenog ogleda bio je provera direktnog i indirektnog uticaja primene 1-MCP u voćnjaku na boju pokožice ploda, kao i na druge pomološke faktore bitne za dugo skladištenje i transport jabuke. U opisanom ogledu postignuta je bolja dopunska boja (preko 50% površine ploda) u svim tretmanima na plodovima obe probirne berbe (R1, R2). Najbolji efekat ostvaren je trećim tretmanom (T3) što potvrđuju izmerene prosečne vrednosti L* (svetlina) od 50,19, a* (udeo crvene/zelene nijanse) od 34,94 i b* (udeo žute/plave nijanse) od 27,43 na uzorcima iz prve berbe (R1). Takođe istim T3 tretmanom sličan efekat postignut je i na plodovima iz druge berbe (R2) uz nešto slabije vrednosti obojenja pri čemu je prosečno izmereno: L* (svetlina) 52,02, a* (udeo crvene/zelene nijanse) od 25,79 i b* (udeo žute/plave nijanse) od 25,39. Što se tiče ostalih tretmana, u prvoj berbi R1 najslabije rezultate je dao T1 koji je bio skoro na nivou kontrolnih plodova (K) uz najbolje očuvanje čvrstine ploda, dok je drugi tretman T2 doprineo značajnom obojenju u R1, skoro pa kao T3. Najslabije prosečne rezultate što se tiče obojenja i u R2 dao je ponovo T1 (L*59,23, a*21,63 i b*28,64), a T2 očekivano bolje (L*58,95, a*23,31 i b*28,17). U cilju potvrde da primena 1-MCP u zasadu jabuke ne utiče direktno na obojenje i promenu boje pokožice ploda, već kroz odlaganje momenta berbe direktno preko blokade receptora etilena u plodu i smanjenja produkcije istog urađena je analiza uticaja razgradnje skroba i nivoa etilena na promenu boje (ΔE^*) primenom metode višestruke regresije. Vrednost p za oba faktora (etilen i skrob p=0,34) je bila veća od praga statističke značajnosti 0,05, što upravo potvrđuje gore navedeno. Takođe, koeficijent determinacije R^2 ukazuje na direktni uticaj ova dva faktora 48%, a da neki drugi faktori utiču na promenu boje skoro 52% i to pre svega dnevno noćne temperaturne oscilacije, kao i osvetljenost plodova u krošnji. Što su plodovi duže izloženi ovim faktorima na stablu zahvaljujući 1-MCP, to će obojenost biti bolja uz očuvanje skladišnog potencijala, čvrstine ploda, a preko smanjenja produkcije etilena.

Ključne reči: etilen, biljni regulatori, čvrstina, berba, Gala

IV/U1

INFLUENCE OF APPLICATION OF 1-MCP BEFORE APPLE HARVEST ON GROUND AND OVER COLOR OF FRUIT

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Considering the evident change in climate and the negative impact of stressful factors on the intensity of apple ripening due to the production of ethylene in the orchard, there was a need to delay the harvest and slow down the ripening, directly affecting the production and absorption of ethylene by blocking its receptors. Ethylene intensify ripening thus makes it difficult to harvest fruits in optimal parameters for long storage. In the case of the Gala cultivar, one of the key reasons for applying 1-MCP before harvest is that by slowing down ripening and postponing harvest by two to three weeks, it is possible to obtain a more intense red over color and preserve green ground color. During August 2023, before the harvest, a trial was set up on the Gala cultivar in Titel (Ćirić Agro). Three treatments were performed with the plant regulator 1-MCP (preparation Harvista), at the same dose (8.75 l/ha), every seven days at different levels of starch breakdown in the apple fruit and ethylene production. The aim of this experiment was to verify the direct and indirect influence of the application of 1-MCP in the orchard on the color of the skin of the fruit, as well as on other pomological factors important for long-term storage and transport of apples. In the described experiment, a better over color was achieved (over 50% of the fruit surface) in all treatments on the fruits of both picks of harvest (R1, R2). The best effect was achieved by the third treatment (T3), which is confirmed by the measured average values of L* (brightness) of 50.19, a* (red/green shade share) of 34.94 and b* (yellow/blue shade share) of 27.43 on the samples from the first harvest (R1). Also, with the same T3 treatment, a similar effect was achieved on the fruits from the second harvest (R2) with somewhat weaker coloration values, where the average was measured: L* (brightness) 52.02, a* (proportion of red/green shade) of 25.79 and b* (proportion of yellow/blue shades) from 25.39. As for the other treatments, in the first harvest R1, the weakest results were given by T1, which was almost at the level of control fruits (K) with the best retention of fruit firmness, while the second treatment T2 contributed to a significant coloration in R1, almost like T3. The lowest average results in terms of coloring in R2 were again given by T1 (L*59.23, a*21.63 and b*28.64), and T2, as expected, better (L*58.95, a*23.31 and b*28.17). In order to confirm that the application of 1-MCP in an apple tree does not directly affect the coloring and change the color of the skin of the fruit, but rather by delaying the moment of harvesting by directly affecting the parameters of maturity, and by blocking the ethylene receptor in the fruit and reducing its production, an analysis of the influence of starch decomposition was carried out and ethylene levels on color change (ΔE*) using the multiple regression method. The p value for both factors (ethylene and starch p=0.34) were higher than the statistical significance threshold of 0.05, which confirms the above. Also, the coefficient of determination R^2 indicates the direct influence of these two factors by 48%, and that some other factors affect the color change by almost 52%, primarily day-night temperature oscillations, as well as the brightness of the fruits in the canopy. The longer the fruits are exposed to these factors on the tree with the help of 1-MCP, the better the coloring will be while preserving the storage potential, the firmness of the fruit, and through the reduction of ethylene production.

Keywords: ethylene, plant regulators, firmness, harvest, Gala

IV/U2

UTJECAJ KATEGORIJE ZRELOSTI NA KAKVOĆU PLODA BRESKVE „REDHAVEN“

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Istraživanje je provedeno od 08. do 21.07.2023. kada su breskve sorte 'Redhaven' brane svaki drugi dan (ukupno 605 bresaka sa jedinim kriterijem prisutnosti dopunske boje) u komercijalnom voćnjaku smještenom u Novakima Bistranjskim, Hrvatska. Plodovi su na temelju tvrdoće podijeljeni na šest kategorija zrelosti: i) zrelost za dugački opskrbni lanac (R1, ≤7,26 i >5,44 kg cm^{-2}), ii) zrelost za srednje udaljen opskrbni lanac (R2, ≤5,44 i >4,59 kg cm^{-2}), iii) zrelost ispod definirane maksimalne tvrdoće u svrhu očuvanja optimalnih svojstava kakvoće (R3, ≤4,59 i >3,57 kg cm^{-2}), iv) spremne za kupnju (R4, ≤3,57 i >1,84 kg cm^{-2}), v) spremne za konzumaciju (R5, ≤1,84 i >0,9 kg cm^{-2}) i vi) prezrele (R6, ≤0,9 kg cm^{-2}). Kategorija zrelosti je imala značajan utjecaj na sljedeća svojstva: indeks oblika ploda, volumen, masa, gustoća ploda, indeks apsorbancije klorofila (I_{AD}), dielektrična svojstva – impendanca (Zs) i fazni kut (θ), L, a*, b*, C i h° parametri osnovne i dopunske boje ploda, udio dopunske boje ploda, titracijska kiselost (TA) i omjer topljive suhe tvari i titracijske kiselosti (TST/TA). Međutim, kategorija zrelosti nije značajno utjecala na sadržaj topljive suhe tvari. Najjasnije razlike između različitih kategorija zrelosti su zabilježene za I_{AD} gdje su se kategorije zrelosti R1, R2, R3 i R4 (1,53 ± 0,30, 1,22 ± 0,33, 0,75 ± 0,26, 0,48 ± 0,47, respektivno) značajno razlikovale prema Tukey-ovom HSD testu ($P \leq 0.05$) međusobno i u odnosu na R5 i R6 (0,29 ± 0,17 i 0,16 ± 0,13, respektivno), koje se nisu međusobno razlikovale. Najveća korelacija sa tvrdoćom je zabilježena za ne-destruktivni parametar I_{AD} (0,78), te potom a* i h° parametar osnovne boje ploda (-0,72 i 0,69, respektivno). Od destruktivnih parametara najveća razina korelacije sa tvrdoćom je zabilježena za TST/TA (-0,66) te potom TA (0,60) i θ (0,46).

Ključne riječi: kakvoća ploda, ne-destruktivne analize, korelacijska analiza, zrelost breskve

Zahvalnica: Ovo istraživanje je financiralo Sveučilište u Rijeci, broj ugovora uniri-drustv-18-122.

IV/U2

SEGREGATION OF FRUIT QUALITY TRAITS IN RELATION TO PEACH "REDHAVEN" MATURITY STAGE

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This study was conducted from 08 to 21 July 2023 during which each second day peaches 'Redhaven' where harvested (in total 605 peaches with the only criterion of additional colour presence) from commercial orchard located in Novaki Bistranjski, Croatia. Peaches were segregated on different maturity stages according to their firmness values: i) maturity for long distance chain store (R1, ≤7.26 and >5.44 kg cm^{-2}), ii) maturity for medium distance chain store (R2, ≤5.44 and >4.59 kg cm^{-2}), iii) maturity below defined maximum firmness in order to preserve optimal quality traits (R3, ≤4.59 and >3.57 kg cm^{-2}), iv) ready to buy (R4, ≤3.57 and >1.84 kg cm^{-2}), v) ready to eat (R5, ≤1.84 and >0.9 kg cm^{-2}) and vi) overripe (R6, ≤0.9 kg cm^{-2}). Maturity category had significant effect on following traits: fruit shape ratio, volume, mass, density, chlorophyll absorbance index (I_{AD}), dielectric properties - impedance (Zs) and phase angle (θ), L, a*, b*, C and h° ground and additional colour parameters, share of additional colour, titratable acidity (TA) and ratio of total soluble solids and titratable acidity (TSS/TA). However, no significant effect was obtained for total soluble solids. Most clear differences between maturity categories were obtained for I_{AD} where according to Tukey's HSD test ($P \leq 0.05$) R1, R2, R3 and R4 (1.53 ± 0.30, 1.22 ± 0.33, 0.75 ± 0.26, 0.48 ± 0.47, respectively) significantly differed mutually and in relation to R5 and R6 (0.29 ± 0.17 and 0.16 ± 0.13, respectively), which did not significantly differ between each other. Highest correlation level with firmness was obtained for non-destructive parameter I_{AD} (0.78), followed by a* and h° ground colour parameters (-0.72 and 0.69, respectively). Regarding destructive parameters, the highest correlation level with firmness was obtained for TSS/TA (-0.66) followed by TA (0.60) and θ (0.46).

Keywords: fruit quality, non-destructive analysis, correlation analysis, peach maturity

Acknowledgement: This research was funded by the University of Rijeka, grant number uniri-drustv-18-122.

IV/U3

KOMBINACIJA TRETMANA PRE I NAKON BERBE SA CILJEM OČUVANJA KVALITETA PLODA KAJSIJE TOKOM SKLADIŠTENJA

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S obzirom na to da je etilen jedan od ključnih faktora koji doprinosi brzom sazrevanju i propadanju voća, ovo istraživanje je imalo za cilj da ispita da li kombinacija tretmana pre i nakon berbe može smanjiti sazrevanje i gubitke kvaliteta plodova kajsije sorte „Buda" tokom skladištenja. Upoređivana su dva folijarna tretmana pre berbe, urea (46% N u amidnom obliku) i kalcijum (Ca - Wuxal®Calcium). Ovi tretmani su primenjivani tri puta tokom vegetacione sezone (u fazama prečnika ploda 11 mm, 21 mm i 30 mm). Tretmani nakon berbe uključivali pakovanja sa modifikovanom atmosferom (MAP) i 1-metilciklopropen (1-MCP), koji su primenjeni na ohlađenim plodovima kajsije (I_{AD} indeks 0,4-0,8). Gubitak mase ploda, sadržaj hlorofila i gubitak čvrstoće mereni su odmah po berbi (0 dan), nakon 15 dana čuvanja u uslovima normalne atmosfere (0±1 °C, relativna vlažnost vazduha 90±5%) kao i nakon tri dana čuvanja na sobnoj temperaturi (20 °C). Kombinacija tretmana kalcijumom i MAP-om postigla je najmanji gubitak mase i čvrstoće ploda nakon 15+0 i 15+3 dana čuvanja. Najveći gubitak mase ploda na sobnoj temperaturi zabeležen je kod plodova iz kontrole. MAP tretmani su pokazali veću efikasnost u smanjenju I_{AD} indeksa nakon 15 i 15+3 dana čuvanja u poređenju sa kontrolom i MCP tretmanom, ali su uzrokovali veće gubitke tokom tri dana čuvanja na sobnoj temperaturi. Rezultati pokazuju da određene kombinacije tretmana pre i nakon berbe mogu smanjiti gubitke kvaliteta ploda nakon skladištenja. Iako MAP tretmani uzrokuju veće gubitke tokom čuvanja na sobnoj temperaturi, ukupni gubici su i dalje manji u poređenju sa kontrolnim tretmanima.

Ključne reči: Buda, masa ploda, čvrstina, sadržaj hlorofila

Zahvalnica: Istraživanje je finansiralo Ministarstvo prosvete, nauke i tehnološkog razvoja Republike Srbije, na osnovu ugovora o realizaciji i finansiranju naučno-istraživačkog rada u 2024. godini, Poljoprivredni fakultet, Univerzitet u Novom Sadu, broj 451-03-66/2024-03/200117.

IV/U3

COMBINING PRE- AND POST-HARVEST TREATMENTS TO REDUCE FRUIT QUALITY LOSSES DURING STORAGE

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Given that ethylene is one of the key factors contributing to the rapid ripening and deterioration of fruit, this study aimed to investigate whether a combination of pre- and post-harvest treatments can reduce ripening and quality losses in 'Buda' apricot fruits during storage. Two foliar treatments before harvest were compared: urea (46% N in amide form) and calcium (Ca - Wuxal®Calcium). These treatments were applied three times during the growing season (at fruit diameters of 11 mm, 21 mm, and 30 mm). Post-harvest treatments included modified atmosphere packaging (MAP) and 1-methylcyclopropene (1-MCP), applied to cooled apricot fruits (IAD index 0.4-0.8). Fruit weight loss, chlorophyll content, and firmness loss were measured immediately after harvest (day 0), after 15 days of storage in normal atmosphere conditions (0±1°C, relative humidity 90±5%), and after three days of storage at room temperature (20°C). The combination of calcium and MAP treatments achieved the least weight and firmness loss after 15+0 and 15+3 days of storage. The greatest weight loss at room temperature was recorded in the control group. MAP treatments showed greater efficiency in reducing the IAD index after 15 and 15+3 days of storage compared to the control and MCP treatments but caused greater losses during three days of storage at room temperature. The results indicate that certain combinations of pre- and post-harvest treatments can reduce quality losses in fruits after storage. Although MAP treatments cause greater losses during storage at room temperature, the overall losses remain lower compared to the control treatments.

Keywords: Buda, fruit weight, firmness, chlorophyll content

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IV/U4

KARAKTERISTIKE RAKIJE OD CRNE RIBIZLE

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Rakija od crne ribizle je redak, ali i, zahvaljujući aromatičnim karakteristikama, veoma interesantan proizvod za savremene potrošače koji tragaju za inovativnim proizvodima i nesvakidašnjim senzornim doživljajima. U radu su prikazani rezultati dvogodišnjih ispitivanja kvaliteta rakija proizvedenih od tri sorte crne ribizle – Ben Sarek, Ben Lomond i Čačanska crna. Rakije su proizvedene klasičnim postupkom, od spontano fermentisanih, izmuljanih plodova uz korišćenje tradicionalne dvostruke destilacije. Nizak sadržaj šećera u plodovima i odabrani tradicionalan način prerade uslovili su male prinose destilata. Dobijene rakije su analizirane metodima GC/FID i GC/MS. Pored najzastupljenijih isparljivih komponenata koji čine telo voćnih destilata, analizirane su i aromatične komponente koje su karakteristične za ovu voćnu rakiju. Sve rakije su zadovoljavale zahteve regulative u pogledu najzastupljenijih isparljivih sastojaka, izuzev po sadržaju metanola koji je u svim uzorcima bio iznad zakonski dozvoljene vrednosti. Kvantifikovano je ukupno 37 manje zastupljenih, karakterističnih isparljivih jedinjenja (2 aldehida, 1 acetal, 5 alkohola, 3 kiseline, 8 estara i 18 terpenoida). Utvrđeno je da se monosortne rakije značajno razlikuju po sadržaju određenih komponenata. Preradom Čačanske crne dobijene su rakije sa najvećim sadržajem alkohola i estara, među kojima su najzastupljeniji bili 1-heksanol, etilbutirat i etilheksanoat. Najveći sadržaj terpenoida, sa dominantnim linalool oksidom, terpinen-4-olom, α-terpineolom i spatulenolom, nađen je u rakijama sorte Ben Lomond. Najmanji sadržaji većine ispitivanih komponenata nađeni su u rakiji sorte Ben Sarek. Sve sortne rakije, imale su visok senzorni kvalitet u obe godine. Međutim, nešto više senzorne ocene dobile su rakije od sorte Ben Sarek, koje su u obe godine bile ocenjene zlatnom medaljom. Rakije od ostale dve sorte su, u zavisnosti od godine, bile ocenjene srebrnom, odnosno zlatnom medaljom.

Ključne reči: *Ribes nigrum,* sorta, hemijski sastav, aroma, senzorne karakteristike

Zahvalnica: Finansijski podržalo Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije (Broj ugovora: 451-03-66/2024-03/200215).

IV/U4

CHARACTERISTICS OF BLACKCURRANTS SPIRIT

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Blackcurrant spirit is rare, but thanks to its aromatic characteristics, it is also a very interesting product for modern consumers who are looking for innovative products and unusual sensory experiences. The paper presents the results of a two-year examination of the quality of spirits produced from three varieties of black currant: Ben Sarek, Ben Lomond, and Čačanska Crna. Blackcurrant spirits were produced from spontaneously fermented crushed fruits using traditional double distillation. The low sugar content in the fruits and the chosen traditional way of processing resulted in low distillate yields. The spirits were analyzed by the GC/FID and GC/MS methods. All spirits met the requirements of the regulations regarding the major volatile compounds, except for the methanol content, which in all samples was above the legally allowed value. A total of 37 minor volatile components were quantified (2 aldehydes, 1 acetal, 5 alcohols, 3 acids, 8 esters, and 18 terpenoids). It was found that the contents of some minor components vary considerably among monovarietal spirits. By processing Čačanska Crna, the spirits with the highest contents of alcohols and esters were obtained (1-hexanol, ethyl butyrate, and ethyl hexanoate were the most abundant). The highest content of terpenoids, with dominant linalool oxide, terpinen-4-ol, α-terpineol, and spathulenol, was found in spirits of the Ben Lomond variety. The lowest contents of most of the examined components were found in spirits of the Ben Sarek variety. All varietal spirits had a high sensory quality in both years. Spirits from the Ben Sarek variety were awarded a gold medal in both years. Spirits from the other two varieties were awarded a silver or gold medal, depending on the year.

Keywords: *Ribes nigrum,* variety, chemical composition, aroma, sensory characteristics

Acknowledgement: Supported by the Ministry of Science, Technological Development and Innovation of the RS (Contract number: 451-03-66/2024-03/200215).

IV/U5

UTICAJ PROCESA SUŠENJA NA HEMIJSKI SASTAV SUŠENIH VIŠANJA

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Sušeno voće predstavlja značajan izvor energije za organizam zahvaljujući visokom sadržaju šećera, a zbog prisutnih fenolnih jedinjenja, koja doprinose povećanju antioksidativnog kapaciteta, sušeno voće se sve češće ubraja i u visokovredne namirnice. U Srbiji višnja po godišnjoj proizvodnji, posle šljive i jabuke, a zajedno sa malinom, zauzima treće odnosno četvrto mesto. Najveće količine se izvoze u svežem ili smrznutom stanju, ali se, takođe, plodovi koriste i u prehrambenoj industriji za proizvodnju sokova, džemova, vina, likera, rakije, dok se neznatne količine prerađuju sušenjem. U toku sušenja dolazi do promena pojedinih komponenata hemijskog sastava u stepenu koji zavisi od sastava ploda i uslova tokom procesa sušenja. Stoga je cilj ovog rada poređenje sadržaja šećera, ukupnih kiselina, odnosa šećer/kiseline, ukupnih fenola i antioksidativnog kapaciteta u svežim i osušenim višnjama. Za ispitivanje su korišćene sorte višnje stvorene u Institutu za voćarstvo, Čačak (Šumadinka i Sofija) i autohtone sorte Oblačinska i Feketićka. Sušenje iskoštičenih plodova je obavljeno u eksperimentalnoj sušari na temperaturi vazduha 70 °C do postizanja 75% ukupne suve materije. Kod dobijenih osušenih plodova ispitivanih sorti višnje uočene su manje vrednosti svih ispitivanih parametara računato na 100 grama ukupne suve materije u odnosu na sveže plodove, ali to smanjenje nije uticalo na odnos šećer/kiseline koji definiše ukus sušenog ploda. Ispoljene razlike u hemijskom sastavu svežih i sušenih višanja bile su posledica sortnih karakteristika. Sorta Feketićka je imala najveći odnos šećer/kiseline, dok su sorte Šumadinka i Sofija imale najveće vrednosti antioksidativnog kapaciteta i sadržaja ukupnih fenola, kako u svežim tako i u sušenim plodovima.

Ključne reči: višnja, sorta, primarni metaboliti, ukupni fenoli, antioksidativni kapacitet

Zahvalnica: Ovo istraživanje je finansirano od strane Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije (Broj ugovora: 451-03-66/2024-03/200215 i 451-03-66/2024-03/200088) i Fonda za nauku Republike Srbije (GRANT No 7739716, CherrySeRB).

IV/U5

THE INFLUENCE OF THE DRYING PROCESS ON THE CHEMICAL COMPOSITION OF DRIED SOUR CHERRIES

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Dried fruit is an important source of energy due to its high content of sugars, and due to the presence of phenolic compounds that contribute to the antioxidant capacity, dried fruit is considered as high-value food. Sour cherries, together with raspberries, ranks third and fourth in terms of fruits annual production in Serbia, after plums and apples. The largest quantities are exported - fresh or frozen, but the fruits are also used in the food industry in production of juices, jams, wine, liqueurs, brandy, while small quantities are processed by drying. During drying, certain components of the chemical composition change and a degree of the change primarily depends on the composition of the fruit and the conditions during the drying process. Therefore, the aim of this work was comparison of the contents of sugars, total acids, sugar/acid ratio, total phenols and antioxidant capacity between fresh and dried sour cherries. The study evaluated sour cherry cultivars created at the Fruit Research Institute, Čačak ('Šumadinka' and 'Sofija') and autochthonous cultivars 'Oblačinska' and 'Feketićka'. The drying of pitted fruits was carried out in an experimental dryer at an air temperature of 70 °C until reaching 75% of the total dry matter. Compared to fresh fruits, the obtained dried fruits had a lower content of all tested parameters calculated per 100 grams of total dry matter, but this reduction did not affect the sugar/acid ratio that defines the taste of the dried fruit. The observed differences in chemical composition of fresh and dried sour cherries were the result of cultivars characteristics. The cultivar 'Feketićka' had the highest sugar/acid ratio, while the highest values of antioxidant capacity and content of total phenols, both in fresh and dried fruits, were detected in 'Šumadinka' and 'Sofija'.

Key words: cultivar, primary metabolites, total phenols, antioxidant capacity

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IV/U6

ISKORIŠĆENJE ŠEĆERNIH SIRUPA KAO SPOREDNIH PROIZVODA OSMOTSKOG SUŠENJA VOĆA U PROIZVODNJI VOĆNIH NADEVA

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Tokom proizvodnje osmotski dehidriranog (OD) voća kao sporedni proizvod nastaje velika količina šećernog sirupa. Dalja upotrebna vrednost takvih sirupa direktno zavisi od vrste voća, primenjenog tehnološkog postupka i broja ciklusa upotrebe. Istraživana je mogućnost upotrebe šećernih sirupa kao nusproizvoda osmotski dehidrisanog voća u proizvodnji voćnih nadeva, u zavisnosti od broja ciklusa upotrebe sirupa. Za eksperiment su korišćeni šećerni sirupi iz osmotske dehidracije višnje dobijeni od lokalnog proizvođača. Proizvedeni su voćni nadevi od sirupa iz različitih ciklusa (korišćeni su sirupi iz šest ciklusa proizvodnje), a zatim je utvrđivan rok trajanja praćenjem promena najvažnijih parametara kvaliteta nadeva. Radi ubrzanja postupka određivanja roka trajanja korišćeni su temperaturni akceleratori. Na svaka dva meseca u periodu od pola godine ispitivao se sadržaj monomernih antocijana i sadržaj polimernih bojenih materija, kao ključnih faktora roka trajanja voćnih nadeva. Rezultati ukazuju da upotreba šećernih sirupa do petog ciklusa osmotske dehidracije višnje ima pozitivan uticaj na kvalitet voćnih nadeva. Glavni razlog za to je ekstrakcija aromatičnih i bojenih materija tokom OD.

Ključne reči: osmotska dehidracija, voćni nadevi, bojene materije, sirup

IV/U6

UTILIZATION OF SUGAR SYRUPS AS BY-PRODUCTS OF OSMOTIC FRUIT DRYING IN THE PRODUCTION OF FRUIT FILLINGS

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The production of osmotically dehydrated (OD) fruit generates substantial quantities of sugar syrup as a by-product. The potential for further utilization of these syrups is contingent upon the type of fruit, the technological procedure applied, and the number of reuse cycles. This study explores the feasibility of utilizing sugar syrups, derived as by-products of osmotic fruit dehydration, in the production of fruit fillings, with a specific focus on the impact of syrup reuse cycles. Sugar syrups from the osmotic dehydration of sour cherries, were supplied by a local producer. Fruit fillings were formulated using syrups from six different dehydration cycles, and their shelf life was assessed by monitoring of the main quality parameters. To accelerate shelf-life determination, temperature accelerators were applied. The study period lasted six months, and sampling was done every two months. The contents of monomeric anthocyanins and polymeric pigments, as key indicators of fruit fillings quality and shelf life, were evaluated. The results suggest that sugar syrups from up to the fifth cycle of sour cherry osmotic dehydration exhibit a beneficial impact on the quality of fruit fillings. This enhancement is attributed to the extraction of aromatic and pigment compounds during the osmotic dehydration process.

Keywords: osmotic dehydration, fruit fillings, pigments, syrup

IV/U7

PROFIL AROME VINA SORTE STANUŠINA UTVRĐEN SA GC-MS

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Stanušina je autohtona makedonska sorta vinove loze, koja se gaji uglavnom u najstarijem tikveškom vinskom okrugu, u regionu blizu Tikveškog jezera (Begnište, Resava i Brušani) u Republici Severnoj Makedoniji. Glavna karakteristika ove sorte je visoka izdržljivost, posebno na suše i sposobnost da raste u vinogradima sa ne baš plodnim zemljištima. Pre perioda širenja filoksere u XIX veku, koja je nanela razornu štetu zarazom korena evropske *Vitis vinifera*, uključujući i vinovu lozu u Makedoniji, Stanušina je bila glavna sorta za proizvodnju crvenog vina u regionu. U ovoj studiji proizvedeno je devet vina sorte Stanušina u tikveškom vinskom okrugu u cilju utvrđivanja aromatičnog profila vina. Analiza aromatičnog sastava je izvršena pomoću GC-MS sistema koji se sastoji od gasnog hromatografa GC-17A i masenog spektrometra GCMS-QP5050A nakon tečno-tečne ekstrakcije. Detektovana su ukupno 42 aromatična jedinjenja koja otkrivaju složen profil arome vina Stanušina sačinjen od viših alkohola, estara, masnih kiselina, terpena, isparljivih fenola i sumpora i drugih jedinjenja. Dominantna jedinjenja su bili viši alkoholi, a među njima je glavno jedinjenje bio izoamil alkohol (sa voćnom aromom kruške i banane), a zatim 2-feniletil alkohol (sa prijatnom cvetnom aromom ruže). U grupi estara dominirao je etil acetat, koji utiče na cvetnu i kompleksnu aromu vina, a zatim slede etil laktat i etil sukcinat. Terpenski alkoholi kao što su nerol, geraniol, linalol i terpeniol, koji određuju aromu muskatnih sorti vinove loze, otkriveni su u Stanišini, među kojima su linalol i geraniol bili glavni terpeni. Ova studija daje značajnu aromatičnu karakterizaciju crvenih vina sorte Stanišine korisnu za vinogradare i vinare, potvrđujući da ova authtona sorta poseduje tipičnost i kvalitet i da se treba uzeti u obzir za proizvodnju kvalitetnih vina.

Ključne reči: aroma, alkholi, estri, terpeni, vino Stanušine

Zahvalnica: Ovaj rad je podržan grantom CEEPUS, SK-1516-02-2122 Network BioScinec, Food and Health, kojim je bio pokriven studijski boravak Dragane Gicev na Mendel univerzitetu u Brnu, Fakultet za poljoprivredne nauke, Katedra za vinogradarstvo i vinarstvo, gde su izvršene analize.

IV/U7

AROMA PROFILE OF STANUŠINA WINES DETERMINED BY GC-MS

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Stanušina is an autochthonous Macedonian grape variety, grown mainly at the oldest Tikveš wine district, at the region near to the Tikveš Lake (Begnište, Resava and Brusani) in Republic of North Macedonia. The main characteristic of this variety is its high endurance, especially on droughts and it ability to grow at vineyards with not very fertile soils. Before the period when the phylloxera was spread in XIX century causing devastating damage by infecting roots of European *Vitis vinifera*, including the grapevines in Macedonia too, Stanušina was the main variety for producing red wine in the region. In this study, nine Stanušina wines from the Tikveš wine district have been produced in order to determine their aroma profile. The analysis of aromatic composition was performed with GC-MS system consisted of GC-17A Gas Chromatograph and GCMS-QP5050A Mass Spectrometer after liquid-liquid extraction. In total, 42 aroma compounds were detected revealing a complex aroma profile of Stanušina wines composed of high alcohols, esters, fatty acids, terpenes, volatile phenols and sulphur and other compounds. The dominant compounds were high alcohols, and among them, isoamyl alcohol (with fruity aroma of pear and banana) was the major compound, followed by 2-phenylethyl alcohol (with pleasant floral aroma of rose). Ethyl acetate, which influence floral and complex wine aroma, dominated in the group of esters, followed by ethyl lactate and ethyl succinate. Terpene alcohols such as nerol, geraniol, linalool and terpeniol, which determine the aroma of Muscat grape varieties, were detected in Stanušina, in which linalool and geraniol were the main terpenes. This study provides an important aroma characterization of Stanušina red wines useful for the viticulturists and winemakers confirming that this autochthonous variety possesses typicality and quality and should be considered for production of quality wines.

Keywords: aroma, alcohols, esters, terpenes, Stanušina wine

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IV/U8

UTICAJ INICIJATIVE OTVORENI BALKAN NA TRGOVINU VOĆEM

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Otvorena balkanska inicijativa (OBI) uključuje privrede zemalja koje nisu članice EU. Osim OBI-a, tu su CEFTA sporazum i Berlinska inicijativa. Svaki od njih ima uticaj na trgovinu. Kako sektor voća i povrća brzo raste u regionu, fokus je na njemu. Cilj ovog rada je: prvo, objasniti glavne razlike između tih inicijativa, drugo, opisati glavne promene u OBI-ju i konačno, treće, analizirati uticaj na sektor i trgovinu robom u zemljama članicama. Rezultati pokazuju da je glavna ideja u svim inicijativama slobodna trgovina. Suštinske promene se sastoje u smanjenju necarinskih barijera. Konačno, uticaj na sektor povrća je evidentan i različit po zemljama i proizvodima, dok u sektoru voća gotovo da nema promena.

Ključne riječi: Otvorena balkanska inicijativa, voće i povrće, trgovina

IV/U8

IMPACT OF THE OPEN BALKAN INITIATIVE ON FRUIT TRADES

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Open Balkan Initiative (OBI) includes the economy of non-EU members. Besides the OBI there is the CEFTA agreement and Berlin Initiative. Each of those has an impact on trade. As the fruit and vegetable sector is fast growing in the region, the focus is on those. The aim of this paper is: first, to explain the main differences between those initiatives, second, to describe the main changes in the OBI and finally, third, to find out the impact on the sector and the commodity trade in member countries. The results show that the main idea in all initiatives is free trade. The main changes include the reduction in non-tariff barriers. Finally, the impact on the vegetable sector is evident and different by countries and products, while in the fruit sector, there are almost no changes.

Keywords: Open Balkan Initiative, fruit and vegetable, trade

IV/P1

UTICAJ NAČINA I TERMINA BERBE NA KVALITET PLODOVA KUPINE (*Rubus fruticosus* L.)

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Cilj ovog istraživanja bio je da se utvrdi uticaj načina i termina berbe na kvalitet plodova kupine. Ogledom su obuhvaćene dve sorte kupine (Loch Ness i Triple Crown), a berba je vršena manuelno i mehanizovano. Uporedna ispitivanja dva načina branja plodova kupine vršena su u periodu pune zrelosti plodova, i to tokom treće (I berba) i četvrte (II berba) nedelje branja, u komercijalnom zasadu u okolini Uba u 2019. godini. Granična vrednost sile veze ploda sa peteljkom, koju je mašinski berač trebao da savlada iznosila je 1.2 N. Najveću masu ploda imala je sorta Loch Ness (7,2 g) ubrana mašinski u drugom terminu berbe. Takođe, plodovi sorte Loch Ness, u istom terminu i načinu branja, imali su najveći sadržaj rastvorljive suve materije (13,4%) i ukupnih šećera (11,3%). Najveću vrednost indeksa slasti imali su plodovi sorte Triple Crown (10,8) koji su ubrani ručno u drugom terminu branja. Plodovi ispitivanih sorti imale su značajno veće vrednosti sadržaja vitamina C u prvoj berbi u odnosu na drugi termin berbe. Pored toga, u prvom terminu berbe najveće vrednosti zabeležene su prilikom mašinskog branja (40,5 i 42,4 mg). Ukupna vrednost antocijana kod ispitivanih sorti značajno je bila veća u drugom terminu berbe u odnosu na prvi termin. Najveća vrednost ukupnih antocijana zabeležena je kod plodova sorte Triple Crown (53,2 mg) ubranih mašinskim putem. Najveći broj ubranih zrelih plodova mašinskim putem zabeležen je kod sorte Triple Crown (89%) u drugoj berbi, a najmanji kod sorte Loch Ness (57%) u prvom terminu branja.

Ključne reči: berba, sorta, ukupni šećeri, vitamin C, antocijani

Zahvalnica: Istraživanja u ovom naučnom radu podržana su od strane Ministarstva nauke i tehnološkog razvoja Republike Srbije broj 451-03-65/2024-03/200116.

IV/P1

INFLUENCE OF WAY AND TIME OF HARVESTING ON THE QUALITY OF BLACKBERRY FRUITS (*Rubus fruticosus* L.)

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The aim of this research was to determine the influence of the way and time of harvesting on the quality of blackberry fruits. The trial included two cultivars of blackberries (Loch Ness and Triple Crown), and harvesting was done manually and mechanized. Comparative tests of two ways of picking blackberry fruits were carried out in the period of full ripeness of the fruits, during the third (first harvest) and fourth (second harvest) weeks of picking, in a commercial orchard near Municipality of Ub in 2019. The limit value of the force of the connection between the fruit and the stem, which the machine picker had to overcome, was 1.2 N. The largest fruit weight was the variety Loch Ness (7.2 g), harvested mechanically in the second time of the harvest. Also, the fruits of the Loch Ness cultivar, at the same time and way of picking, had the highest content of soluble solids (13.4%) and total sugars (11.3%). The fruits of the Triple Crown cultivar (10.8), which were picked by hand in the second picking period, had the highest value of the sweetness index. The fruits of the tested varieties had significantly higher values of vitamin C content in the first harvest compared to the second harvest. In addition, in the first period of harvest, the highest values were recorded during machine picking (40.5 and 42.4 mg). The total value of anthocyanin in the examined cultivars was significantly higher in the second harvest time than in the first. The highest value of total anthocyanins was recorded in the fruits of the Triple Crown variety (53.2 mg) harvested by machine. The highest percentage of machine-harvested ripe fruits was recorded in the Triple Crown cultivar (89%) in the second harvest, and the lowest in the Loch Ness cultivar (57%) in the first picking period.

Keywords: harvest, cultivar, total sugar, vitamin C, anthocaynin

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IV/P2

UTJECAJ FENILALANINA NA KAKVOĆU I BIOKEMIJSKI SASTAV MANDARINKE „CHACHARA" TIJEKOM ČUVANJA U HLADNJAČI

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Istraživanje je provedeno od 09. do 29. 11. 2023. kada je istraživan utjecaj potapanja mandarinki Unshiu (*Citrus unshiu* Markowitz) 'Chachara' u otopinu fenilalanina (6 mM) na kakvoću i biokemijski sastav tijekom skladištenja u hladnjači (5 °C). Plodovi su na dan tretiranja dopremljeni iz komercijalnog voćnjaka mandarinke smještenog u dolini rijeke Neretve, pokraj Opuzena. Uz početno mjerenje, mjerenja su još izvođena u tri termina, odnosno 6, 13. i 20. dan skladištenja. Prema t-testu ($P \leq 0.05$) u sva tri termina zabilježen je značajan pozitivan utjecaj fenilalanina na ukupan sadržaj polifenola, flavonoida i proteina te antioksidacijsku aktivnost (DPPH i ABTS metoda). U zadnjem terminu mjerenja zabilježene su sljedeće vrijednosti biokemijskih svojstava za netretirane i tretirane mandarinke: ukupan sadržaj polifenola 19,07 ± 4,74 i 26,76 ± 1,94 mg EGK/100 g jestivog dijela (respektivno), ukupan sadržaj flavonoida 12,62 ± 3,09 i 17,97 ± 1,16 mg EK/100 g jestivog dijela (respektivno), antioksidacijska aktivnost (DPPH metoda) 74,26 ± 10,05 i 105,54 ± 7,58 µmol ET/100 g jestivog dijela (respektivno), antioksidacijska aktivnost (ABTS metoda) 83,89 ± 10,94 i 145,71 ± 13,03 µmol ET/100 g jestivog dijela (respektivno) i ukupan sadržaj proteina 0,97 ± 0,23 i 1,31 ± 0,09 g kimozina /100 g jestivog dijela. S druge strane ni u jednom terminu nije zabilježen značajan utjecaj fenilalanina na kalo, randman (kao udio jestivog dijela), tvrdoću, topljivu suhu tvar (TST), titracijsku kiselost (TA) i TST/TA. Iz navedenoga može se zaključiti da se fenilalanin može koristiti kao sredstvo pospješivanja bioaktivnog sastava mandarinke 'Chachara'. Međutim, potrebno je također napomenuti da iako navedeno svojstvo nije mjereno, vizualno je zapaženo brže propadanje tretiranih plodova. Stoga su potrebna daljnja istraživanja kako bi se razjasnio utjecaj fenilalanina na propadanje plodova.

Ključne riječi: fenilalanin, skladištenje u hladnjači, mandarinka, bioaktivna svojstva

Zahvalnica: Ovo istraživanje je financirano od strane HRZZ UIP-2020-02-7496 ¨Neretvanska mandarina-kemijska karakterizacija i inovativni tretmani poslije berbe¨.

IV/P2

PHENYLALANINE EFFECT ON FRUIT QUALITY AND BIOCHEMICAL PROPERTIES OF MANDARIN „CHACHARA" DURING COLD STORAGE

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This study was conducted from November 9 to 29, 2023, when the influence of a dipping solution of phenylalanine (6 mM) on the quality and biochemical composition of Unshiu mandarins (*Citrus unshiu* Markowitz) 'Chachara' was investigated during cold storage (5 °C). On the first day of treatment, fruit were delivered from a commercial mandarin orchard located in the Neretva river valley, near the city of Opuzen. In addition to the initial measurement, measurements were also performed in three terms, namely on the 6th, 13th and 20th day of storage. According to the t-test ($P \leq 0.05$) in all three terms, a significant positive influence of the treatment on the total polyphenol, total flavonoid and total protein content and antioxidant activity (DPPH and ABTS methods) was recorded. In the last measurement term, the following biochemical trait values were recorded for nontreated and treated mandarins: total polyphenol content 19.07 ± 4.74 and 26.76 ± 1.94 mg GAE/100 g of edible part (respectively), total flavonoid content 12.62 ± 3.09 and 17.97 ± 1.16 mg QE/100 g of edible part (respectively), antioxidant activity (DPPH) 74.26 ± 10.05 and 105.54 ± 7.58 µmol TE/100 g of edible part (respectively), antioxidant activity (ABTS) 83.89 ± 10.94 and 145.71 ± 13.03 µmol TE/100 g of edible part (respectively) and total protein content 0.97 ± 0.23 and 1.31 ± 0.09 g chymosin/100 g of edible part (respectively). On the other hand, no significant effect of the treatment was recorded for weight loss, share of edible fruit part, firmness, total soluble solids (TSS), titratable acidity (TA) and TSS/TA. It can be concluded that phenylalanine can be used as a mean for enhancing the bioactive composition of the 'Chachara' mandarin. However, it should also be noted that, although the mentioned property was not measured, a higher proportion of rotten fruit was visually observed in the treated fruit. Therefore, new studies are needed to clarify the effect of phenylalanine on fruit deterioration.

Keywords: phenylalanine, cold storage, mandarin, bioactive properties

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IV/P3

UTICAJ TRETMANA NAKON BERBE NA KVALITET PLODOVA CRVENE RIBIZLE (*Ribes rubrum* L.) TOKOM ČUVANJA

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Cilj ovog istraživanja je bio da se ispita uticaj primene različitih tretmana posle berbe na kvalitet i promene fizičkih i hemijskih osobina plodova crvene ribizle tokom čuvanja. Ogledom su obuhvaćene dve sorte crvene ribizle, Redpoll i Rovada. Odmah nakon berbe, grozdovi su klasirani, smešteni u polietilenske otvorene kutije (masa uzorka 200 g ± 5%) i prskani rastvorima tri preparata: aloe vera (50%), cirkon (150 ppm) i koloidini rastvor srebra (50 ppm). Čuvanje plodova obavljeno je u hladnjači sa kontrolisanom temperaturom (+ 3° C) i vlažnošću vazduha (80-85%). Promene u hemijskim i fizičkim osobinama plodova su određivane u sledećim terminima: 7, 14 i 21 dan nakon uskladištenja tokom dve uzastopne godine (2019-2020). Najmanji gubitak u masi i čvrstini bobice tokom čuvanja, imali su grozdovi sorte Redpoll tretirani rastvorom srebra (2,2% i 6,8%, po redosledu), a najveći sorte Rovada tretirani cirkonom (6,2% i 15,1%, po redosledu). Kod obe sorte, najmanji gubitak u masi i čvrstoći bobice zabeležen je u tretmanu sa rastvorom srebra, pri čemu značajne razlike nisu zabeležene nakon 7 i 14 dana čuvanja u odnosu na nulti dan. Najveće povećanje sadržaja ukupnih šećera tokom čuvanja zabeleženo je kod bobica sorte Rovada tretiranih cirkonom (prosečno 6,2%), a najmanje kod plodova sorte Redpoll tretiranih aloe verom (2,3%). Kod obe sorte najveće vrednosti ukupnih šećera zabeležene su nakon 14 dana čuvanja. Najveći sadržaj vitamina C imali su plodovi sorte Rovada tretirani cirkonom (prosečno 45,2 mg/100 g sv.p.), a najmanji sorte Redpoll tretirani aloe verom (prosečno 32,5 mg). Kod obe sorte i svih tretmana najveći sadržaj vitamina C imali su plodovi čuvani 7 dana. Najveći uticaj na očuvanje fizičkih osobina bobice imao je tretman sa rastvorom srebra, tok je na poboljšanje hemijskih osobina najveći uticaj imao tretman cirkonom.

Ključne reči: aloe vera, cirkon, koloidno srebro, ukupni šećeri, vitamin C

Zahvalnica: Ova istraživanja su finansirana Ugovorom o realizaciji naučnoistraživačkog rada u 2024. godini između Ministarstva za nauku, tehnološki razvoj i inovacije Republike Srbije i Univerziteta u Beogradu, Poljoprivrednog fakulteta (Ugovor br. 451-03-65/2024-03/200116).

IV/P3

INFLUENCE OF POST-HARVEST TREATMENT ON FRUIT QUALITY OF RED CURRANTS (*Ribes rubrum* L.) DURING STORAGE

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The aim of this research was to examine the impact of the application of foliar treatments after harvest on the quality and changes in the physical and chemical properties of red currant fruits during storage. The experiment included two red currant cultivars, 'Redpoll' and 'Rovada'. Immediately after harvesting, the bunches were classified, placed in polyethylene open boxes (mass of sample, 200 g ± 5%) and treated with solutions of three preparations: aloe vera (50%), zircon (150 ppm) and colloidal silver solution (50 ppm). Fruits were stored in a refrigerator with controlled temperature (+ 3° C) and air humidity (80-85%). Changes in chemical and physical properties were performed 7, 14 and 21 days after storage in the two consecutive years (2019 and 2020). The smallest loss in berry mass and firmness during storage had bunches of 'Redpoll' cultivar treated with silver solution (2.2% and 6.8%, respectively), and the largest had 'Rovada' cultivar treated with zircon (6.2% and 15.1%, respectively). In both cultivars, the smallest loss in berry mass and firmness was recorded in the treatment with silver solution, while no significant differences were recorded after 7 and 14 days of storage compared to the zero day. The greatest increase in the content of total sugars during storage was recorded in the berries of cultivar 'Rovada' treated with zircon (6.2% on average), and the least in the fruits of cultivar 'Redpoll' treated with aloe vera (2.3%). To the both cultivars, the highest values of total sugars were recorded after 14 days of storage. The highest content of vitamin C was recorded in fruits of cultivar 'Rovada', treated with zircon (on average 45.2 mg/100 g FW), and the lowest in berries of cultivar 'Redpoll' treated with aloe vera (on average 32.5 mg/100 g FW). In both cultivars and all treatments, the berries stored for 7 days had the highest content of vitamin C. Silver solution treatment had the highest impact on the preservation of the physical properties of the berries, while treatment with zircon had the greatest impact on the improvement of the chemical properties.

Keywords: aloe vera, zircon, colloidal silver, total sugars, vitamin C

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IV/P4

UTICAJ JESTIVIH OMOTAČA NA POJAVU SIVE PLESNI ZA VREME ČUVANJA PLODOVA MANDARINE

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Gubici plodova voća na globalnoj razini veći su od 40 %, pri čemu je značajan udeo ovih gubitaka pripisan propadanju plodova nakon berbe od patogenih gljiva kao npr. *Botrytis cinerea.* Upravljanje ovim problemom je složeno zbog ograničenja dostupnih fungicida koji se koriste u kontroli širenja ovog gljivičnog patogena, a što zahteva istraživanje ekološki održivih alternativa. Primena jestivih omotača na plodovima voća prije skladištenja održiv je pristup ublažavanju kvarenja svježih proizvoda nakon berbe. Jestivi omotači igraju važnu ulogu u ublažavanju gubitaka nakon berbe, uključujući gubitak vlage, uticaj na sazrijevanje i fizikalno-kemijsko propadanje. Ovo istraživanje istraživalo je uticaj tri vrste jestivih omotača (hitozan, zein i kombinacija hitozana i zeina) na suzbijanje sive plesni koju uzrokuje *Botrytis cinerea* na plodu mandarine za vreme skladištenja. Rezultati pokazuju da su plodovi obloženi zeinom pokazali najveću inhibiciju rasta sive plesni, zatim "sloj po sloj" omotača hitozan-zein i samo hitozan, u usporedbi s kontrolnim uzorcima. Ovi rezultati pokazuju da jestivi omotači učinkovito kontroliraju patogene nakon berbe, nudeći obećavajuće rešenje za smanjenje gubitka plodova.

Ključne reči: *Botrytis cinerea*, propadanje ploda, hitozan, zein, posle berbe

Zahvalnica: Autori se zahvaljuju na financijskoj podršci Hrvatskoj zakladi za znanost kroz projekt pod nazivom Neretvanska mandarina-kemijska karakterizacija i inovativni tretmani poslije berbe (CITREA) (UIP-2020-02-7496).

IV/P4

THE IMPACT OF EDIBLE COATINGS ON THE OCCURRENCE OF GREY MOULD DURING THE STORAGE OF MANDARIN FRUITS

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More than 40% of fruits harvested globally are lost, with a significant proportion of this loss attributed to post-harvest rots caused by fungal pathogens such as *Botrytis cinerea*. The management of this issue is complex due to the constraints of available fungicides in controlling the spread of this fungal pathogen, necessitating the exploration of environmentally sustainable alternatives. The application of edible coatings on fruits prior to storage is a sustainable approach to mitigating the spoilage of fresh produce post-harvest. Edible coatings play a crucial role in mitigating post-harvest losses, including moisture loss, ripening, and physicochemical deterioration. This study investigates the impact of three types of edible coatings (chitosan, zein, and a combination of chitosan and zein) on the suppression of grey mould caused by *Botrytis cinerea* on mandarin fruit during storage. The results show that zein-coated fruits exhibited the highest inhibition of fungal growth, followed by 'layer-by-layer' chitosan-zein coatings, and chitosan alone, in comparison to control samples. These results indicate that edible coatings effectively control post-harvest pathogens, offering a promising solution to reduce fruit loss.

Keywords: *Botrytis cinerea*, fruit loss, chitosan, zein, post-harvest

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IV/P5

FIZIČKO-HEMIJSKA KARAKTERIZACIJA VINA SORTE VRANEC KORIŠĆENJEM INFRACRVENE SPEKTROSKOPSKE FOURIEROVE TRANSFORMACIJE (FT-IR)

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U ovoj studiji proizvedena su vina sorte Vranec iz Tikveškog vinogorja (berba 2022) i analizirana su pomoću infracrvene spektroskopske Fourierove transformacije (FT-IR). Određeni su osnovni fizičko-hemijski parametri: alkohol, specificna tezina, redukujući šećeri, pH vrednost, ukupna kiselost, isparljiva kiselost, slobodni i ukupni SO_2. Sva vina su bila dobrog kvaliteta, sa relativno visokim sadržajem alkohola (12,5-15,98%). pH vrednost se kretala u rasponu od 3,53 do 3,74, ukupna kiselost u rasponu od 4,63 do 7,74 g/L, a isparljiva kiselost od 0,34 do 0,78 g/L, što znači da su sva vina bila hemijski i mikrobiološki stabilna. Pored toga, sva vina bila su zaštićena od oksidacije, sa dovoljno slobodnog SO_2 (u proseku: 9,28 mg/L) i ukupnog SO_2 (u proseku: 21,07 mg/L). Utvrđen je i sadržaj pojedinih organskih kiselina u kojima je dominantno jedinjenje vinska kiselina (prosečna vrednost: 2.92 g/L), zatim jabučna kiselina (prosečna vrednost: 0,69 g/L), mlečna kiselina (prosečna vrednost: 0,52 g/L) i limunska kiselina (prosečna vrednost: 0,31 g/L). Sorbinska kiselina nije određena u vinima, što znači da sorbinska kiselina nije korišćena kao konzervans. Glukonska kiselina, koja je najvažniji parametar zdravstvenog stanja grožđa jer se smatra indikatorom bolesti *Botrytis cinerea*, prvi put je utvrđena u makedonskim vinima sorte Vranec, a sadržaj se kretao od 0,86 do 3,80 g/L, što se smatra normalnim vrednostima, potvrđujući fizičku i hemijsku stabilnost vina. Pored toga, određen je Folin-Ciocalteau (FC) indeks i parametri boje. Sva vina su pokazala relativno visok FC indeks, kako se i očekivalo, jer je sorta Vranec bogata polifenolima. Dominirala je crvena boja (raspon: 51,44 do 55,17%), zatim žuta boja (raspon: 32,96 do 34,06%) i plava boja (raspon: 11,8 do 14,51%). Sva vina su pokazala zadovoljavajući sjaj, u rasponu od 52,79 do 59,38%. Generalno, vina sorte Vranec su pokazala veoma dobru fizičku, hemijsku i mikrobiološku stabilnost, karakterističnu za visokokvalitetna crvena vina.

Ključne reči: osnovni parametri, organske kiseline, parametri boje, Vranec, FT-IR

IV/P5

PHYSICOCHEMICAL CHARACTERIZATION OF VRANEC WINES USING FOURNIER TRANSFORM INFRARED (FT-IR) SPECTROSCOPY

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In this study, Vranec wines from Tikveš wine district were produced (vintage 2022) and analyzed with Fournier Transform Infrared (FT-IR) spectroscopy. The basic physicochemical parameters have been determined: alcohol, density, reducing sugars, pH value, total acidity, volatile acidity, free and total SO_2. All wines presented good quality, containing relatively high content of alcohol (range: 12.5 to 15.98%). The pH value ranged from 3.53 to 3.74, the total acidity was in range from 4.63 to 7.74 g/L and the volatile acidity ranged from 0.34 to 0.78 g/L, which means that all wines were chemically and microbiologically stable. In addition, all wines were protected from oxidation, containing sufficient free SO_2 (on average: 9.28 mg/L) and total SO_2 (on average: 21.07 mg/L). The content of individual organic acids was also determined, in which tartaric acid was the dominant compound (average value: 2.92 g/L), followed by malic acid (average value: 0.69 g/L), lactic acid (average value: 0.52 g/L) and citric acid (average value: 0.31 g/L). Gluconic acid, which is the most important parameter for the health of grapes since it is considered as indicator of *Botrytis cinerea* disease, was determined for the first time in Macedonian Vranec wines, and the content ranged from 0.86 to 3.80 g/L, which are considered as normal values, confirming the physical and chemical stability of wines. In addition, the Folin-Ciocalteau (FC) Index and colour parameters have been determined. All wines presented relatively high FC index, as expected, since Vranec variety is rich in polyphenols. The red colour dominated (range: 51.44 to 55.17%), followed by yellow colour (range: 32.96 to 34.06%) and blue colour (range: 11.8 to 14.51%). All wines presented satisfactory brilliance, ranged in 52.79 to 59.38%. In general, Vranec wines presented very good physical, chemical and microbiological stability, characteristic for high quality red wines.

Keywords: basic parameters, organic acids, colour parameters, Vranec, FT-IR

IV/P6

FIZIČKO-HEMIJSKA I SENZORSKA ANALIZA PROIZVODA MADŽUN (MELASA GROŽĐA) OD SORTI GROŽĐA GAJENIH U USLOVIMA REPUBLIKE SEVERNE MAKEDONIJE

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U ovom istraživanju ispitivana su fizičko-hemijska i senzorska svojstva uzoraka proizvoda Madžun (grožđana melasa) proizvedenih tradicionalnom metodom od pet sorti grožđa (Kardinal, Vranac, Afus ali, Stanušina i Smederevka) uzgajanih u zemljišno-klimatskim uslovima Tikveškog vinogorja. Određeni su sadržaj rastvoljive suve materije, pH vrednost, titraciona kiselost i sadržaj hidroksimetilfurfurala (HMF) i dobijeni su rezultati 61,67-84,98%, 3,11-4,47, 3,8-11,1 g/L i 620,30-875,30 mg/kg, redom. Utvrđeno je da je prosečan sadržaj fruktoze i glukoze u ispitivanim uzorcima bio 39,64%, odnosno 40,86%. Sadržaj saharoze u svim uzorcima bio je na pragu detekcije (<0,1%), što ukazuje da nije dodat šećer prilikom proizvodnje grožđane melase (Madžun). Određen je ukupan sadržaj fenola (TPC) i utvrđene su značajne razlike između uzoraka ($P<0,01$). Senzorsku analizu izvršilo je 7 treniranih ocenjivača. Sve članice su bile žene sa iskustvom u senzorskom ocenjivanju biljne hrane. Ocenjivani su sledeći elementi: boja, miris, ukus, slatkoća, kiselost, tekstura i aftertejst. Maksimalni broj poena mogao je da bude 20 (ISO 6564, ISO 8587 i ISO 11036). Na osnovu senzorske analize zaključeno je da je najbolji uzorak Madžuna (grožđane melase) bio od sorte grožđa Vranac sa najvećim brojem poena 17,92.

Ključne reči: Madžun, sorte grožđa, hidroksimetil furfural, saharoza, ukupni fenoli, senzorska analiza

IV/P6

PHYSICO-CHEMICAL AND SENSORY ANALYSIS OF THE PRODUCT MADŽUN (GRAPE MOLASSES) FROM GRAPE VARIETIES GROWN UNDER THE CONDITIONS OF REPUBLIC OF NORTH MACEDONIA

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In this study, the physico-chemical and sensory properties of samples of the product Madžun (grape molasses) produced according to the traditional method from five different grape varieties (Cardinal, Vranec, Afus ali, Stanushina, Smederevka) grown under the soil and climatic conditions of the Tikvesh wine-growing region were investigated. The soluble solids, pH value, titratable acidity and hydroxymethylfurfural (HMF) content of the samples were determined to be 61.67-84.98%, 3.11-4.47, 3.8-11.1 g/L and 620.30-875.30 mg/kg, respectively. The mean fructose and glucose content of the samples was 39.64% and 40.86%, respectively. The sucrose content was at the detection limit (<0.1 %) in all samples. This indicates that no sugar was added during the production of grape molasses (Madžun). Total phenolic content (TPC) was determined and significant differences were found between the samples ($P<0.01$). The sensory analysis of the samples was performed by 7 trained evaluators. All members were women with experience in sensory evaluation of plant-based foods. The following elements were evaluated: color, odor, taste, sweetness, acidity, texture and aftertaste. The maximum score could be 20 (ISO 6564, ISO 8587 and ISO 11036). Based on the results of the sensory evaluation, it was concluded that the Madžun (grape molasses) sample from the Vranec grape variety achieved the highest score of 17.92 points.

***Keywords*:** Madžun, grape varieties, hydroxymethyl furfural, sucrose, TPC, sensory analysis

IV/P7

FIZIČKOHEMIJSKA, ANTIOKSIDATIVNA I ANTIMIKROBNA SVOJSTVA CRVENIH VINA IZ PODRUČJA TREBINJA

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Vino je jedno od najstarijih i široko rasprostranjenih alkoholnih pića, veoma kompleksnog sastava. Generlno, vino najvećim dijelom čine voda i etanol, dok se ostala jedinjenja javljaju u znatno manjim količinama (kiseline, fenola jedinjenja, minerali, šećeri itd.). U ovom radu, tokom dvije uzastopne godine, ispitivana su osnovna fizičkohemijska svojstva crnog grožđa i vina, kao i antioksidativna i antimikrobna svojstva vina iz područja Trebinja, Bosna i Hercegovina. Vina su proizvedena na standardan način i fizičkohemijska svojstva vina su utvrđena standardnim metodama analiza propisanim od strane Međunarodne organizacije za vinovu lozu i vino (OIV). Rezultati analiza su pokazali, da su godina istraživanja, sorta, kao i njihova interakcija imali snažan uticaj na fizičkohemijska svojstva grožđa. Pored toga, u vinima je određen i sadržaj ukupnih fenola, flavonoida i antocijanina, a za ispitivanje antioksidativne aktivnosti korišteni su FRAP, DPPH i ABTS testovi. Vina proizvedena u 2020. godini pokazala su bolja antioksidativna svojstva u odnosu na vina proizvedena u 2021. godini, a najbolje antioksidativno dejstvo pokazalo je vino Vranac, u kome je registrovan i najviši sadržaj ukupnih fenola. Četiri patogene i uslovno patogene bakterije: *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* i *Bacillus cereus*, patogena kvasnica *Candida albicans* i dvije probiotske kulture: *Lactobacillus plantarum* i *Saccharomyces boulardii* korišćene su za testiranje antimikrobne aktivnosti vina. Sva ispitivana vina su pokazala slično antimikrobno dejstvo.

Ključne riječi: vino, fizičkohemijska, antioksidativna i antimikrobna svojstva

IV/P7

PHYSICOCHEMICAL, ANTIOXIDATIVE AND ANTIMICROBIAL PROPERTIES OF RED WINES FROM THE TREBINJE AREA

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Wine is one of the oldest and widespread alcoholic beverages, with a very complex composition. In general, wine is mostly composed of water and ethanol, while other compounds appear in much smaller amounts (acids, phenolic compounds, minerals, sugars, etc.). In this paper, during two consecutive years, the basic physicochemical properties of red grapes and wine, as well as the antioxidant and antimicrobial properties of wine from the Trebinje area, Bosnia and Herzegovina, were investigated. The wines were produced in a standard way and the physicochemical properties of the wine were determined by standard methods of analysis recommended by the International Organisation of Vine and Wine (OIV). The results of the analysis showed that the year of research, the variety, as well as their interaction had a strong influence on the physicochemical properties of grapes. In addition, the content of total phenols, flavonoids and anthocyanins was determined in the wines, and the FRAP, DPPH and ABTS tests were used to examine the antioxidant activity. Wines produced in the vintage 2020. showed better antioxidant properties compared to wines from the vintage 2021, and the best antioxidant effect was shown by the Vranac wine in which the highest content of total phenols was also registered. Four pathogenic and conditionally pathogenic bacteria: *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus* and *Bacillus cereus*, pathogenic yeast *Candida albicans* and two probiotic cultures: *Lactobacillus plantarum* and *Saccharomyces boulardii* were used to test the antimicrobial activity of wine. All tested wines showed a similar antimicrobial effect.

Keywords: wine, physicochemical, antioxidant and antimicrobial properties

IV/P8

HEMIJSKI SASTAV I SENZORNE KARAKTERISTIKE BELOG VINA IZ KONVERZIJE U BELOPALANAČKOM VINOGORJU

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Kada govorimo o kvalitetu vina prevashodno se misli na njegove senzorske karakteristike (boja, bistrina, miris, ukus, harmoničnost) što predstavlja njegov spoljašnji kvalitet. Međutim, postoji i čitav niz unutrašnjih činilaca kvaliteta vina poput hemijskog sastava, nutritivnog sastava, tržišno-potrošačkog i zakonodavno-pravnih činilaca kvaliteta, a od posebnog značaja su higijensko-sanitarni činioci kvaliteta. Kada je reč o njima, sa aspekta konvencionalne proizvodnje vina najznačajniji činilac su rezidue pesticida, a kada govorimo o organskom vinogradarstvu, biodinamičkom, prirodno integrisanom, od značaja su količine biogenih amina, teških metala i mikotoksina. Cilj rada bio je utvrditi hemijski sastav i senzorske karakteristike vina, dobijenih iz konverzije vinograda pod sortama grožđa vinove loze Tamjanika bela i Sovinjon beli u Belopalanačkom vinogorju. Dobijeni rezultati ukazuju da su sadrzaji histamina, ohratoksina A, pesticida i teških metala (arsen, kadmijum, živa, olovo i bakar) u okviru granica propisanih važećim pravnim aktima. Može se zaključiti da je senzorna analiza pokazala da se vino dalje može usavršavati po pitanju pronalaženja rešenja za poboljšanje mirisnih i ukusnih karakteristika.

Ključne reči: konverzija, histamin, ohratoksin A, pesticidi

Zahvalnica: Ovaj rad je podržan od strane Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije kao i Poljoprivrednog fakulteta Univerziteta u Beogradu (Broj projekta 451-03-65/2024-03/200116).

IV/P8

THE CHEMICAL COMPOSITION AND SENSORY PROPERTIES OF WHITE WINE FROM VINEYARDS IN CONVERSION FROM THE BELA PALANKA WINE REGION

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When we talk about the quality of a wine, we primarily mean its sensory characteristics (color, clarity, smell, taste, balance), which represent its external quality. However, there is a whole range of internal factors of wine quality such as chemical composition, nutritional composition, market and consumer quality factors, legislative and legal factors and hygienic-sanitary quality factors that are of particular importance. In terms of conventional wine production, the most important factors are pesticide residues, but in terms of organic, biodynamic and naturally integrated viticulture, the levels of biogenic amines, heavy metals and mycotoxins are important. The aim of this study was to determine the chemical and sensory properties of Tamjanika and Sauvignon Blanc white wines from vineyards in the Bela Palanka wine region. The results obtained show that the content of histamine, ochratoxin A, pesticides and heavy metals (arsenic, cadmium, mercury, lead and copper) is within the limits prescribed by current legislation. The sensory analysis has shown that the wine can be further improved by finding solutions to enhance its aromatic and flavor characteristics.

Keywords: conversion, histamine, ochratoxin A, pesticides

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IV/P9

UTICAJ PANDEMIJE COVID-19 NA TRGOVINU VOĆEM I POVRĆEM U REPUBLICI SRBIJI

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Izvoz voća iz Republike Srbije u 2023. godini je iznosio oko 407 miliona kilograma, odnosno 770 miliona EUR, što je po vrednosti manje nego u prethodne dve godine, ali više u odnosu na period pre pojave pandemije COVID-19. Količina izvezenog voća u periodu 2018-2023, pre, u toku i posle pandemije ima opadajući trend. Najvažniji izvozni proizvod je smrznuta malina i bobičasto voće, sa udelom od oko 40% u ukupnom izvozu voća. Najvažniji spoljnotrgovinski partneri su Nemačka, Francuska i Belgija. Jabuke su najvažniji sveži izvozni proizvod sa udelom od 14% ali sa tendencijom smanjenja. Ruska Federacija je glavno izvozno trziste za jabuke. Cilj ovog rada je da utvrdi uticaj pandemije COVID-19 na trgovinu voćem u Republici Srbiji. Posmatran je period 2018-2023, a korisćeni su podaci o spoljnoj trgovini HS-6. Rezultati analize pokazuju da je došlo do smanjenja izvezenih količina. Prosečna izvozna cena je rasla u posmatranom periodu, što je uticalo na blaže smanjenje vrednosti izvoza. Pandemija COVID-19 je negativno uticala na trgovinske tokove, čiji su se efekti jače osetili sa zakašnjenjem. Značaj glavnih inostranih kupaca voća iz Republike Srbije se menja, što nije isključiva posledica pandemije COVID-19.

Ključne reči: voće, Republika Srbija, izvoz, Pandemija COVID-19

IV/P9

SERBIAN FRUIT AND VEGETABLES TRADE AND THE COVID-19 PANDEMIC

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The export of fruit from the Republic of Serbia in 2023 amounted to about 407 million kilograms, i.e. 770 million EUR, which is less in value than in the previous two years, but more compared to the period before the onset of the COVID-19 pandemic. The amount of exported fruit in the period 2018-2023, before, during and after the pandemic, has a decreasing trend. The most important export product is frozen raspberries and berries, with a share of about 40% in total fruit exports. The most important foreign trade partners are Germany, France and Belgium. Apples are the most important fresh export product with a share of 14%, but with a decreasing tendency. The Russian Federation is a major export market for apples. The aim of this paper is to determine the impact of the COVID-19 pandemic on the fruit trade in the Republic of Serbia. The period 2018-2023 was observed, and data on foreign trade HS-6 were used. The results of the analysis show that there was a decrease in exported quantities. The average export price grew in the observed period, which had an effect on a milder decrease in the value of exports. The COVID-19 pandemic had a negative impact on trade flows, the effects of which were more strongly felt with a delay. The significance of the main foreign buyers of fruit from the Republic of Serbia is changing, which is not the sole consequence of the COVID-19 pandemic.

Keywords: fruit, Serbia, export, COVID-19

IV/P10

PRINOSNA VREDNOST KAO POKAZATELJ EKONOMSKE OPRAVDANOSTI INVESTIRANJA U PODIZANJE ZASADA ORAHA

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Zasad oraha je dugoročna investicija koja iziskuje visoka finansijska ulaganja pri zasnivanju, a u odnosu na druge voćne vrste karakteriše se dužim uzgojnim periodom i srazmerno dugim periodom eksploatacije. Investiranje u podizanje zasada povlači brojne rizike od kojih su važniji: finansijski, proizvodni, tržišni i sl. Cilj istraživanja u ovom radu je analiza ekonomske opravdanosti investiranja i mogućeg izbegavanja ili ublažavanja finansijskog rizika. Na osnovu proizvodno-ekonomskih parametara podizanja i eksploatacije zasada u praksi poljoprivredne proizvodnje u Srbiji za tzv. bugarski orah, sastavljen je model zasada na površini od 10 ha. Planirani period uzgoja je pet godina, period eksploatacije je 35 godina i prosečan prinos je 3,2 t/ha. Pored planiranog prinosa ploda oraha, procenjena je vrednost drvne mase koja se može očekivati posle odbitka troškova seče i krčenja zasada. Prema naturalnim iznosima inputa i autputa i odgovarajućim tržišnim cenama, utvrđena su novčana primanja i izdavanja po godinama za ceo investicioni period. Uz kamatnu stopu od 8% i primenom postupka eskontovanja i diskontovanja, izračunate su uzgojna i prinosna vrednost zasada, kao gornja granica ekonomski prihvatljivih ulaganja.

Ključne reči: zasad oraha, vrednovanje, ekonomska opravdanost

Zahvalnica: Istraživanje je deo nacionalnog projekta br. 451-03-65/2024-03/200116.

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CAPITALIZED VALUE AS AN INDICATOR OF THE ECONOMIC JUSTIFICATION OF INVESTING IN RAISING WALNUT PLANTATION

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Walnut plantation is a long-term investment that requires high financial investments at the time of establishment, and compared to other fruit species, it is characterized by a longer growing period and a relatively long period of exploitation. Investing in raising plantation involves numerous risks, of which the most important are: financial, production, market, etc. The aim of the research in this paper is to analyze the economic justification of investment and the possible avoidance or mitigation of financial risk. Based on the production and economic parameters of raising and exploiting plantation in the practice of agricultural production in Serbia for the so-called Bulgarian walnut, a model of plantation on an area of 10 ha was created. The planned planting period is five years, the exploitation period is 35 years, and the average yield is 3.2 t/ha. In addition to the planned yield of walnuts, the value of the wood mass that can be expected after deducting the costs of felling and clearing plantation was estimated. According to the natural amounts of inputs and outputs and corresponding market prices, cash receipts and issuances were determined by year for the entire investment period. With an interest rate of 8% and applying the discounting and discounting procedure, the cultivation and capitalized value of plantation were calculated, as the upper limit of economically acceptable investments.

Keywords: walnut plantation, valuation, economic justification

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IV/P11

STANJE I TENDENCIJE U PROIZVODNJI VAŽNIJIH VOĆNIH VRSTA U REPUBLICI SRBIJI

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Voćarstvo predstavlja značajnu granu poljoprivrede koja doprinosi povećanju nacionalnog dohotka, razvoju industrije i trgovine, kao i izvoza Republike Srbije. Cilj rada je analiza kretanja proizvodnih indikatora važnijih voćnih vrsta u Republici Srbiji, u vremenskom periodu od 2005. do 2021. godine. Analiza podataka izvršena je korišćenjem metoda deskriptivne statistike u koje spadaju aritmetička sredina, interval varijacije, koeficijent varijacije, i godišnja stopa promene. Svi podaci za izračunavanje indikatora proizvodnje preuzeti su sa zvaničnih internet stranica Republičkog zavoda za statistiku Srbije. Rezultati istraživanja pokazuju da je u ispitivanom periodu, prosečno učešće površina pod voćnjacima u ukupno korišćenim poljoprivrednim površinama iznosilo 4,88% i ispoljava tendenciju neznatnog povećanja. Iako je šljiva po površinama i dalje dominantna vrsta, u periodu od 2005. do 2021. godine površine pod ovom voćnom vrstom su se smanjivale po prosečnoj godišnjoj stopi od -0,83%. S druge strane, površine pod jabukom, malinom i višnjom su povećane po prosečnim godišnjim stopama 1,61%, 3,34% i 1,12% respektivno. U cilju povećanja proizvodnje voća u našoj zemlji, za šta postoje realne mogućnosti, s obzirom na povoljne prirodne uslove za gajenje gotovo svih kontinentalnih vrsta voćaka, potrebno je, pored povećanja površina pod voćnjacima, uvođenje savremenih tehnologija gajenja.

Ključne reči: voće, proizvodni indikatori, Republika Srbija

Zahvalnica: Rad je nastao kao rezultat istraživanja u okviru "Ugovora o prenosu sredstava za finansiranje naučnoistraživačkog rada zaposlenih u nastavi na akreditovanim visokoškolskim ustanovama u 2024. godini, evidencioni broj ugovora: 451-03-65/2024-03/200116".

IV/P11

THE CURRENT STATEAND TRENDS IN THE PRODUCTION OF THE MAIN FRUIT SPECIES IN THE REPUBLIC OF SERBIA

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Fruit growing is an important branch of agriculture that contributes to the increase of national income, the development of industry and trade and the export of the Republic of Serbia. The aim of the work is to analyze the development of production indicators of the main fruit crops in the Republic of Serbia in the period from 2005 to 2021. The data analysis was carried out using methods of descriptive statistics, which include the arithmetic mean, variation interval, coefficient of variation and annual rate of change. All data for the calculation of production indicators were taken from the official website of the Statistical Office of the Republic of Serbia. The results of the study show that the average share of fruit-growing areas in the total utilized agricultural area amounted to 4.88% in the period under study, with a slight tendency to increase. Although plums are still the dominant fruit species in terms of area, the area under this fruit species declined at an average annual rate of -0.83% between 2005 and 2021. In contrast, the area under apples, raspberries and sour cherries increased at average annual rates of 1.61%, 3.34% and 1.12% respectively. In order to increase fruit production in our country, for which there are certainly opportunities given the favorable natural conditions for the cultivation of almost all continental fruit species, it is necessary not only to increase the area under cultivation, but also to introduce modern cultivation technologies.

Keywords: fruit, production indicators, Republic of Serbia

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