

# 53. hrvatski i 13. međunarodni simpozij agronoma: zbornik sažetaka

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**Brmež, Mirjana; Puškarić, Josipa; Siber, Tamara; Raspudić, Emilija;  
Varga, Mirela; Poporivć, Brigita; ...,; Đurđević, Boris; Jug, Irena; Jug,  
Danijel; ...**

**Edited book / Urednička knjiga**

*Publication status / Verzija rada:* **Published version / Objavljena verzija rada (izdavačev PDF)**

*Publication year / Godina izdavanja:* **2018**

*Permanent link / Trajna poveznica:* <https://urn.nsk.hr/urn:nbn:hr:151:277791>

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*Download date / Datum preuzimanja:* **2024-06-30**



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53<sup>rd</sup> CROATIAN AND 13<sup>th</sup> INTERNATIONAL  
**SYMPOSIUM ON**



**AGRICULTURE**

ZBORNİK SAŽETAKA  
BOOK OF ABSTRACTS

Croatian <sup>53</sup>  
*sa*  
2018 <sup>13</sup>  
International  
Symposium on  
Agriculture

Izdavač | Published by **Poljoprivredni fakultet  
Sveučilišta Josipa Jurja Strossmayera u Osijeku  
Faculty of Agriculture,  
University Josip Juraj Strossmayer in Osijek**

Za izdavača | Publisher **Krunoslav Zmaić**

Glavni urednici | Editors in Chief **Vlatka Rozman  
Zvonko Antunović**

Tehnički urednici | Technical  
Editors **Željka Klir  
Josipa Puškarić  
Ivana Varga  
Daniel Haman  
Darko Kerovec**

Oblikovanje | Design by **Ras Lužaić**

Tisak | Print by **VIN Grafika**

ISSN **2459-5551**

53. HRVATSKI I 53<sup>rd</sup> CROATIAN AND  
13. MEĐUNARODNI 13<sup>th</sup> INTERNATIONAL  
SIMPOZIJ SYMPOSIUM ON  
AGRONOMA AGRICULTURE

18. – 23. veljače 2018. | Vodice | Hrvatska  
18 – 23 February 2018 | Vodice | Croatia

**ZBORNİK SAŽETAKA** | **BOOK OF ABSTRACTS**

Vodice, OLYMPIA Sky

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**53. hrvatski i 13. međunarodni simpozij agronoma**

**18. do 23. veljače 2018., Vodice, Hrvatska**



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**53<sup>rd</sup> Croatian & 13<sup>th</sup> International Symposium on Agriculture**

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# SADRŽAJ | CONTENTS

## 00

### Plenarna izlaganja Plenary section

Ricardo A. Azevedo.....	1
<b>New approaches and challenges to study plant responses to heavy metals</b>	
Zed Rengel.....	3
<b>Producing healthy food: biofortification of cereal crops with zinc</b>	

## 01

### Agroekologija, ekološka poljoprivreda i zaštita okoliša Agroecology, Organic Agriculture and Environment Protection

Mirjana Brmež, Josipa Puškarić, Tamara Siber, Emilija Raspudić, Mirela Varga, Brigita Popović.....	7
<b>Influence of liquid chicken manure preparation on soil health and agrochemical properties</b>	
Marko Černe, Igor Palčić, Igor Pasković, Nikola Major, Marija Romić, Marina Diana Igrc, Aleksandra Perčin, Smiljana Goreta Ban, Benjamin Zorko, Branko Vodenik, Denis Glavič Cindro, Dean Ban .....	8
<b>Razina metala u tragovima i radionuklida u komunalnom mulju te njegova primjena u poljoprivredi</b> <b>Trace metals and radionuclide levels in municipal sludge and its utilization in agriculture</b>	
Marija Ćaćić, Željka Zgorelec, Darija Bilandžija, Aleksandra Perčin, Milan Mesić, Mihaela Blažinkov .....	10
<b>Does mineral and organic fertilization affect CO<sub>2</sub> emissions and soil quality?</b>	
Boris Đurđević, Irena Jug, Danijel Jug, Vesna Vukadinović, Bojan Stipešević, Bojana Brozović .....	11
<b>Mjerenje respiracije CO<sub>2</sub> brzom metodom na kiselim tlima tretiranim biougljenom</b> <b>Measuring CO<sub>2</sub> respiration rate using rapid method on acid soils treated with biochar</b>	
Nilda Ersoy, Serpil Yilmaz, İbrahim Yilmaz .....	13
<b>Determination of pesticide residues for lemon (<i>Citrus limon</i> L.) cultivars grown by good agricultural practices (GAP)</b>	
Tanja Gotlin Čuljak, Ivan Juran, Dinka Grubišić, Karla Lovasić, Dora Sabolović .....	14
<b>Utjecaj cvjetnih pojaseva na brojnost oprašivača, humifikatora i epigejske faune</b> <b>Impact of flower strips on pollinators, earthworms and epigeic fauna population</b>	
Vladimir Ivezić, Meri Engler, Brigita Popović, Zdenko Lončarić, Tihana Teklić, Ružica Lončarić.....	16
<b>Agroekološki i ekonomski aspekti primjene novih kalcizacijskih materijala</b> <b>Agroecological and economical aspects of application of new liming materials</b>	
Danijela Jungić, Stjepan Husnjak, Vida Vladimir.....	18
<b>Degradacija kemijskih značajki tla unutar zone zahvata autoceste Zagreb-Split u Hrvatskoj</b> <b>Degradation of soil chemical properties within the area impact of Zagreb-Split highway in Croatia</b>	
Drago Kraljević, Pavo Baličević, Tomislav Pandurović.....	20
<b>Održivost razvoja uporabe dizelskih goriva u uvjetima ekološkog razvoja energetike</b> <b>The sustainability of the Diesel fuel usage under ecological conditions of the development of energetics</b>	

Pavo Lucić, Vlatka Rozman, Anita Liška, Renata Baličević, Marija Ravlić, Ivan Paponja.....	22
<b>Insekticidna učinkovitost mješavine lavandina i inertnih prašiva na žitnog kukuljičara</b> <b><i>Rhyzopertha dominica</i> (Fab.)</b> <b>Insecticidal efficacy of combination of lavandin and inert dusts against lesser grain borer</b> <b><i>Rhyzopertha dominica</i> (Fab.)</b>	
Ivica Ljubičić, Magdalena Bilušić.....	24
<b>Fotointerpretacija arhivskih ortofoto snimaka na području općine Poličnik</b> <b>Photointerpretation of archival orthophoto of the Poličnik area</b>	
Ivica Ljubičić, Marija Horvat.....	26
<b>Modeliranje ekološke niše za ljekovitu kadulju (<i>Salvia officinalis</i> L.)</b> <b>Ecological niche modeling of kitchen sage (<i>Salvia officinalis</i> L.)</b>	
Nikola Major, Mia Brkljača, Igor Palčić, Marko Černe, Igor Pasković, Smiljana Goreta Ban, Zoran Užila, Josipa Perković, Dean Ban.....	28
<b>Utjecaj dodatka komposta i biogljenena na enzimatsku aktivnost crvenice i rendzine</b> <b>The effect of compost or biochar addition on enzymatic activity of terra rossa and rendzina soils</b>	
Josip Mikuš, Sara Roje, Ana Bratoš Cetinić.....	30
<b>Mikrozooplankton ušća rijeke Neretve</b> <b>Microzooplankton of the estuary of the Neretva river</b>	
Francesco Nugnes, Stefania Laudonia, Antonio Pietro Garonna, Umberto Bernardo, Ahmed El-Kenawy, Angela D'Accolti, Ugo Picciotti, Francesco Porcelli.....	32
<b>The <i>Aleurocanthus spiniferus</i> (OSW) in Europe: a becoming invasive threat to citrus also</b>	
Igor Palčić, Marko Černe, Igor Pasković, Nikola Major, Zoran Užila, Josipa Perković, Danko Cvitan, Smiljana Goreta Ban, Aleksandra Perčin, Marina Diana Igrc, Marija Romić, Dean Ban.....	33
<b>Potencijal komine masline i komunalnog mulja u proizvodnji biogljenena za primjenu u poljoprivredna tla</b> <b>Potential of olive pomace and sewage sludge in the production of biochar for use in agricultural soils</b>	
Marina Palfi, Jasenka Ćosić, Karolina Vrandečić, Helena Tomić-Obrdalj.....	35
<b>Antifungalno djelovanje eteričnih ulja na <i>Botrytis cinera</i> u <i>in vitro</i> uvjetima</b> <b><i>In vitro</i> antifungal activity of essential oils on <i>Botrytis cinerea</i></b>	
Ana Pintar, Dario Jareš, Josip Lakić, Klara Barić.....	37
<b>Biotest za utvrđivanje osjetljivosti šećerne repe na rezidue mezotriona</b> <b>Bioassay for determining susceptibility of sugar beet to mesotrione residues</b>	
Ivica Prpić.....	39
<b>Preciznom poljoprivredom proizvodimo više s manje</b> <b>Precision agriculture produce more with less</b>	
Mario Sraka, Mario Parić, Dubravka Škevin, Jasminka Butorac, Ivica Kisić, Ivan Magdić.....	41
<b>Agroekološki uvjeti uzgoja industrijske konoplje u Hrvatskoj</b> <b>Agroecological conditions related to industrial hemp breeding in Croatia</b>	
Ivana Šestak, Milan Mesić, Ivica Kisić, Željka Zgorelec, Aleksandra Perčin, Darija Bilandžija, Igor Bogunović.....	43
<b>Hiperspektralno snimanje kukuruza u svrhu procjene sadržaja ukupnog dušika i prinosa na razini lista i pokrova</b> <b>Hyperspectral sensing of corn for assessment of N content and grain yield on leaf and canopy level</b>	
Valentina Šoštarčić, Natalija Carin, Marika Turčinov, Klara Barić, Maja Šćepanović.....	45
<b>Klijavost korovne vrste <i>Ambrosia artemisiifolia</i> L. u ovisnosti o lokalitetu sazrijevanja sjemena</b> <b>Germination of <i>Ambrosia artemisiifolia</i> L. from different seed maturation environment</b>	

Marko Vinceković, Snježana Topolovec-Pintarić, Slaven Jurić, Edyta Đermić, Nenad Jalšenjak.....	47
<b>Simultana inkapsulacija bioaktivnih komponenata za ishranu i zaštitu bilja</b> <b>Simultaneous encapsulation of bioactive agents for plant nutrition and protection</b>	
Intissar Zarrouk, Wafa Ghrici, Moktar Dridi, Mohamed Rabeh Hajlaoui.....	49
<b>Efficacy of silicon in the induction of tomato resistance against <i>Botrytis</i> stem canker</b>	
Jolda Zotaj, Arlinda Čači, Joana Kokalari, Alketa Lame, Efrosini Kokalari (Teli), Sadik Cenolli .....	50
<b>Quercetin as green corrosion inhibitor of aluminium</b>	
Ina Živatkauskienė, Arvydas Povilaitis.....	51
<b>Denitrification bioreactors application to order decrease nutrient losses via drained agricultural areas</b>	

## 02 | Agroekonomika i ruralna sociologija / Agricultural Economics and Rural Sociology

Ivana Franjić, Marija Tumpak, Dubravka Živoder .....	55
<b>Važnost brendiranja hrane za ruralni razvoj i turizam Hrvatske</b> <b>Importance of branding food for rural development and tourism in Croatia</b>	
Günay Güngör, İbrahim Yılmaz, Serpil Yılmaz.....	57
<b>Production economics and marketing strategies of wine enterprises as a result of government policies implemented in Turkey</b>	
Ivica Kelam, Drago Kraljević, Stevan Radić .....	58
<b>Povijesni pregled razvoja i procesa regulacije genetički modificiranih usjeva u Republici Hrvatskoj</b> <b>Historical overview of the development and process of regulating genetically modified crops in the Republic of Croatia</b>	
Mirna Leko Šimić.....	60
<b>Food souvenirs: marketing research design</b>	
Lara Liović, Ranko Gantner .....	61
<b>Čepinski kupus u sinergiji znanosti, tradicije i lokalnih potencijala</b> <b>Čepin's cabbage in the synergy of science, tradition and local potentials</b>	
Anton Štern, Darinka Bosnar, Marjana Koren, Sonja Boštjančič, Natalija Brečko .....	63
<b>The economics of investment in a solar power plant</b>	
Anton Štern, Darinka Bosnar, Jurij Gunzek, Jerneja Planinšek Žlof, Magda Guček, .....	64
<b>Self-Sufficiency with Electrical Energy – Net Metering</b>	

## 03 | Genetika, oplemenjivanje bilja i sjemenarstvo / Genetics, Plant Breeding and Seed Production

Jasenska Antunović Dunić, Mario Franić, Lidija Begović, Vlatko Galić, Selma Mlinarić, Domagoj Šimić, Vera Cesar .....	67
<b>Antioksidacijski odgovor kukuruza izazvan viškom kadmija i smanjenom količinom vode</b> <b>Antioxidative response challenged by excess cadmium and water limitation in maize</b>	
Lidija Begović, Mario Franić, Vlatko Galić, Selma Mlinarić, Jasenska Antunović Dunić, Domagoj Šimić, Vera Cesar .....	69
<b>Utjecaj suše i kadmija na sadržaj lignina u korijenu kukuruza</b> <b>Effect of drought and cadmium on lignin content in maize root</b>	

Ivica Buhiniček, Dražen Kaučić, Manuel Velazquez Almaraz, Zdravko Kozić, Jerko Gunjača, Hrvoje Šarčević, Mirko Jukić, Domagoj Stepinac.....	71
<b>Nakupljanje toplinskih jedinica u Hrvatskoj i Meksiku i oplemenjivanje kukuruza</b> <b>Accumulation of heat units in Croatia and Mexico and maize breeding</b>	
Gordana Bukvić, Ranko Gantner, Željka Greger, Natalija Steiner .....	73
<b>Svojstva klijanaca i biljaka engleskog ljujla nakon pet godina skladištenja na različitim temperaturama</b> <b>Seed quality and plant traits of perennial ryegrass after five years of storage at various temperatures</b>	
Peter Dolničar .....	75
<b>New resistant potato varieties at the Agricultural Institute of Slovenia</b>	
Mario Franić, Vlatko Galić, Antun Jambrović, Tatjana Ledenčan, Zvonimir Zdunić, Ivan Brkić, Josip Brkić, Andrija Brkić, Domagoj Šimić .....	76
<b>Broj izvornih oplemenjivačkih populacija u germplazmi kukuruza Poljoprivrednoga instituta Osijek</b> <b>Number of founder breeding populations in maize germplasm of Agricultural institute Osijek</b>	
Sonja Grljušić, Nikolina Šimić, Luka Andrić, Ivica Beraković, Tomislav Duvnjak, Aleksandra Sudarić .....	78
<b>Klijanje i rani rast genotipova soje u različitim uvjetima trajanja osmopriminga</b> <b>Germination and early growth of soybean genotypes under different conditions of osmopriming duration</b>	
Sonja Grljušić, Georg Drezner, Marko Černe, Marko Maričević, Ivica Ikić, Hrvoje Šarčević, Ana Lovrić, Krešimir Dvojković, Marko Ivić, Dario Novoselović .....	80
<b>Učinak GxO interakcije i stabilnost uroda zrna ozime pšenice u Republici Hrvatskoj</b> <b>Effect of GxE interaction and grain yield stability of winter wheat in Republic of Croatia</b>	
Sunčica Guberac, Sonja Petrović, Andrijana Rebekić, Vedran Orkić, Vlado Guberac, Sonja Vila .....	84
<b>Distribucija Dreb 1 gena u germplazmi ozime pšenice</b> <b>Distribution of Dreb 1 genes in winter wheat germplasm</b>	
Ivanka Habuš Jerčić, Maja Žulj Mihaljević, Mara Bogović, Jerko Gunjača.....	84
<b>Razlike u morfološkim i agronomskim svojstvima heljde u različitim uvjetima uzgoja</b> <b>Differences in morphological and agronomic traits of buckwheat in diverse breeding conditions</b>	
Daniela Horvat, Valentina Španić, Marijana Tucak, Georg Drezner, Zvonimir Zdunić .....	86
<b>Procjena parametara pecivne kakvoće pšenice tijekom 2015. i 2016. godine</b> <b>Assessment of wheat bread-making quality during 2015 and 2016</b>	
Goran Jukić, Ivan Varnica, Krešimir Šunjić, Ivica Delić .....	88
<b>Prinos i kakvoća zrna najzastupljenijih sorti pšenice u Republici Hrvatskoj</b> <b>Grain yield and quality of most common wheat varieties in Croatia</b>	
Katarina Jukić, Ivica Ikić, Marko Maričević, Ivan Živković.....	90
<b>Vrijednosti uroda i pokazatelji kvalitete ozime pšenice u proizvodnoj 2016./2017. godini</b> <b>Grain yield and quality indicators of winter wheat in 2016/2017 production</b>	
Mirko Jukić, Zdravko Kozić, Marija Mlinarić, Ivica Buhiniček .....	92
<b>Ispitivanje eksperimentalnih BC hibrida kukuruza u sušnoj 2017. godini</b> <b>Testing of experimental BC maize hybrids in drought 2017</b>	
Yalcin Kaya, Behiye Banu Bilgen, Mehmet Ibrahim Yilmaz, Veli Pekcan, Caglar Colak, Goksel Evcı .....	94
<b>Development of oleic type sunflower inbred lines resistant to broomrape and downy mildew using molecular markers</b>	
Ana Lovrić, Krešimir Đuretec, Ivica Ikić, Marko Maričević, Katarina Jukić, Jerko Gunjača, Hrvoje Šarčević .....	95
<b>Učinak selekcije u F<sub>3</sub> razdvajajućoj generaciji na dormatnost F<sub>7</sub> potomstava kod pšenice</b> <b>The effect of selection in F<sub>3</sub> segregating generation on grain dormancy of F<sub>7</sub> progenies in wheat</b>	

Marko Maričević, Katarina Jukić, Ivica Ikić, Ana Lovrić, Jerko Gunjača, Hrvoje Šarčević.....	97
<b>Dialelna analiza otpornosti ozime pšenice na fuzarijsku palež klasa</b> <b>Diallel analysis of Fusarium head blight resistance in winter wheat</b>	
Maja Matoša Kočar, Aleksandra Sudarić, Sonja Vila, Sonja Petrović, Andrijana Rebekić, Ana Josipović, Antonela Markulj Kulundžić .....	99
<b>Varijabilnost sadržaja izoflavona u domaćim genotipovima soje</b> <b>Variability of isoflavone content in domestic soybean genotypes</b>	
Maja Mazur, Sonja Vila, Ivan Brkić, Tatjana Ledenčan, Domagoj Šimić .....	101
<b>Nenamjerna selekcija na kasniju cvatnju i segregacijska distorzija kod dihaploidnih populacija kukuruza</b> <b>Inadvertent selection for late flowering and segregation distortion in doubled haploid maize populations</b>	
Selma Mlinarić, Mario Franić, Vlatko Galić, Jasenka Antunović Dunić, Lidija Begović, Domagoj Šimić, Vera Cesar .....	1033
<b>Utjecaj kadmija i suše na fotosintetsku učinkovitost u kukuruzu</b> <b>The effect of cadmium and water stress on photosynthetic performance in maize</b>	
Ivan Pejić, Krešo Pandžić, Milan Mesić, Davor Tomšić, Nataša Strelec Mahović, Tanja Likso, Aleksandra Sudarić, Snježana Čavlovićak, Bojan Marković, Goran Jukić, Ivica Buhiniček, Domagoj Stepinac, Mirta Rastija, Dario Iljkić, Vesna Samobor, Gvozden Dumičić, Sara Godena, Marija Pecina, Domagoj Šimić, Hrvoje Šarčević .....	105
<b>Vremenski uvjeti u mikropokusima sa kukuruzom i sojom na 19 lokacija širom Hrvatske u 2017. godini</b> <b>Weather conditions in maize and soybean field micro trials at 19 locations across Croatia in 2017</b>	
Barbara Pipan, Lovro Sinkovič, Aleš Sedlar, Jelka Vozlić-Šuštar, Vladimir Meglič.....	107
<b>Common bean core collection development using Central and South Eastern European germplasm</b>	
Mirta Rastija, Ivica Buhiniček, Antun Jambrović, Bojan Marković, Domagoj Stepinac, Dario Iljkić, Vesna Samobor, Snježana Čavlovićak, Gvozden Dumičić, Sara Godena, Goran Jukić, Saša Vuletić, Dragutin Žibrin, Elvino Šetić, Jerko Gunjača, Domagoj Šimić, Ivan Pejić, Hrvoje Šarčević .....	108
<b>Analiza prinosa hibrida kukuruza u mikropokusima širom Hrvatske u sušnoj 2017. godini</b> <b>Analysis of maize hybrids yield in field micro trials throughout Croatia in dry 2017</b>	
Ivana Rukavina, Ivan Varnica, Goran Jukić, Ivica Delić.....	110
<b>Ovlaštenje za DUS tehničko ispitivanje pšenice i ječma na razini EU</b> <b>Entrustment of DUS technical examination for wheat and barley on EU level</b>	
Aleksandra Sudarić, Snježana Čavlovićak, Ivan Varnica, Goran Jukić, Saša Vuletić, Domagoj Stepinac, Marko Maričević, Dario Iljkić, Mirta Rastija, Vesna Samobor, Gvozden Dumičić, Stipe Ivić, Sara Godena, Jerko Gunjača, Marija Pecina, Hrvoje Šarčević, Ivan Pejić .....	112
<b>Varijabilnost prinosa zrna soje u ovisnosti o genotipu i okolini uzgoja u sušnoj 2017. godini</b> <b>Variability of soybean grain yield in relation to genotype and growing environment in dry 2017 year</b>	
Gordana Šimić, Ivan Abičić, Krešimir Dvojković, Daniela Horvat, Georg Drezner, Alojzije Lalić .....	114
<b>Stupanj modifikacije zrna ječma ozimih i jarih sorti tijekom slađenja</b> <b>Extent of modification of winter and spring barley grain during malting</b>	
Valentina Spanic, Ivan Abicic, Tihana Marcek, Marija Viljevac Vuletic, Daniela Horvat, Bojan Sarkanj.....	116
<b>Mikotoksini Fusarima u sladu pšenice</b> <b>Fusarium mycotoxin on wheat malt</b>	
Sanja Špoljarić Marković, Marijana Böhm, Renata Hanzer.....	118
<b>Uloga i značaj Laboratorija za ispitivanje sjemena, ZSR, HCPHS u sjemenarstvu Republike Hrvatske</b> <b>Role and significance of seed testing Laboratory, ISS, CCAFRA in Croatian seed production</b>	
Marijana Tucak, Svetislav Popović, Tihomir Čupić, Goran Krizmanić, Daniela Horvat .....	120
<b>Procjena parametara kvalitete višegodišnjih krmnih leguminoza</b> <b>Assessment of quality properties of perennial forage legumes</b>	

Monika Vidak, Zlatko Liber, Zlatko Šatović, Martina Grdiša, Klaudija Carović-Stanko .....	122
<b>Izrada sržnih kolekcija hrvatskih genetskih izvora graha</b>	
<b>Development of core collections of Croatian common bean genetic resources</b>	

# 04

## Povrćarstvo, ukrasno, aromatično i ljekovito bilje / Vegetable Growing, Ornamental, Aromatic and Medicinal Plants

Amornnat Thuppia, Pornrut Rabintossaporn, Suphaket Saenthaweesuk, Nuntiya Somparn .....	127
<b>Antioxidative effects of <i>Bauhinia acuminata</i> water extract in rat</b>	
Linda Chularojmontri, Khwandow Kunchana, Thanakorn Surarak, Suvara Wattanapitayakul.....	128
<b>Evaluation of papaya extract on DNA damage and cell signaling in keratinocytes exposed to ultraviolet radiation</b>	
Boris Dorbić, Nikolina Buač, Emilija Friganović, Elma Temim, Ljiljana Nanjara, Alisa Hadžiabulić, Bojan Simovski .....	129
<b>Biološke, ekološke i ukrasne karakteristike javora negundovca (<i>Acer negundo</i> L.) s primjenom na krajobraznim površinama grada Knina</b>	
<b>Biological, ecological and ornamental characteristics of ash-leaf maple (<i>Acer negundo</i> L.) with application on landscape surfaces of the city of Knin</b>	
Boris Dorbić, Sandra Dukić, Emilija Friganović, Margarita Davitkovska, Zvezda Bogevska, Ana Vujošević, Sandra Popović.....	131
<b>Percepcije i stavovi o ukrasnim karakteristikama i primjeni submediteranskog listopadnog drveća u zimskom razdoblju</b>	
<b>Perceptions and attitudes about ornamental characteristics of sub-mediterranean deciduous trees during the winter season</b>	
Dinka Grubišić, Tanja Gotlin Čuljak, Ivan Juran, Valentina Bodiš, Danijela Holcinger .....	133
<b>Repelentno djelovanje biljnih pripravaka na puževe golaće u salati i kupusu</b>	
<b>Repelling effect of herbal preparations on slugs in salad and cabbage</b>	
Ines Han Dovedan, Kim Paliska-Smoković, Miroslav Poje, Lepomir Čoga.....	135
<b>Utjecaj mikorize i gnojidbe na rast i razvoj vrste pelargonija (<i>Pelargonium zonale</i>)</b>	
<b>Influence of mycorrhizae and fertilization on the growth and development of the pelargonium species (<i>Pelargonium zonale</i>)</b>	
Miroslav Lisjak, Marija Špoljarević, Nada Parađiković, Marija Kristić, Marijan Dragičević, Tihana Teklić .....	137
<b>Utjecaj natrijevog hidrogensulfida na fiziološke pokazatelje solnog stresa kod paprike (<i>Capsicum annuum</i> L.)</b>	
<b>Influence of sodium hydrogensulfide on physiological indicators of salt stress in pepper (<i>Capsicum annuum</i> L.)</b>	
Urarat Nanna, Seewaboon Sireeratawong .....	139
<b>Anti-inflammatory activity of <i>Thunbergia laurifolia</i> Lindl. Extract</b>	
Nantawan Soonklang, Suphaket Saenthaweesuk, Nuntiya Somparn, Rungrat Jitvaropas, Amornnat Thuppia, Seewaboon Sireeratawong .....	140
<b>Wound healing activity of <i>Allium ascalonicum</i> Linn. extract in rats</b>	
Igor Palčić, Maja Romić, Marina Diana Igrc, Dean Ban, Marina Lukić, Smiljana Goreta Ban .....	141
<b>Utjecaj udjela herbe i duljine ekstrakcije na sastav vodenog ekstrakta koprive</b>	
<b>Effect of herb content and extraction length on stinging nettle water extract composition</b>	

Igor Pasković, Tomislav Radić, Igor Palčić, Marina Lukić, Dean Ban, Katarina Hančević, Danko Cvitan, Zoran Užila, Smiljana Goreta Ban .....	143
<b>Utjecaj gnojidbe i primjene mikoriznih gljiva na prinos i kvalitetu industrijske rajčice</b> <b>Impact of fertilization and mycorrhizal fungi application on yield and quality of processing tomato</b>	
Josipa Perković, Danko Cvitan, Igor Palčić, Marko Černe, Nikola Major, Smiljana Goreta Ban, Igor Pasković, Dean Ban .....	145
<b>Utjecaj kompostirane komine masline i komunalnog mulja na vegetativne pokazatelje kineskog kupusa</b> <b>Olive pomace and sewage sludge compost affect Chinese cabbage vegetative parameters</b>	
Maja Pintar, Mladen Šimala, Tatjana Masten Milek, Vjekoslav Markotić .....	147
<b>Različite lisne buhe na biljnim vrstama iz porodice Fabaceae u Hrvatskoj</b> <b>Different psyllids on plant species from family Fabaceae in Croatia</b>	
Pornrut Rabintossaporn, Suphaket Saenthaweek, Nuntiya Somparn, Amornnat Thuppia .....	149
<b>A histological study of pancreatic beta cells in streptozotocin –induced diabetic rats treated with <i>Ocimum americanum</i></b>	
Tatjana Prebeg, Sandra Bedran, Ivanka Žutić .....	150
<b>Učinak mehanički izazvanog stresa na presadnice nevena i kadifica</b> <b>The effect of mechanically-induced stress on <i>Calendula officinalis</i>, <i>Tagetes patula</i> and <i>Tagetes erecta</i> transplants</b>	
Borjan Ranilović, Josipa Mikulić, Smiljana Goreta Ban, Ivanka Boras, Monika Zovko .....	152
<b>Primjena infracrvene termografije u detekciji vodnog stresa kod presadnica rajčice</b> <b>Application of infrared thermography for determination of water stress in tomato seedlings</b>	
Tamara Rehak Biondić, Jasna Milanović, Ivan Poje .....	154
<b>Rasprostranjenost i molekularna identifikacija kupusne cistolike nematode (<i>Heterodera cruciferae</i>) u Varaždinskoj županiji</b> <b>Distribution and molecular identification of the cabbage cyst nematode (<i>Heterodera cruciferae</i>) in the Varaždin county</b>	
Suphaket Saenthaweek, Nuntiya Somparn, Rungrat Jitvaropas, Amornnat Thuppia, Seewaboon Sireeratawong .....	156
<b>Effects of <i>Allium ascalonicum</i> Linn. extract on antimicrobial activity in rats</b>	
Lovro Sinković, Barbara Pipan, Aleš Kolmanič, Marijan Nečemer, Filip Šibul, Ivana Nemeš, Aleksandra Tepić, Vladimir Meglič .....	157
<b>Identification and quantification of nutritionally important compounds in different legume species</b>	
Nuntiya Somparn, Veerapol Kukongviriyapan, Suphaket Saenthaweek .....	158
<b>Study on antiproliferative and apoptotic effects of high dose vitamin C in Cholangiocarcinoma cell line</b>	
Branimir Urlić, Marko Runjić, Gvozden Dumičić, Gabriela Vuletin Selak, Maja Jukić Špika, Marija Mandušić, Katja Žanić .....	Error! Bookmark not defined.
<b>Tehnike reduciranog navodnjavanja kod uzgoja cijepljene rajčice</b> <b>Effect of deficit irrigation on grafted tomato cultivation</b>	
Tomislav Vinković, Monika Tkalec, Nada Parađiković, Brigita Popović, Jasna Kraljićak .....	161
<b>Utjecaj lokacije, gnojidbe i biostimulatora na rast i razvoj autohtone baranjske začinske paprike</b> <b>Influence of location, fertilization and biostimulants on growth and development of autochthonous baranyan spice pepper</b>	
Ivana Vitasović Kosić .....	163
<b>Samonikle mediteranske biljke kao tradicionalno povrće - tradicionalno znanje u općini Kršan (Istra, Hrvatska)</b> <b>Wild Mediterranean plants as vegetable food – traditional knowledge in Kršan municipality (Croatia)</b>	



Ana Vujošević, Sandra Popović, Ilinka Pećinar, Đorđe Moravčević .....	165
<b>The effect of indol-3-acetic acid on productive characteristics of bulbous corm flower species</b>	

## 05 | Ratarstvo / Field Crop Production

Darko Jelković .....	169
<b>Kako spriječiti propadanje proizvodnje krumpira u Hrvatskoj</b> <b>How to prevent deterioration of potato production in Croatia</b>	
Nikolina Kajić, Jurislav Babić, Jelena Panak Balentić, Antun Jozinović, Đurđica Ačkar, Borislav Miličević, Marijana Grec, Marija Kovačević-Babić, Drago Šubarić.....	171
<b>Pšenica obogaćena selenom upotrebljena za proizvodnju kukuruznih snack proizvoda</b> <b>Wheat enriched by selenium incorporated in corn snack products</b>	
Vesna Krsteska, Petre Stojanoski .....	173
<b>Management of <i>Helicoverpa armigera</i> on tobacco</b>	
Đuro Lukić, Kristijan Puškarić, Robert Matasović, Zoran Kurtović, Ljiljana Turek.....	174
<b>BC hibridi kukuruza u proizvodnim pokusima u 2017. godini</b> <b>BC maize hybrids in production trials in 2017</b>	
Ronald Mandumbu, Agathar Kamota, Kufa Mutsengi, Cosmas Parwada, Munyati Vincent .....	176
<b>The fall armyworm (<i>Spodoptera frugiperda</i>) damage and management to Zimbabwe farmers: implications to food security</b>	
Valentina Pelivanoska, Biljana Jordanoska .....	177
<b>Investigations on the major production properties of some domestic and introduced oriental tobacco varieties</b>	

## 06 | Ribarstvo, lovstvo i pčelarstvo / Fisheries, Game Management and Beekeeping

Helena Babačić, Tomislav Treer.....	181
<b>Utjecaj lokacije, iskustva, metode lova i vremenskih prilika na rezultate rekreativnog ribolova</b> <b>The influence of location, experience, catching method and weather conditions on the results of recreational fishing</b>	
Ivica Bošković, Andrian Draganić, Tihomir Florijančić, Marin Kalistović, Dražen Degmečić, Siniša Ozimec .....	183
<b>Utjecaj klimatskih faktora na gospodarenje srnećom divljači u državnom otvorenom lovištu XVI/14 Trizlovi - Rastovo</b> <b>Influence of climate factors on the management of roe deer game in the state open hunting ground XVI / 14 Trizlovi - Rastovo</b>	
Nikola Budak, Toni Safner, Ana Gračanin, Krešimir Kavčić, Ivan Gligora, Josip Tomljanović, Nikica Šprem .....	185
<b>Dinamika rasta rogova kod europskog muflona u sjevernojadranskoj regiji</b> <b>The dynamics of the horn growth in European mouflon of North Adriatic region</b>	

Mate Budimir, Tihomir Florijančić, Ivan Cvitković, Renata Potza, Siniša Ozimec .....	187
<b>Lovno gospodarenje u odabranim lovištima Splitsko-dalmatinske županije u razdoblju 2007. – 2017.</b> <b>Hunting management practice in the selected hunting grounds in Split – Dalmatia County in the period 2007 – 2017</b>	
Marica Maja Dražić, Gordana Duvnjak, Vesna Orehovački, Mato Čačić, Janja Filipi .....	189
<b>Utjecaj godine uzgoja na morfološka svojstva reproduktivnih organa matice sive pčele</b> <b>(<i>Apis mellifera carnica</i>)</b> <b>The effect of the breeding year on the morphological traits of the Carniolan honey bee queen</b> <b>(<i>Apis mellifera carnica</i>) reproductive organs</b>	
Dinko Jelkić, Ras Lužaić, Anđelko Opačak, Siniša Ozimec, Karolina Tucak .....	191
<b>Trophy structure of common carp, pike, wels catfish and pike-perch in Drava – Danube fishing zone</b>	
Krešimir Kavčić, Francesca Brivio, Stefano Grignolio, Damir Ugarković, Igor Stankić, Marco Apollonio, Nikica Šprem .....	1922
<b>Mogu li povoljni stanišni uvjeti i hibridizacija između podvrsta predstavljati važan čimbenik u razvoju rogova divokoze?</b> <b>Could favourable habitat conditions and hybridization between subspecies represent an important factor in chamois horn development?</b>	
Svjelana Krstulović Šifner, Dragana Bošnjak, Mirela Petrić, Igor Isajlović, Nedo Vrgoč .....	194
<b>Obilježja dubokomorskog glavonošca <i>Ancistroteuthis lichtensteini</i> u Jadranskom moru</b> <b>Characteristics of the deep-sea cephalopod <i>Ancistroteuthis lichtensteini</i> in the Adriatic Sea</b>	
Abdellah Morsi, Fateh Mimeche, Mohamed Biche .....	196
<b>Population dynamic of Algerian Barbel <i>Luciobarbus callensis</i> (Valenciennes, 1842) (Cyprinidae) in El-Harrach river (North of Algeria)</b>	
Anđelko Opačak, Dinko Jelkić, Ras Lužaić, Ana Kovačić .....	197
<b>Procjena šteta od neprijatelja i štetnika riba u šaranskim ribnjacima</b> <b>Assessment of damage done by fish predators at carp fish farms</b>	
Poljak Milan, Kristijan Tomljanović, Marijan Grubešić, Boris Lazarević, Milan Oršanić .....	1999
<b>Utjecaj raznovrsnosti usjeva i gnojidbe na izbirljivost u prehrani jedinki jelena običnog</b> <b>(<i>Cervus elaphus</i> L.)</b> <b>Effect of crop diversity and fertilization on the selectivity in nutrition of red deer (<i>Cervus elaphus</i> L.)</b>	
Tomislav Šarić, Ivan Župan, Andreja Borec, Nino Perović, Ana Marija Prpić, Branimir Baždarić .....	201
<b>Quality parameters of Novigrad mussels for PDO application</b>	
Serpil Yilmaz, İbrahim Yılmaz .....	202
<b>The Effects of the Policy Implemented in the Aquaculture Sector on the Economic Development in the Context of Sustainability in Turkey</b>	

## 07

## Stočarstvo / Animal Husbandry

Gordana Duvnjak, Dalibor Bedeković, Zlatko Janječić, Ivica Kos, Zlata Kralik, Marica Maja Dražić .....	205
<b>Kvaliteta rasplodnih jaja kokoši hrvaticе</b> <b>Quality of Hrvatica hen breeding eggs</b>	
Danijel Karolyi; Zoran Luković; Krešimir Salajpal; Dubravko Škorput; Ivan Vnućec; Vedran Klišanić; Željko Mahnet; Ana Kaić; Sven Menčik .....	207
<b>Kakvoća trupova i mesa turopoljskih svinja iz uzgoja na otvorenom</b> <b>Carcass and meat quality of <i>Turopolje</i> pigs reared outdoors</b>	

Antun Kostelić, Besi Roić, Branko Šoštarić, Danijel Mulc, Željko Cvetnić, Boris Habrun, Petra Bagović .....	209
<b>Utjecaj iskorjenjivanja artritisa encefalitisa koza na zdravlje stada i tehnologiju uzgoja</b> <b>Influence of CAE eradication on herd health and breeding technology</b>	
Mateja Krga, Šimun Zamberlin, Jasminka Špoljarić, Biljana Radeljević, Iva Horvat Kesić, Martina Pejić, Dijana Plavljanić, Neven Antunac, Nataša Mikulec .....	211
<b>Primjena inovativne i brze metode protočne citometrije za određivanje psihotropnih bakterija u sirovom mlijeku</b> <b>Application of innovative and rapid flow cytometry method for determination of psychotropic bacteria in raw milk</b>	
Zoran Luković, Danijel Karolyi, Krešimir Salajpal, Vedran Klišanić, Dubravko Škorput .....	213
<b>Tovna svojstva banijske šare svinje</b> <b>Fattening traits of Banija spotted pig</b>	
Vladimir Margeta, Kristina Gvozdanović, Goran Kušec, Ivona Djurkin Kušec, Dalida Galović, Žarko Radišić, Polona Margeta .....	215
<b>Zaštita mesa crne slavonske svinje - fajferice oznakom izvornosti</b> <b>Crna Slavonska pig - fajferica meat protection with designation of origin</b>	
Kristina Matković, Danijel Marušić, Mario Ostović, Srećko Matković, Željko Pavičić, Hrvoje Lucić .....	217
<b>Utjecaj gustoće naseljenosti na pojavu kontaktnog dermatitisa na nogama pilića u tovu</b> <b>Effect of stocking density on the occurrence of contact dermatitis on broiler legs</b>	
Pero Mijić, Tina Bobić, Vesna Gantner, Ante Bagarić, Ante Ivanković.....	219
<b>Mogućnosti proizvodnje goveđeg mesa i mlijeka u Republici Hrvatskoj sustavima ispaše na travnatim površinama</b> <b>Possibilities of production of beef and milk in Croatia in grazing systems on grasslands</b>	
Zvonimir Prpić, Ivan Vnučec, Josip Vrdoljak, Boro Mioč.....	221
<b>Sezonske varijacije proizvodnje i kakvoće kozjeg mlijeka tijekom godina s ekstremno toplim vremenskim prilikama</b> <b>Seasonal variations of production and quality of goat's milk in extremely warm calendar years</b>	
Dragica Šalomon, Polona Margeta, Vedran Klišanić, Sven Menčik, Danijel Karolyi, Željko Mahnet, Dubravko Škorput, Krešimir Salajpal .....	223
<b>Preliminarno istraživanje genetske raznolikosti populacije banijske šare svinje mikrosatelitskim biljezima</b> <b>Preliminary study on genetic diversity of the Banija spotted pig breed using microsatellite markers</b>	
Tomislav Šperanda, Mislav Đidara, Martina Pavlić, Ágnes Petrovics, Marcela Šperanda.....	225
<b>Primjena huminske kiseline kao dodatka hrani u proizvodnji prasadi</b> <b>Humic acid as a feed additive in piglets production</b>	
Milna Tudor Kalit, Iva Dolenčić Špehar, Krešimir Salajpal, Dubravka Samaržija, Samir Kalit.....	227
<b>Recovery of milk fat to Škripavac cheese produced from standardised milk</b>	
Nediljko Ževrnja .....	228
<b>Edukativni centar s tradicijskim pasminama domaćih životinja u park šumi Marjan, Split - realnost ili ne?</b> <b>Educational Centre with traditional breeds of domestic animals in the Park Forest Marjan, Split - reality or not?</b>	

Ivana Alpeza, Ana Jeromel, Luna Maslov, Martina Lipar .....	233
<b>Netipična aroma dozrijevanja (UTA) u hrvatskim vinima; senzorna analiza i sadržaj 2-aminoacetofenona (2-APP) Unypical aging off flavour (UTA) in Croatian wines; sensory detection and content of 2-aminoacetophenone (2-AAP)</b>	
Mia Brkljača.....	235
<b>Apple fruit diameter and daily fruit growth rate at three crop loads</b>	
Darko Cenbauer, Silvio Šimon, Edi Maletić, Zvezdana Marković, Ivana Tomaz, Domagoj Stupić, Željko Andabaka, Darko Preiner .....	236
<b>Utjecaj podloge na sadržaj i sastav organskih kiselina u moštu cv. Graševina (<i>Vitis vinifera</i> L.) Influence of the rootstock on the content and composition of organic acids in must of Graševina cv. (<i>Vitis vinifera</i> L.)</b>	
Kristijan Franin, Nikolina Predovan, Šime Marčelić, Tomislav Kos.....	238
<b>Fauna pipa (Insecta: <i>Curculionidae</i>) u maslinicima na području Zadarske županije Weevils fauna (Insecta: <i>Curculionidae</i>) in olive orchards of Zadar County</b>	
Sara Godena, Dario Ivić, Ivana Dminić Rojnić, Bernardina Hlevnjak Pastrovicchio .....	240
<b>Istraživanje pojave sušenja masline u Istri A survey on olive decline in Croatian Istria</b>	
Irena Gregurec – Tomiša, Božena Barić .....	242
<b>Istraživanje brojnosti cikade <i>Scaphoideus titanus</i> Ball i zlatne žutice vinove loze u Koprivničko – križevačkoj županiji The research of the number of leafhopper <i>Scaphoideus titanus</i> Ball and Flavescence doree symptoms in Koprivnica – Križevci County</b>	
Dunja Halapija Kazija, Bernardica Milinović, Tvrtko Jelačić, Danijel Čiček, Predrag Vujević.....	244
<b>Kvaliteta ploda i kemijske karakteristike sorti jabuka uzgojenih u sustavu održive voćarske proizvodnje Fruit quality and chemical traits of apple varieties grown in sustainable production system</b>	
Ivana Horvat, Sanja Radeka, Tomislav Plavša, Urska Vrhovsek, Domen Škrab, Igor Lukić.....	246
<b>Effect of tannin addition on the efficacy of bentonite fining and the quality of Malvazija istarska (<i>Vitis vinifera</i> L.) wine</b>	
Tvrtko Jelačić, Bernardica Milinović, Dunja Halapija Kazija, Danijel Čiček, Predrag Vujević.....	247
<b>Senzorska procjena sušenih plodova sorti šljive podvrgnutih kemijskim i mehaničkim predtretmanima Sensory evaluation of dried plum fruits treated with chemical and mechanical pre-treatments</b>	
Ana Jeromel, Ana-Marija Jagatić Korenika, Željko Andabaka, Ivana Tomaz .....	249
<b>Aromatski profil vina različitih crnih sorata (<i>V. vinifera</i> L.) dozrijevanih u hrastovim bačvama Volatile profile of red wines from different grape varieties (<i>V. vinifera</i> L.) aged in oak barrels</b>	
Jasminka Karoglan Kontić, Željko Andabaka, Domagoj Stupić, Zvezdana Marković, Darko Preiner, Edi Maletić, Ivana Tomaz, Mirela Osrečak, Marko Karoglan .....	251
<b>Promjene u sastavu i sadržaju antocijana tijekom faze dozrijevanja grožđa Changes in composition and content of anthocyanin during the ripening phase of grapes</b>	

Bernard Kozina , Josip Volarević , Vesna Kostanjevečki .....	253
<b>Utjecaj duljine trajanja maceracije na kemijski sastav i kakvoću vina sorte 'Plavac mali' (<i>V. vinifera</i> L.)</b>	
<b>Influence of the maceration time lenght on the chemical composition and wine quality of 'Plavac mali' variety (<i>V. vinifera</i> L.)</b>	
Toni Kujundžić, Mato Drenjančević, Davor Kralik, Tomislav Vidaković, Dejan Bošnjak, Vladimir Jukić .....	255
<b>Energetska vrijednost i godišnji prirast drvene mase nekih kultivara vinove loze (<i>Vitis vinifera</i> L.) na različitim podlogama</b>	
<b>Energy value and annual increment of some varieties of grapevine (<i>Vitis vinifera</i> L.) on different rootstocks</b>	
Vanja Lach, Zdenko Lončarić, Martina Skendrović Babojelić .....	257
<b>Utjecaj kalcija na fizikalno-kemijska svojstva plodova trešnje 'Regina' i 'Sweetheart'</b>	
<b>Effect of calcium on physicochemical characteristics of sweet cherry fruit 'Regina' and 'Sweetheart'</b>	
Igor Lukić, Marin Krapac, Sara Godena, Mirella Žanetić, Karolina Brkić Bubola, Marina Lukić, Marta Stranić, Ivana Horvat.....	259
<b>Comparison of Istrian and Dalmatian virgin olive oils based on aroma and phenol profiles</b>	
Kristine Margaryan, Mato Drenjančević, Vladimir Jukić, Toni Kujundžić, Gagik Melyan, Rouben Aroutiounian .....	260
<b>A retrotransposon-inserted <i>VvmybA1a</i> allele analysis of Armenian and Croatian grapevines</b>	
Gayane Melyan, Aghvan Sahakyan, Kima Dangyan, Andranik Barsegyan, Arayik Vardanyan.....	261
<b><i>In vitro</i> propagation of <i>Vitis vinifera</i> L. variety 'Yereskheni'</b>	
Ines Mihaljević, Krunoslav Dugalić, Dominik Vuković, Vesna Tomaš, Marija Viljevac Vuletić.....	262
<b>Preliminarni rezultati o utjecaju mehaničkog prorjeđivanja cvjetova na urod i kvalitetu ploda šljive</b>	
<b>Preliminary results on the effect of mechanical bloom thinning on yield and fruit quality in plum fruits</b>	
Bernardica Milinović, Dunja Halapija Kazija, Predrag Vujević, Tvrtko Jelačić, Danijel Čiček.....	264
<b>Sastav fenola u svježem plodu, sušenom plodu i soku tradicionalnih i otpornih sorti jabuka uzgojenih u intenzivnom sustavu proizvodnje</b>	
<b>Phenol content in fresh and dried fruit and juice of traditional and resistant apple varieties grown in intensive production system</b>	
Ivana Pajač Živković, Božena Barić, Gabrijel Seljak, Boris Duralija, Darija Lemić, Aleksandar Mešić .....	266
<b>Razvoj octenih muha (Diptera, Drosophilidae) u plodovima različitih sorata jagode</b>	
<b>The development of Drosophilid species (Diptera, Drosophilidae) in different strawberry cultivars</b>	
Marina Pavlović, Jelena Lončar, Željko Jakopović, Jadranka Frece, Ksenija Markov, Slaven Zjalić .....	268
<b>Prisutnost okratoksigenih gljivica u vinogradima Sjeverne i Srednje Dalmacije</b>	
<b>The presence of ochratoxigenic fungi in vineyards of North and Central Dalmatia</b>	
Darko Preiner, Zvezdana Marković, Iva Šikuten, Anita Mihovilović, Maja Žulj Mihaljević.....	270
<b>Razvoj sintetskih kimer vinove loze</b>	
<b>Development of Grapevine Synthetic Chimeras</b>	
Ivan Prša, Višnja Vučetić, Maja Telišman Prtenjak, Branimir Omazić, Željka Prša, Marko Karoglan, Ivana Vladimira Petric, Silvio Šimon .....	272
<b>Klimatski uvjeti Primorske Hrvatske i njihov utjecaj na sortu Plavac mali</b>	
<b>Climate conditions in Coastal Croatia and theirs influence on grapevine variety Plavac mali</b>	
Aleksandar Stanisavljević, Ivna Štolfa, Marija Špoljarević, Dejan Bošnjak, Ana Vuković, Rosemary Vuković, Branka Viljanac, Tihana Teklić .....	274
<b>Antioksidativni odgovor na NaOCl i pH u presadnicama malina iz TIB sustava</b>	
<b>Antioxidant response to NaOCl and pH in raspberries transplants from TIB System</b>	

Jasna Rumora.....	276
<b>Potencijal rasta, rodnosti i kvalitete grožđa cv. 'Plavac mali' (<i>Vitis vinifera</i> L.) u uvjetima melioriranog krša</b>	
<b>The potential growth, yield and grape quality cv. 'Plavac mali' (<i>Vitis vinifera</i> L.) under conditions of meliorated karst</b>	
Iva Šikuten, Zvezdana Marković, Darko Preiner, Darko Vončina, Domagoj Stupić, Željko Andabaka, Jasminka Karoglan Kontić, Edi Maletić.....	278
<b><i>In vitro</i> razmnožavanje i krioprezervacija virusima zaraženih genotipova vinove loze</b>	
<b><i>In vitro</i> propagation and crypreservation of virus infected grapevine cultivars</b>	
Josip Tadić, Frane Strikić.....	280
<b>Digitalni pristup kvantitativnim analizama lista voćnih vrsta</b>	
<b>Digital approach to quantitative fruit leaf analysis</b>	
Vesna Tomaš, Ines Mihaljević, Dominik Vuković, Krunoslav Dugalić, Marija Viljevac Vuletić.....	282
<b>Mogućnosti suzbijanja kruškine buhe</b>	
<b>Possibility of pear psylla control</b>	
Predrag Vujević, Dunja Halapija Kazija, Bernardica Milinović, Tvrtko Jelačić, Danijel Čiček.....	284
<b>Vrednovanje morfološko – pomoloških svojstava sorti jabuka uzgojenih u sustavu održive voćarske proizvodnje</b>	
<b>Assessment of morphological and pomological characteristics of apples produced within the system of sustainable fruit production</b>	





**Plenarna izlaganja**

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## New approaches and challenges to study plant responses to heavy metals

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Heavy metals can be extremely toxic to any living cell. They can cause major disturbances on plant growth. Plants may respond differently to the exposure to heavy metals depending on a number of aspects such as plant species, level of metal accumulation, and stage of development, among others. Some metals may accumulate in seeds or other edible plant parts and in that way enter the food chain. Metals such as copper, nickel, zinc, iron, manganese are essential for all living organisms but become toxic at higher concentrations. Other such as cadmium, aluminum, mercury and lead do not appear to have any essential role in metabolism. Although these elements are present in nature, their concentration in the environment has increased due to anthropogenic activities. Most of the literature produced over the last 20 years has concentrated on studies to understand plant responses to the metal toxicity and to identify the mechanisms that may confer tolerance to such stressful conditions caused by these elements. Some metals have received more attention such as cadmium and aluminum but there is plenty of information for most of them. Studies involving the use of plants such as the metal hyperaccumulators in phytoremediation of contaminated areas have also received a great deal of attention. However, some years now the large majority of papers published are repetitive and do not really add major advances to this topic. It does not mean that such studies are not useful, but there are other aspects that deserve more attention and new technologies that must be used more intensively. For instance, an aspect that appears to need more information is on the uptake and distribution of metals by the plants. Although it seems to be an obvious aspect a more detailed investigation is needed to better understand how different plant species cope with the exposure to varying concentrations of metal possibly pointing to different strategies to deal with the eventual stress caused by the element. In a similar manner, the “Omics” technologies have been used but a lot more can be done, but although promising, the use of such Omics technologies may show that plant responses to abiotic stress are more complicated than initially thought. The identification of QTL’s for metal tolerance is quite interesting in the same way that mutants (and transgenic) plants are being produced for some plant species in order to identify more tolerant lines and by doing this explain the tolerance mechanisms involved as well. Genotoxicity studies are also scarce compared to what is currently present in the literature for other aspects such oxidative stress response. Such approach is important as it identifies the direct damage of a certain metal on chromosomes and cell division. The use of grafting to study stress responses is another elegant possibility that has not been employed in a way it could have been. An interdisciplinary approach should be considered, particularly when considering the complexity of the studies that are now required. It is important to establish not only the precise metal/metalloid that is present in a plant but it is also necessary to know in what form it is present (speciation), the biomolecules to which they are bound and the coordination groups involved. Therefore, studies involving analytical chemistry for chemical speciation and metallomics are necessary. Another aspect that now appears to be fast evolving is the production and characterization of nanoparticles (NPs) and their impact in the environment.

Recently, the use of NPs in commercial products and industrial applications has significantly increased, although understanding the interaction mechanisms at the molecular level between the NPs and the biological systems is clearly lacking. The information that can be further obtained from such type of studies can provide a better understanding of the mechanisms of detoxification, helping us to understand the different molecular **and** cellular mechanisms involved in cell stress responses. These data may be useful in breeding programs or biotechnological alternatives to produce and/or select tolerant plants that may be used in phytoremediation in order to reduce the amount of heavy metals in contaminated areas. (Financial support by FAPESP and CNPq).

**Key words:** *heavy metals, metallomics, metal toxicity, oxidative stress, plant stress response.*

## **Producing healthy food: biofortification of cereal crops with zinc**

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### **Summary**

Zinc is an essential micronutrient for all organisms, including plants and humans. More than 30% of the world's population (about 2.5 billion people) is Zn deficient, causing problems in physical and mental development, immune system suppression, etc., with severe cases resulting in death. While prevalent in developing countries, Zn deficiency in humans occurs in developed countries as well.

Food consumption provides the main route of Zn intake for most people. The plant-based food, particularly from cereal grains, contains low Zn. Concentration of Zn in the plant-based food correlates with available Zn in soil in which plants grew. In soils with low Zn availability, increased Zn content in edible crop parts can be achieved via agronomic and genetic biofortification. Agronomic biofortification includes Zn application to seed (seed priming), soil and/or foliarly. Genetic biofortification is achieved by selecting and breeding cultivars with enhanced capacity to accumulate Zn in edible parts. Using transgenic approaches (eg. overexpressing nicotianamine synthase gene involved in transport of zinc to developing grains) is an effective way to biofortify cereal grains, even though social and political attitudes toward genetic engineering result in prohibition of such crops in some countries. Chromosomal loci associated with Zn remobilization from vegetative tissues into developing grain were characterized, paving the way for identification of molecular markers for improving Zn remobilization into grain to enhance biofortification.

*Key words: biofortification, grain, remobilization, zinc*



**Agroekologija,  
ekološka poljoprivreda  
i zaštita okoliša**

**01**

**Agroecology,  
Organic Agriculture  
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## **Influence of liquid chicken manure preparation on soil health and agrochemical properties**

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### **Summary**

The aim of this study was to determine the influence of liquid chicken manure preparation on nematode biodiversity as indicator of soil health and agrochemical properties. Field experiment was conducted through two years into two treatments with three samplings per year. One treatment was control treatment (C) and other was treated with liquid chicken manure preparation (LCMP). In the first year of this study treatments were carried out in wheat plantation, while in the following year the culture was rapeseed. Results indicate that genus biodiversity was significantly numerous (18% in wheat, 28% in rapeseed) in treatments with LCMP. Indices of disturbance (MI, MI (2-5), PPI/MI) show statistically significant differences through two years indicating ecosystem stability, reduction of phytoparasitic nematodes and the multitude of beneficial nematodes in treatment with LCMP compared to C. Structural index signifies that treatment with LCMP had better soil structure in the first year of study, but statistical significance is noted in the second year. Analysed agrochemical properties highlight the increasement of organic matter by 60% which changed primarily poor soil into humus richer soil. Also, content of P and K heightens in treatment with LCMP compared to C. It can be concluded that the usage of LCMP significantly increases nematode biodiversity in the soil and ecosystem stability while with higher amount of humus, P and K economic inputs are lowered.

**Key words:** *nematode biodiversity, wheat, rapeseed, agrochemical properties*



## Razina metala u tragovima i radionuklida u komunalnom mulju te njegova primjena u poljoprivredi

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### Sažetak

Cilj ovog rada bio je ispitati koncentraciju metala u tragovima i radionuklida u komunalnom mulju s pročištača diljem Hrvatske kako bi se utvrdili parametri za sigurnu primjenu komunalnog mulja u poljoprivrednoj proizvodnji. U uzorcima dehidrirang mulja određene su ukupne koncentracije Cd, Cr i Pb na ICP-OES-u te <sup>238</sup>U i <sup>232</sup>Th primjenom gama spektrometrije. Nadalje, dehidrirani komunalni mulj je kompostiran kako bi se procijenila mogućnost njegovog korištenja kao poboljšivača tla. Rezultati pokazuju da u različitim uzorcima mulja koncentracije Cd variraju od 0,6–0,9; Cr od 15,8–55,7 i Pb od 33,6–57,9 mg kg<sup>-1</sup> s.t., što je obzirom na "Pravilnik o gospodarenju muljem iz uređaja za pročišćavanje otpadnih voda kada se mulj koristi u poljoprivredi" ispod dopuštenog sadržaja teških metala u obrađenom mulju. Sadržaj <sup>238</sup>U je u rasponu od 1,1–4,3 mg kg<sup>-1</sup> s.t. a sadržaj <sup>232</sup>Th je u rasponu od 1,7–7,6 mg kg<sup>-1</sup> s.t. što je na razini prirodno prisutnih koncentracija. Visok sadržaj P, N i organske tvari u komunalnom mulju ukazuje na njegov potencijal kao zamjene za mineralna gnojiva. Međutim, nizak omjer C/N u mulju predstavlja ograničavajući čimbenik u kompostiranju. Temeljem ovih podataka proučavani komunalni muljevi mogu se koristiti na poljoprivrednim površinama s obzirom na ograničenja navedena u Pravilniku. Kompostiranje otpadnog mulja predstavlja obećavajuću strategiju sa ciljem ponovne upotrebe mineralnih hraniva iz navedenog otpada.

**Ključne riječi:** komunalni mulj, metali u tragovima, radionuklidi, poljoprivreda, kompostiranje

## Trace metals and radionuclide levels in municipal sludge and its utilization in agriculture

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### Summary

The aim of this study was to screen the levels of trace metals and radionuclides in the sewage sludge from different sewage treatment plants across the Croatia to establish a baseline data for sludge safe application in agriculture. In the dewatered sewage sludge, the concentrations of Cd, Cr, Pb, <sup>238</sup>U and <sup>232</sup>Th were determined. The metal and radionuclide concentrations were measured using the ICP-OES and gamma-ray spectrometry, respectively. Furthermore, the composting experiment was conducted to evaluate the sludge reuse as soil amendment. The results showed that concentrations of Cd, Cr and Pb in various sludge samples varied from 0.6–0.9, 15.8–55.7 and 33.6–57.9 mg kg<sup>-1</sup> d.w., respectively, which is below the threshold limits according to Croatia's legislative on sewage sludge agricultural use. Concentrations of <sup>238</sup>U and <sup>232</sup>Th, which ranged from 1.1–4.3 and 1.7–7.6 mg kg<sup>-1</sup> d.w., respectively, are in the area of a natural background. A high P, N and organic matter contents in sewage sludge indicates its potential to substitute the mineral fertilizers. In contrast, the low C/N is a limiting factor for the compost production where high demands for carbonaceous materials are essential. According to obtained data it seems that studied sludge waste may be applied to soil considering the legislative-based dose. Composting of sewage sludge may be a promising strategy for nutrient recovery from municipal waste.

**Key words:** *sewage sludge, trace metals, radionuclides, agriculture, composting*

## Does mineral and organic fertilization affect CO<sub>2</sub> emissions and soil quality?

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### Summary

Agricultural sector is one of the major source of CO<sub>2</sub> due to increased decomposition of soil organic matter caused by disturbance various agricultural practices such as fertilization, tillage and irrigation. The objectives of this study were to determine the influence of mineral and organic fertilization in winter wheat agroecosystem on CO<sub>2</sub> respiration and soil quality. Field experiment was conducted in Potok near Popovača, where soil type is drained lowland distric Stagnosols. Investigated period (2016) was characterized by higher annual precipitation than average (+159 mm), higher average annual temperature (+1.5 °C) and real evapotranspiration (+30 mm). Four investigated treatments were OF (organic fertilization – 40 t/ha of solid farmyard mixed manure), MF (mineral fertilization – 300 kg N/ha), C (control treatment) and BF (black fallow). Mean annual values of C-CO<sub>2</sub> flux ranged from 7.8 kg/ha x day (BF) to 21.9 kg/ha x day (OF) and were statistically significant. Annual yield ranged from 1.12 t/ha (C) to 7.37 t/ha (MF) and values were statistically significant (SAS 9.1: p < 0.05). Organic matter content in soil ranged from 1.39 % (C) to 2.80 % (OF). Application of organic and mineral fertilizers and calcification had influence on soil chemical characteristics and daily C-CO<sub>2</sub> flux, but not on average annualy emissions.

**Key words:** soil respiration, calcification, winter wheat, yield, C-CO<sub>2</sub> flux

## Mjerenje respiracije CO<sub>2</sub> brzom metodom na kiselim tlima tretiranim biougljenom

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### Sažetak

Laboratorijske metode za mjerenje respiracije tla kao što je titracijska metoda često su složene i vremenski zahtjevne. Kompanija Solvita® razvila je 24-satnu novu brzu metodu koja se bazira na primjeni pH-osjetljivog gela. On detektira respiraciju CO<sub>2</sub> unutar standardizirane inkubacijske posude u kojoj se nalazi uzorak tla koji se vlaži te tako imitira prirodni ciklus sušenja i vlaženja tla. Nakon 24 h, gel se uklanja iz posude za inkubaciju i analizira na digitalnom elektroničkom čitaču boja te se izražava kao mg CO<sub>2</sub>-C kg<sup>-1</sup> tla. Cilj rada je testirati primjenjivost nove brze metode i utjecaj biougljena na respiraciju tla. Istraživanja respiracije tla provedena su tijekom vegetacijskog razdoblja 2016. godine na kiselim tlima na dvije lokacije u Osječko-baranjskoj i Virovitičko-podravskoj županiji. Uzorkovanje tla provedeno je tri puta tijekom vegetacije kukuruza. Biougljen je bio glavni faktor s tretmanima: kontrola, 5, 10 i 15 t ha<sup>-1</sup> biougljena. Prosječna vrijednost respiracija tla izmjerena na lokaciji u Virovitičko-podravskoj županiji bila je statistički značajno viša od vrijednosti mjerenja provedenog na lokaciji u Osječko-baranjskoj županiji. Također, primjena biougljena u najvišoj dozi, u odnosu na ostale tretmane, nije statistički značajno djelovala na povećanje respiracije CO<sub>2</sub>. Iz provedenih istraživanja može se zaključiti da je biougljen ostao stabilan u tlu, odnosno postignuta je sekvestracija ugljika te da je primijenjena brza metoda mjerenja respiracije CO<sub>2</sub> uvelike ujednačila i pojednostavila laboratorijska mjerenja.

***Ključne riječi:*** CO<sub>2</sub> respiracija tla, kiselina tla, sekvestracija ugljika, biougljen, brza metoda

## Measuring CO<sub>2</sub> respiration rate using rapid method on acid soils treated with biochar

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### Summary

Laboratory methods for soil CO<sub>2</sub> respiration like Base Trap Titration (BTT) method are often time consuming and complicated. Because of this a new method for soil respiration testing is developed by Solvita<sup>®</sup>. The new 24-hour rapid method using a pH-sensitive gel (paddle) measure soil respiration or CO<sub>2</sub> “burst” which is result of controlled drying-rewetting of soil sample that is inside of standardized incubation jar. After 24 h, the paddle is removed from the incubation jar and analyzed with a digital color reader (DCR) and expressed in mg CO<sub>2</sub>-C kg<sup>-1</sup> soil. The aim of the paper is to test the applicability of the new rapid method and the effect of biochar application on the soil respiration. The soil samples were taken three times during 2016 year of experiment on maize field trials. Experiment was set up at two locations on acid soils in Osijek-Baranja, and Virovitica-Podravina County, Croatia. Biochar was the main factor and the treatments were control, 5, 10 and 15 t ha<sup>-1</sup> of biochar. Average CO<sub>2</sub> respiration at location Virovitica-Podravina was significantly higher than the respiration on location Osijek-Baranja. Also, application of biochar in the highest dose has no statistically significant effect on CO<sub>2</sub> respiration increase comparing to other treatments. So, it can be concluded that biochar was stable in soil and achieved carbon sequestration and that rapid method for measuring CO<sub>2</sub> respiration unifies and simplifies laboratory process.

**Key words:** *CO<sub>2</sub> soil respiration, acid soil, carbon sequestration, biochar, rapid method*

## Determination of pesticide residues for lemon (*Citrus limon* L.) cultivars grown by good agricultural practices (GAP)

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### Summary

Lemons are generally different from other citrus species consumed with other foods and have acidic fruits. Lemon juice is useful for health and is a good source of vitamin C, flavonoids and antioxidants. For pre-harvest and post-harvest protection, pesticide use is common in the production of lemons and many chemicals are used to control disease and pests. On the other hand Good Agricultural Practices (GAP) includes agricultural techniques which environmentally-conscious, is not harmful to human and animal health, target protection of natural resources, provide traceability and food security. With these kinds of production techniques, it is aimed at agricultural production which is socially viable, economically profitable and sustainable. This research was carried out in the Aksu District of Antalya to demonstrate the effectiveness of good agriculture practices in the lemon orchard. The varieties taken in the experiment were Enterdonat and Karalimon. In the study, pesticide residue levels were determined in fruit extracts as well as analyzes for water and soil. Extraction steps and all analyzes were carried out at the Proanaliz Food Control Laboratory. High-precision analytical instruments such as LC-MS / MS and GC-MS were used for pesticides residues. A total of 506 pesticide active substances were analyzed in LC-MS / MS and 113 pesticide active substances in GC-MS in fruit extracts. In this research carried out in 2015 and 2016, samples of both years were not found to be detectable to the tolerance values of Turkish Food Codex (TFC).

**Key words:** *lemon, GAP, pesticides, residue, Serik-Antalya*

## Utjecaj cvjetnih pojaseva na brojnost oprašivača, humifikatora i epigejske faune

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### Sažetak

U okviru Zajedničke poljoprivredne politike Europske unije, a u svrhu poboljšavanja funkcionalne bioraznolikosti, uspostavljeni su različiti agroekološki programi. Jedna od mjera jest i uspostava poljskih traka koja poljoprivrednicima omogućava financijsku potporu pri čemu im se plaćaju troškovi provedbe određenih mjera. Poljske trake uključuju cvjetne i travne pojaseve koji osiguravaju sklonište i hranu za korisne organizme (predatore i oprašivače), pružaju stanište za neke vrste ptica, a svaka ima svoju specifičnu ulogu. Cilj ovog istraživanja je utvrditi brojnost i vrste oprašivača, brojnost, vrste i biomasu gujavica te brojnost najvažnijih grupa predatora na implementiranim cvjetnim pojasevima i kontrolnim površinama unutar agroekosustava. Rezultati istraživanja pokazuju značajno veću brojnost oprašivača, humifikatora i epigejske faune (predatora) na zasijanim cvjetnim pojasevima u odnosu na kontrolne površine. Tijekom provedbe istraživanja uočeni su određeni nedostaci u zakonodavstvu te su potrebne određene izmjene pravilnika o provedbi izravne potpore poljoprivredi i mjerama ruralnog razvoja kao i revizija određenih područja u okviru pravilnika.

***Ključne riječi:*** mjere ruralnog razvoja, bioraznolikost, agroekosustav, cvjetni pojasevi

## **Impact of flower strips on pollinators, earthworms and epigaeic fauna population**

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### **Summary**

Within EU Common Agricultural Policy to enhance functional biodiversity, different agroecological programs are established. One of the measure are field strips which allow financial support to producers whereby costs of measures implementation are payed. Field strips include flower and grass strips which provide shelter and food for beneficial organisms (predators and pollinators), offer shelter for birds and each of them has its specific role. The main goal of this research is to determine number and species of pollinators, number, species and biomass of earthworms and number of the most important predator groups on flower strips and control areas within agroecosystem. Results show significantly higher number of pollinators, earthworms and epigaeic predator species on implemented flower strips compared to control areas. During this investigation certain shortcomings in legislation were observed and specific changes on the implementation of direct subsidies and measures of rural development as well as revision of certain areas within directive are needed.

**Key words:** *measures of rural development, biodiversity, agroecosystem, flower strips*



## **Agroekološki i ekonomski aspekti primjene novih kalcizacijskih materijala**

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### **Sažetak**

Za neutralizaciju suvišne kiselosti poljoprivrednih tala sve češće se koriste nusproizvodi iz industrijske proizvodnje. Cilj istraživanja je utvrditi mogućnost primjene tri nova kalcizacijska materijala, nusproizvoda iz industrije: a) drveni pepeo (elektrana na biomasu), b) filterska prašina (nusproizvod iz cementare) i c) bazična troska (nusproizvod iz proizvodnje željeza). Ekološka i ekonomska isplativost novih materijala je uspoređena s karbokalkom kao kalcizacijskim sredstvom dostupnom na tržištu. Na temelju dvogodišnjih vegetacijskih pokusa s lucernom utvrđeno je da su pepeo i filterska prašina jednako uspješni u neutralizaciji suvišne kiselosti kao i karbokalk, dok je bazična troska podigla pH vrijednosti u odnosu na kontrolu, no statistički slabije nego ostala tri kalcizacijska sredstva. Na prinos lucerne je jedino primjena pepela pokazala pozitivan utjecaj. Niti jedan istraživani materijal nije pokazao štetno opterećenje na okoliš. S ekonskog stajališta, na područjima u blizini cementare i elektrane na biomasu filterska prašina i pepeo imaju veći potencijal u odnosu na karbokalk jer je jedan od većih troškova kalcizacije dovoz kalcizacijskog materijala. Dodatna prednost pepela je njegova hranjiva vrijednost koja dodatno može smanjiti potrebe za gnojidbom. Filterska prašina i pepeo se svakako preporučuju kao kalcizacijski materijali uz redovan monitoring stanja tla.

***Ključne riječi:*** bazična troska, filterska prašina, karbokalk, pepeo

## **Agroecological and economical aspects of application of new liming materials**

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### **Summary**

Lately, it has become common to use byproducts from various industries as liming material at agricultural soils. The aim of present research is to determine the possibility of applying three new liming materials, byproducts from the industry: a) wood ash (biomass power plant), b) filter dust (cement factory byproduct) and c) blast-furnace slag (iron and steel making industry). The environmental and economic viability of new materials is compared to the lime material from sugar factory which is already available on the market. Based on the two year vegetation experiments with the alfa-alfa it was found that wood ash and filter dust were equally successful in the neutralizing the excess acidity just as well as the lime material from sugar factory. The blast-furnace slag also raised the pH value in comparison to the control. However, this increase of pH was significantly lower compared to the other three liming materials. Only wood ash had a positive effect on alfalfa yield. None of the investigated materials showed a negative impact on the environment. From the economic standpoint, filter dust and ash have the potential to be used as a liming material in the area near the biomass and cement factories as one of the bigger costs in application of lime is the transportation of liming materials to the fields. An additional advantage of wood ash is its nutritional value which can further reduce the need for fertilization. Filter dust and ash are certainly recommended as liming materials with regular monitoring of soil conditions.

**Key words:** *blast-furnace slag, filter dust, lime, wood ash*

## Degradacija kemijskih značajki tla unutar zone zahvata autoceste Zagreb-Split u Hrvatskoj

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### Sažetak

Ciljevi istraživanja bili su: (1) odrediti sadržaj humusa i reakciju (pH) tla u površinskom (0-10 cm) i potpovršinskom horizontu (10-50 cm) unutar i izvan zahvata autoceste Zagreb-Split, te (2) dati preporuke za popravak oštećenih tala s obzirom na utvrđene promjene navedenih značajki tla. Istraživanja su provedena tijekom 2006. godine na dijelu autoceste Zagreb-Split, od čvora Gospić do tunela Sveti Rok. Ova dionica podijeljena je na 20 lokacija, a svaka lokacija na dvije podlokacije- tlo unutar zone zahvata autoceste (oštećeno tlo) i izvan zone zahvata (izvorno tlo). Sve podlokacije oštećenog tla unutar svake lokacije grupirane su u VI grupa s obzirom na njihov specifičan položaj, tj. način oštećenja. Na većini podlokacija s oštećenim tlima uočene su pojave dehumizacije i zakiseljavanja tla. Sadržaj humusa u oštećenim tlima varirao je u rasponu od 0,5% do 4,3%, na 0-10 cm i od 0,1 do 7,2 % na 10-50 cm dubine, a u izvornim od 2,2 do 9,9% na 0-10 cm i od 0,9 do 9,9% na 10-50 cm dubine tla. Unutar I i II grupe tala (odmorišta i pokosi usjeka), na svakoj lokaciji, u obje dubine tla utvrđene su statistički značajno manje količine humusa u oštećenom tlu u odnosu na izvorno tlo. U III i IV grupi tala (uz zaštitnu ogradu i na padini nasipa) te razlike su statistički značajne samo na dubini 0-10 cm. Reakcija tla (pH) oštećenih tala varirala je od jako kiselog do neutralnog područja (3,76-7,10) dok je u izvornim tlima ona bila jako kisela do kisela (3,74-5,88). S obzirom na pH, između oštećenog i izvornog tla nije bilo statistički značajnih razlika, ali je prisutna varijabilnost između lokacija. U većini oštećenih tala je neophodno provesti mjere humizacije i kalcizacije. Prije i tijekom izgradnje prometnica treba posebnu pažnju posvetiti zaštiti tla.

**Ključne riječi:** oštećenje tla, sadržaj humusa, reakcija tla, autocesta Zagreb-Split

## Degradation of soil chemical properties within the area impact of Zagreb-Split highway in Croatia

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### Summary

The objectives of the study were to: (1) Determine the humus content and the soil reaction (pH) in surface (0-10 cm) and the subsurface soil layer (10-50 cm), inside and outside the area impact of Zagreb-Split highway; (2) give the recommendations about repair of damaged soils due to established changes of the mentioned soil characteristics. Research was carried out in 2006 on the Zagreb-Split highway, in section from Gospić to Sveti Rok tunnel. This section was divided into 20 sites, and each sites on 2 subsites- within the area of the highway (damaged soil) and outside that area (natural soil). All subsites with the damaged soil within each site are classed into VI group with regard to their specific position and the way of damage. At most subsites with damaged soils, the dehumification and acidification of the soil have been observed. The humus content in damaged soils varied from 0.5% to 4.3%, at 0-10 cm depth and from 0.1 to 7.2% at 10-50 cm, and in the natural soils from 2.2 to 9, 9% at 0-10 cm and from 0.9 to 9.9% at 10-50 cm soil depth. Within the I and II groups of soil, (rest areas and slope cuts), at each site and both soil depths, statistically significantly lower humus levels were found in the damaged soil than in the natural soil. In III and IV group of soil (near the barrier ie. on the slope of embankment), these differences are statistically significant only in soil depth 0-10 cm. The soil reaction (pH) of damaged soil varied from very acidic to neutral zone (3.76 to 7.10) while in the natural soils it was very acidic to acid (3.74-5.88). According to the pH there was no statistically significant differences, between the damaged and the natural soil, but there was found variability between sites. In most of the damaged soils it is necessary to spend humication and calcification measures. Prior to and during the road construction, special attention should be paid to soil protection.

**Key words:** soil damage, humus content, soil reaction, highway Zagreb-Split

## Održivost razvoja uporabe dizelskih goriva u uvjetima ekološkog razvoja energetike

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### Sažetak

Uslijed stalnog rasta potrošnje goriva mineralnog podrijetla i znatnog smanjenja podzemnih rezervi nafte, intenzivirana su istraživanja na razvoju uporabe novih bio goriva. Zbog navedenog, izuzetno je interesantno uvođenje obnovljivih goriva. Unatoč tomu najveći broj transportnih te ostalih gospodarskih vozila, kao i znatan broj osobnih vozila i dalje pokreću dizel motori. Cilj rada je istražiti opseg nužnosti dalje primjene goriva mineralnog porijekla u motorima s unutrašnjim izgaranjem tijekom razdoblja razvoja obnovljivih goriva. Dizelsko gorivo se proizvodi iz sirove nafte koja ima ograničene rezerve, nestabilnu cijenu a izgaranjem znatno onečišćuje atmosferu. Nastali štetni plinovi, s visokim sadržajem CO, NO<sub>x</sub> i čestica čađe, povećavaju tzv. efekt staklenika. Da bi se izbjegle negativne posljedice uporabe današnjih konvencionalnih goriva, sve češće se za pogon motora SUI, koriste goriva iz obnovljivih izvora. No uvid u podatke i analiza globalnih kretanja potrošnje nafte pokazuje da će se dinamika iskorištavanja naftnih izvora i dalje povećavati, uslijed naglog razvoja novih ekonomija, kao što su kineska, indijska i druge. Rezultati ovog istraživanja ukazuju na potrebu uvođenja u primjenu takvih obnovljivih goriva biljnog podrijetla koja su po svojim fizikalno-kemijskim svojstvima što sličnija odgovarajućem konvencionalnom gorivu. Tako se dugotrajna ulaganja u razvoj novih vrsta pogonskih motora svode na ulaganja u modifikaciju postojećih motora, radi njihove prilagodbe na rad s zamjenskim biogorivom. Iz navedenog proizlazi nužnost daljeg razvoja motora SUI na pogon biogorivima radi primjene u određenim segmentima transporta. Trenutačno se od biogoriva najviše koriste: biodizelsko gorivo, bioplin, bioetanol, biometanol, biodimetilester, bio-ETBE (etil-tri-butil-eter), bio-MTBE (metil-tri-butil-eter), sintetizirana bio-goriva, bio-vodik, bio-ulje i sl.

***Ključne riječi:*** motori SUI, biogoriva, razvoj dizelskih goriva, ekologija

## **The sustainability of the Diesel fuel usage under ecological conditions of the development of energetics**

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### **Summary**

Due to the steadily growth of fuel consumption which is of mineral origin and significant reduction of underground reserves of oil, research on the development of new biofuels have been intensified. Because of above mentioned, there is huge interest in introducing the renewable fuels. Despite that fact, the largest number of transport and other economy vehicles, as well as a large number of personal vehicles continue to be powered by diesel engines. The aim of this paper is to explore the extent of the necessity for further application of mineral fuels in internal combustion engines during the period of renewable fuel development. Diesel fuel is produced from crude oil that has limited reserves, unstable price and combustion significantly pollutes the atmosphere. The results are harmful gases, with a high content of CO, NO<sub>x</sub> and carbon black particles, which are all increasing the so called - greenhouse effect. In order to avoid the negative consequences of the conventional fuel usage, there is more likely to use renewable fuel for IC engines. But insights into the data and analysis of global oil consumption trends show that the dynamics of oil resource exploitation will continue to increase due to the rapid development of new economies such as Chinese, Indian etc. The results of this research point to the need for introducing renewable fuels of plant origin that are more similar to their corresponding conventional fuel by their physico-chemical properties. Thus, long-term investments in the development of new types of propulsion engines are reduced to investments in modification of existing engines for their adaptation to work with substitute biofuels. The above suggests the necessity for further development of the IC engine in propulsion of biofuels for use in certain transport segments. At present, biofuels are mostly used: biodiesel fuel, biogas, bioethanol, biomethanol, biodimethylester, bio-ETBE (ethyl-tri-butyl ether), bio-MTBE (methyl-tri-butyl ether), synthesized biofuels, bio-hydrogen, bio-oil etc.

**Key words:** *IC engines, biofuels, diesel fuel development, ecology*

## Insekticidna učinkovitost mješavine lavandina i inertnih prašiva na žitnog kukuljičara *Rhizopertha dominica* (Fab.)

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### Sažetak

U sažetku se opisuje laboratorijsko testiranje insekticidne učinkovitosti ekstrakta lavandina *Lavandula x intermedia* (Emeric ex Loisel.) u kombinaciji s dva hrvatska inertna prašiva (D-01 i MA-4) u suzbijanju žitnog kukuljičara *Rhizopertha dominica* (Fab.) na pšenici s dvije doze (300 i 600 ppm) pri ekspoziciji od 7 i 14 dana s ciljem razvoja novih prirodnih insekticida bez negativnog utjecaja na okoliš. Zaprášena pšenica (100 g) s kombinacijom lavandina i inertnih prašiva stavljena je u staklenke volumena 200 ml, nakon čega je introducirano 50 jedinki *R. dominica* različitog spola po tretmanu, starosti 7-21 dan. Svi tretmani su postavljeni kroz četiri ponavljanja. Najviši mortalitet (62,5%) postignut je s kombinacijom lavandina i D-01 pri dozi od 600 ppm nakon 14. dana ekspozicije. Mortaliteti postignuti pri dozi od 600 ppm su statistički značajno viši u odnosu na mortalitete pri dozi od 300 ppm i kontroli kod kombinacije lavandina i D-01 te lavandina i MA-4. U tretmanu s kombinacijom lavandina i MA-4 pri dozi od 300 ppm postignuto je statistički značajno viši mortalitet (9,0%) produljenjem ekspozicije na 14 dana u odnosu na mortalitet (4,5%) postignut nakon 7 dana. Rezultati ukazuju na visoki potencijal kombinacije hrvatskih inertnih prašiva i botaničkih insekticida u suzbijanju *R. dominica*. Potrebno je provesti daljna istraživanja u kombinaciji s drugim biljnim vrstama te istražiti utjecaj na razvoj potomstva. Istraživanja su provedena u sklopu istraživačkog projekta Hrvatske zaklade za znanost IP-11-2013-5570.

**Ključne riječi:** lavandin, ekstrakt, inertna prašiva, *Rhizopertha dominica*, insekticidna učinkovitost

## Insecticidal efficacy of combination of lavandin and inert dusts against lesser grain borer *Rhyzopertha dominica* (Fab.)

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### Summary

The summary describes laboratory testing of insecticidal efficacy of lavandin extract *Lavandula x intermedia* (Emeric ex Loisel.) in combination with two Croatian inert dusts (D-01 and MA-4) against lesser grain borer *Rhyzopertha dominica* (Fab.) on wheat applying two doses (300 and 600 ppm) at exposures of 7 and 14 days with tendency to develop new natural insecticides with no negative impact on the environment. Combination of lavandin and inert dusts were applied in glass jars of 200 ml volume filled up with 100 g of wheat followed by the introduction of 50 *R. dominica* individuals of different sex aged 7-21 days per treatment. The highest mortality rate (62.5%) was achieved by the combination of lavandin and D-01 at the dose of 600 ppm after the 14th day of exposure. Mortality rates of both combinations at the dose of 600 ppm were statistically significantly higher in relation to the mortality rate at the dose of 300 ppm and control treatment. Statistically significant mortality rate (9.0%) was achieved by prolonging the exposure to 14 days in relation to the mortality rate (4.5%) achieved after 7 day exposure in the treatment of combination of lavandin and MA-4 at the dose of 300 ppm. The results point out to a high potential of combination of Croatian inert dusts and botanicals in suppression of *R. dominica*. Further research should be carried out with combination of other plant species and also examine the impact on offspring development. This research was conducted as a part of Croatian Science Foundation research project IP-11-2013-5570.

**Key words:** *lavandin, extract, inert dusts, Rhyzopertha dominica, insecticidal efficacy*



## Fotointerpretacija arhivskih ortofoto snimaka na području općine Poličnik

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### Sažetak

Na području općine Poličnik u posljednjih nekoliko desetljeća primijećeno je zarastanje obradivih površina. Pogodni klimatski uvjeti i sam geografski položaj općine od iznimne su važnosti za poljoprivredu i gospodarstvo. Kartiranje vegetacije korištenjem tradicionalnih metoda nije prihvatljivo zbog veličine površine, raspoloživih ljudskih resursa ali i opasnosti od terenskog istraživanja, pa se pristupilo istraživanju metodom daljinskog promatranja koje je pogodnije od tradicionalnih metoda. Dakle, cilj istraživanja bio je na temelju arhivskih te recentnijih ortofoto snimaka utvrditi i klasificirati staništa te njihove sukcesijske stadije u periodu od 1952. do 2013. godine. Na sve tri istraživane lokacije (oznake: 4048, 4050 i 4052) utvrđeno je povećanje površina šuma, a ponajviše na lokaciji 4050 za čak 0,91 km<sup>2</sup> ili 25,7% od ukupne površine koja je iznosila 3,6 km<sup>2</sup>. Površine obrasle makijom bile su u deficitu upravo zbog samog sukcesijskog stadija i prelaska makije u šume u proteklih 60 godina. Najveća promjena je bila na lokaciji 4048 gdje se površina obrasla makijom smanjila za čak 0,53 km<sup>2</sup> tj. za 15,93% od ukupne površine. Najveća promjena u pogledu porasta travnjačkih površina bila je na lokaciji 4050 gdje je iznosila 0,4 km<sup>2</sup> (10% od ukupne površine). Rezultati odgovaraju postavljenoj hipotezi i progresivnoj sukcesiji na poljoprivrednim površinama područja općine Poličnik.

***Ključne riječi:*** Poličnik, poljoprivreda, sukcesija, GIS, karte

## Photointerpretation of archival orthophoto of the Poličnik area

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### Summary

In the last few decades, overgrowing of farm land has been observed on the area of Poličnik (Zadar, Croatia). Favourable climatic conditions and the geographic position are of paramount importance for the agriculture and economy. Mapping vegetation using traditional methods is unlikely due to the size of the surface itself, the available human resources, but also the danger of field research, so it is approaching a remote sensing method that is more appropriate than traditional methods. Thus, the aim of our research was to determine and classify habitats and their succession stages in the period from 1952 to 2013 on the basis of archival and recent orthophotos. In all three locations of research (marks: 4048, 4050 and 4052) forest areas increased, especially at the mark 4050 for as much as 0.91 km<sup>2</sup> or 25.7% of total of 3.6 km<sup>2</sup> surface area. Surfaces covered with macaque were deficient precisely because of the succession stage and the transition to the forest in the past 60 years. The biggest change was at the location 4048 where the surface covered with maquis shrubland decreased by as much as 0.53 km<sup>2</sup>, that is, by 15.93% of the total area. The most significant change in terms of the increase of the areas covered in grasslands was at the location 4048 where it amounted to 0.42 km<sup>2</sup> (10% of the total area). The results correspond to the established hypothesis and progressive succession on the agricultural areas of the Poličnik area.

**Key words:** *Poličnik, agriculture, succession, GIS, maps*

## Modeliranje ekološke niše za ljekovitu kadulju (*Salvia officinalis* L.)

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### Sažetak

Ljekovita kadulja (*Salvia officinalis* L.) od davnina je poznata kao biljka s mnogim ljekovitim svojstvima, a najpoznatije je kaduljino eterično ulje. Ekološka niša predstavlja zbroj svih okolišnih varijabli koje utječu na rast, preživljavanje i reprodukciju vrste. Zbog velikog potencijala kadulje, cilj je bio napraviti model ekološke niše za područje Hrvatske. GPS koordinate distribucije vrste *Salvia officinalis*, potrebne za modeliranje ekološke niše, preuzete su iz *Flora Croatica Database* baze podataka (FCD). Georeferencirani rasterski klimatski slojevi za 11 varijabli preuzeti su iz WorldClim baze podataka. Svakoj točki prisutnosti vrste pridružena je vrijednost piksela s rastera klimatskih varijabli. U programu Maxent 3.3. izrađen je prediktivni model metodom maksimalne entropije. Što je veća vrijednost piksela, veća je povoljnost staništa. Rezultati pokazuju da varijabla Bio9 (srednja temperatura kvartala s najmanje padalina) ima najveći utjecaj (34,8%) na rast kadulje. Model ekološke niše napravljen na temelju rastera klimatskih varijabli s finijom rezolucijom (1x1km) pokazao je pouzdanije rezultate u odnosu na grublju rezoluciju.

**Ključne riječi:** *Salvia officinalis*, ekološka niša, modeliranje, maksimalna entropija, Hrvatska

## Ecological niche modeling of kitchen sage (*Salvia officinalis* L.)

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### Summary

The kitchen sage (*Salvia officinalis* L.) has long been known as a plant with many healing properties and especially the most famous essential oil. The ecological niche represents the sum of all environmental variables that affect the growth, survival and reproduction of species. Due to its great potential, the aim was to build a model of ecological niche for kitchen sage of Croatia territory. Distribution of *Salvia officinalis* and its GPS coordinates used for modeling ecological niches were taken from the Flora Croatica Database (FCD). Georeferenced raster climatic layers for 11 variables are downloaded from the WorldClim Database. Each vector point of the species is associated with the pixel value of each climatic variable. In Maxent 3.3. a prediction model is made using the maximum entropy method. The higher the pixel value, the greater the convenience of the habitat. The results show that Bio9 (mean temperature of driest quarter) has the greatest influence on the growth of sage with 34.8%. The model of ecological niche made on the basis of the climatic variables with a finer resolution (1x1km) showed more reliable results than the rough resolution.

**Key words:** *Salvia officinalis*, ecological niche, modeling, maximum entropy, Croatia

## Utjecaj dodatka komposta i biougljena na enzimatsku aktivnost crvenice i rendzine

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### Sažetak

Enzimi u tlu imaju važnu ulogu u očuvanju ekologije, fizikalno-kemijskih svojstava i plodnosti tla. Izvor enzima u tlu su prirodno prisutan mikrobiom, biljke te ostali oblici života prisutni u tlu. Aktivnost enzima dehidrogenaze vezana je uz procese oksidacije organskih spojeva kod živih mikroorganizama te je odraz mikrobne biomase u trenutku uzorkovanja. Enzimi fosfataze sudjeluju u prirodnom ciklusu kruženja fosfora te kataliziraju reakciju izdvajanja fosfora vezanog u organske spojeve. Cilj ovog rada je istražiti utjecaj dodatka komposta i biougljena dobivenih iz komine masline ili komunalnog mulja na enzimatsku aktivnost crvenice i rendzine. Kompost ili biougljen je dodan u dvije razine te je mjerena aktivnost enzima dehidrogenaze, kisele fosfataze i alkalne fosfataze. Mjerenje je provedeno u trenutku miješanja supstrata sa zemljom i nakon 30 dana uzgoja kineskog kupusa. Dobiveni rezultati su pokazali da je na aktivnost istraživanih enzima statistički značajno utjecala vrsta obrade organskog otpada, odnosno je li u tlo dodan kompost ili biougljen te količina dodanog supstrata. Porijeklo otpada nije imalo statistički značajan utjecaj na enzimatsku aktivnost tla. Aktivnosti enzima dehidrogenaze i alkalne fosfataze značajno su se razlikovale između crvenice i rendzine, dok su se aktivnosti enzima kisele i alkalne fosfataze značajno razlikovale s obzirom na vrijeme uzorkovanja.

**Ključne riječi:** biougljen, crvenica, enzimatska aktivnost tla, kompost, rendzina

## The effect of compost or biochar addition on enzymatic activity of terra rossa and rendzina soils

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### Summary

Soil enzymes have an important role in maintaining soil ecology, physical and chemical properties and fertility. Sources of soil enzymes are the native soil microbiome, the plant itself, and other life forms present in the soil. The dehydrogenase activity is specific to living microorganisms and reflects microbial biomass at sampling and it plays an important role in oxidation of organic substances. The role of phosphatases is to release phosphorous linked to organic substances and reflect phosphorous cycling. The goal of this study was to compare enzymatic activity of terra rossa and rendzina soils supplemented with compost or biochar produced from olive pomace or sludge waste. Two rates of compost and biochar were added to soils. Dehydrogenase, acid phosphatase (ACP) and alkaline phosphatase (ALP) were measured at the time of mixing of the soil with substrates and 30 days after growing Chinese cabbage. The obtained results indicate that dehydrogenase, ACP and ALP activity are significantly influenced by the method of waste processing, i.e. whether the waste was composted or converted to biochar as well as the rate of added compost or biochar. The source of compost or biochar had no influence on the activity of the enzymes. The dehydrogenase and ALP activity significantly differed between soil types, while ACP and ALP activity was significantly different between sampling points.

**Key words:** *biochar, compost, rendzina, soil enzymatic activity, terra rossa*

## Mikrozooplankton ušća rijeke Neretve

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### Sažetak

Tijekom siječnja, ožujka, svibnja, srpnja i listopada 2014. na postajama Ušće i Osinj na ušću rijeke Neretve istraživana je populacija mikrozooplanktona. Utvrđen je kvalitativni i kvantitativni sastav mikrozooplanktona te je, po prvi put, detaljnije prikazan odnos holoplanktona i meroplanktona u mikrofrakciji zooplanktona istraživanog područja. U svim uzorcima je zabilježena visoka prisutnost mukoznih agregata. Najveća brojnost mikrozooplanktona zabilježena je u svibnju na postaji Ušće (109 600 jed. m<sup>-3</sup>) te u srpnju na postaji Osinj (101 600 jed. m<sup>-3</sup>). Pronađene su sljedeće skupine mikrozooplanktona: Radiolaria, nelorikatni cilijati, Tintinnina, Cladocera, Copepoda (naupliji, kopepoditi i adultni mali kopepodi), Appendicularia, Pteropoda i ličinke bentoskih organizama. Dominantne skupine tijekom svih razdoblja bili su tintinini, nelorikatni cilijati i naupliji kopepoda. Među odraslim malim kopepodima dominirale su vrste *Oithona nana* i *Oncaea media*. Holoplankton je izrazito dominirao nad meroplanktonom na obje postaje tijekom cijelog istraživanog razdoblja s najvećim udjelom od 96,67 % u listopadu i najmanjim udjelom od 85,92 % u ožujku na postaji Ušće. Zbog vjerojatnosti brzih procesa u površinskim slojevima bila bi neophodna istraživanja u kraćim vremenskim razdobljima kojima bi se detaljnije istražio mikrozooplankton na ovom području.

***Ključne riječi:*** ušće rijeke Neretve, mikrozooplankton, holoplankton, meroplankton

## Microzooplankton of the estuary of the Neretva river

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### Summary

During January, March, May, July and October 2014 at the stations Ušće and Osinj in the estuary of the Neretva River the population of microzooplankton was examined. The qualitative and quantitative composition of microzooplankton was determined, and holoplankton and meroplankton ratio in the microfraction of zooplankton of the investigated area was presented in more detail for the first time. The high presence of mucous aggregates was recorded in all samples. The highest number of the microzooplankton was recorded in May at the station Ušće (109.600 ind m<sup>-3</sup>) and in July at the station Osinj (101.600 ind m<sup>-3</sup>). The following groups of the microzooplankton were found: radiolarians, non-loricate ciliates, tintinnids, cladocerans, copepods (nauplii, copepodites and adult small copepods), appendicularians, pteropods and larvae of the other benthic organisms. Tintinnids, non-loricate ciliates and copepod nauplii were the dominant groups during all periods. Among adult small copepods *Oithon nana* and *Oncaea media* were dominant species. Holoplankton strongly dominated over the meroplankton on both stations throughout the investigated period with the highest contribution of 96.67 % in October and the lowest contribution of 85.92 % in March at the Ušće station. Because of the probably rapid processes in the surface layers in the investigated area, it would be necessary to sample microzooplankton more frequently, in shorter time periods, for more detailed results.

**Key words:** *estuary of the Neretva River, microzooplankton, holoplankton, meroplankton*



## The *Aleurocanthus spiniferus* (OSW) in Europe: a becoming invasive threat to citrus also

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### Summary

The orange spiny whitefly (OSW), *Aleurocanthus spiniferus*, is a worldwide known citrus pest native to tropical Asia. Since the beginning of the 20<sup>th</sup> century, OSW spread throughout Asia, the Pacific, central and southern Africa and from 2008 it was intercepted many times in EPPO area (Italy, Croatia and Montenegro). OSW polyphagy is well known, being able to infest more than 90 host plants belonging to unrelated botanical families, although *Citrus* spp. are considered the primary hosts. Accurate samplings highlighted OSW new host associations extending the range of plant families potentially exploitable and confirming the existence of host-shift phenomena. Analyses of the mitochondrial COI gene revealed that OSW Apulian population belongs solely to one of the two haplogroups present in China. Furthermore, the study of microbiota allowed us to identify the principal endosymbiotic bacteria in OSW. So far, field samplings confirmed the presence of predators belonging to Coccinellidae family able to prey on different developmental stages of *A. spiniferus*. These findings could be considered as an opportunity for biological control of OSW. Results laid solid foundations in the knowledge of European OSW populations now invading Italy and neighbouring countries to counteract a pan-Mediterranean invasion of this harmful whitefly. Further studies are essential for the assessment of an effective IPM strategy tailored either for organic or intensive agricultural context.

**Key words:** Alien invasive pest, endosymbiont, insect-bacteria symbiosis, COI, natural enemies

## Potencijal komine masline i komunalnog mulja u proizvodnji biougljena za primjenu u poljoprivredna tla

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### Sažetak

Cilj provedenog istraživanja bio je utvrditi potencijal dvaju organskih materijala, komunalnog mulja i komine masline, u proizvodnji biougljena (biochara) za primjenu u poljoprivredne svrhe. Istraživanje je provedeno iz pretpostavke da će dodatak biougljena u poljoprivredna tla, kroz sekvestraciju ugljika, smanjiti emisije CO<sub>2</sub>, a istovremeno će kroz dodatak biogenih elemenata povećati plodnost tla. Istraživani su materijali pretvoreni u biougljen korištenjem Kon-Tiki sustava otvorenog tipa. Temperatura pirolize mjerenja je termoelementom NiCrNi, te se kretala u rasponu od 520° do 580°C. Utvrđen je kemijski sastav komunalnog mulja, komine masline te dva proizvedena tipa biougljena. Rezultati analize kemijskog sastava pokazali su značajne razlike u količinama pojedinih elemenata u proizvedenim tipovima biougljena u odnosu na korištene sirovine. U polazišnim organskim materijalima je prosječna količina ugljika iznosila 44.5% u komunalnom mulju, te 55.4% u komini masline. Prosječna količina ugljika u biougljenu od komunalnog mulja iznosila je 23.2%, dok u biougljenu od komine masline 77.1%, predstavljajući izniman potencijal za sekvestraciju istog u tlo. Možemo utvrditi da su istraživani organski materijali pogodne sirovine za proizvodnju biougljena sustavom Kon-Tiki, te će se mogućnosti njihove primjene kao gnojiva na poljoprivrednim površinama dalje istraživati.

**Ključne riječi:** organski materijali, klimatske promjene, biougljen, gnojivo

## Potential of olive pomace and sewage sludge in the production of biochar for use in agricultural soils

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### Summary

The aim of the present research was to determine the potential of two organic materials, sewage sludge and olive pomace, in biochar production for application in agricultural purposes. Research was carried out on the assumption that biochar addition to agricultural soil, through carbon sequestration, would reduce CO<sub>2</sub> emissions, while at the same time increase soil fertility through the addition of biogenic elements. The studied materials were converted into biochar using the Kon-Tiki open-type system. Pyrolysis temperature measurement was performed using a NiCrNi thermoelement, and ranged from 520° to 580°C. The chemical composition of sewage sludge, olive pomace and two types of produced biochar was determined. Chemical composition results showed significant differences in the quantities of individual elements in the produced biochars, compared to the raw materials used. In the starting organic materials, the average amount of carbon was 44.5% in sewage sludge and 55.4% in olive pomace. The average amount of carbon in sewage sludge biochar was 23.2%, while in olive pomace biochar was 77.1%, presenting a potential for carbon sequestration in the soil. We can conclude that the investigated organic materials are suitable raw materials for biochar production using the Kon-Tiki system and their application as fertilizers for agricultural purposes will be further investigated.

**Key words:** *organic materials, climate change, biochar, fertilizer*

## Antifungalno djelovanje eteričnih ulja na *Botrytis cinera* u *in vitro* uvjetima

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### Sažetak

Provedeno je *in vitro* ispitivanje antifungalnog djelovanja različitih volumena eteričnih ulja eukaliptusa, limuna, komorača, paprene metvice i timijana te njihovih najvažnijih komponenti na porast ekonomski značajne fitopatogene gljivice *Botrytis cinerea*. Mjerenjem promjera micelija *B. cinerea* tijekom inkubacije zabilježeno je smanjenje rasta micelija ovisno o primijenjenom volumenu. Antifungalno djelovanje eteričnih ulja i njihovih komponenti, smanjuje se s povećanjem duljine inkubacije. Rezultati su pokazali da eterična ulja, u pravilu, imaju bolje djelovanje na fitopatogene gljivice od svojih komponenti. Četvrti dan nakon inokulacije micelija najmanju izračunatu vrijednost IC<sub>50</sub> imalo je eterično ulje timijana. Osmi dan ispitivanja eterična ulja timijana, paprene metvice i komorača, primijenjena u određenim volumenima, u potpunosti su inhibirala rast micelija, dok eterična ulja limuna i eukaliptusa nisu inhibirala rast micelija niti u najvećem primijenjenom volumenu. Na temelju rezultata ovog istraživanja može se zaključiti da pojedina eterična ulja mogu biti dobra alternativa sintetskim fungicidima. Potrebna su daljnja *in vivo* istraživanja koja bi mogla dovesti do razvoja ekološko prihvatljivih sredstava za suzbijanje fitopatogenih gljivica.

**Ključne riječi:** eterično ulje, komponente, promjer micelija, *Botrytis cinerea*

## ***In vitro* antifungal activity of essential oils on *Botrytis cinerea***

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### **Summary**

*In vitro* testing of antifungal activity of different volumes of essential oils of eucalyptus, lemon, fennel, peppermint and thyme, and their most important components on the growth of economically significant phytopathogenic fungus *Botrytis cinerea* was carried out. Measurement of the diameter of mycelium *B. cinerea* during incubation has shown decreasing of micellar growth depending on the volume applied. Antifungal activity of essential oils and their components decreases with increasing of incubation length. The results showed that essential oils, as a rule, have a better effect on phytopathogenic fungi than their components. The fourth day after mycelial inoculation, the lowest calculated value of IC<sub>50</sub> was for thyme essential oil. On the eighth day of testing, essential oils of thyme, peppermint and fennel, applied in certain volumes, completely inhibited the growth of mycelium, while lemon and eucalyptus essential oils did not inhibit the growth of mycelium at the highest applied volume. Based on the results of this research it can be concluded that some essential oils can be a good alternative to synthetic fungicides. Further *in vivo* research is needed that could lead to the development of environmentally acceptable means for suppressing phytopathogenic fungi.

**Key words:** *Essential oil, components, mycelium diameter, Botrytis cinerea*

## **Biotest za utvrđivanje osjetljivosti šećerne repe na rezidue mezotriona**

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### **Sažetak**

Mezotrion je jedan od novijih herbicida za suzbijanje jednogodišnjih širokolisnih i nekih jednogodišnjih uskolisnih korova u kukuruzu. Prema fizikalno-kemijskim svojstvima ne perzistira dugo u tlu. Međutim, perzistentnost herbicida rezultat je interakcije više činitelja stoga se može pretpostaviti da će i perzistentnost mezotriona u pojedinim pedo-klimatskim uvjetima varirati. Metodom biotesta utvrđivan je fitotoksični učinak rezidua mezotriona na šećernu repu. Istraživanje je provedeno na livadsko-fluvijalnom tipu tla na koje su prskalicom za tankoslojnu kromatografiju primjenjene sljedeće doze mezotriona: 0; 0,25; 0,5; 1; 2; 4; 6 i 8  $\mu\text{g a.t./200 g tla}$ . Nakon aplikacije tlo je prenijeto u uzgojne posude, u koje je posijano sjeme šećerne repe. Fitotoksični učinak mezotriona utvrđivan je vizualnom ocjenom fitotoksičnosti 7., 14. i 21. dan nakon aplikacije po skali oštećenja od 0 do 100, nakon čega je utvrđena svježa nadzemna masa šećerne repe i ukupan sadržaj karotenoida. Vizualnom ocjenom najveći fitotoksični učinak utvrđen je 21. dan. U tom roku su utvrđena oštećenja već kod najniže (0,25  $\mu\text{g a.t./200 g tla}$ ) doze, a povećanjem doze povećavao se fitotoksični učinak. Potpuno propadanje biljaka utvrđeno je već pri dozi 4  $\mu\text{g a.t./200 g tla}$ . Utvrđena je i povezanost u redukciji svježe nadzemne mase s redukcijom ukupnog sadržaja karotenoida čija je značajna redukcija također utvrđena već kod primjene najniže istraživane doze mezotriona.

***Ključne riječi:*** *mezotrion, šećerna repa, biotest, rezidui, fitotoksičnost*

## **Bioassay for determining susceptibility of sugar beet to mesotrione residues**

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### **Summary**

Mesotrione is one of the newer herbicides for controlling broad-leaved and grass weeds in maize. According to its physicochemical properties, mesotrione is a non-persistent herbicide. However, a herbicide persistence is a result of complex interactions; therefore, it can be assumed that in a certain pedo-climatic conditions mesotrione persistence may vary. A bioassay method was used to determine the phytotoxicity of mesotrione residues on sugar beet. The soil used in research was meadow-fluvial soil. Mesotrione was applied by a thin layer chromatography sprayer at 0; 0.25; 0.5; 1; 2; 4; 6 and 8  $\mu\text{g}$  a.i. per 200 g of soil. After the application, the soil was transferred to the breeding vessels, in which the seed of sugar beet was sown. The phytotoxicity of mesotrione was determined by visual evaluation of phytotoxicity on 7<sup>th</sup>, 14<sup>th</sup> and 21<sup>st</sup> day after application by using a 0 to 100 scale, after which was determined fresh weight of sugar beet and the total carotenoid content. The highest phytotoxic effect was determined on the 21<sup>st</sup> day by visual evaluation. Damages were established already at the lowest (0.25  $\mu\text{g}$  a.i. per 200 g of soil) dose. Moreover, by increasing the dose, the phytotoxicity increased. Sugar beet plants were completely degraded at a dose of 4  $\mu\text{g}$  a.i. per 200 g soil. A correlation was established in the reduction of fresh weight with the reduction of total carotenoid content, which was already significantly reduced when the lowest mesotrione dose was applied.

**Key words:** *mesotrione, sugar beet, bioassay, residues, phytotoxicity*

## Preciznom poljoprivredom proizvodimo više s manje

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### Sažetak

Do 2050. godine proizvodnja hrane trebala bi se povećati za 70% da može pratiti porast svjetske populacije. U slijedećih 50 godina morat ćemo proizvoditi više hrane nego što smo proizveli u proteklih 10 000 godina te treba izgraditi održivi proizvodni sustav primjenom moderne - već dostupne tehnologije. FAO je već objavio intenzifikaciju održive proizvodnje usjeva (SCPI) kao strateški cilj. Riječ je o većoj proizvodnji s iste obradive površine uz smanjenje negativnih učinaka po okoliš, za što je potrebna primjena stručnog znanja, moderne poljoprivredne mehanizacije i suvremene tehnologije kao što je: satelitska navigacija, senzori, IT – aplikacije. Precizna poljoprivreda znači uraditi pravu stvar, na pravom mjestu, na najbolji način i u pravo vrijeme. Poljoprivrednici su oduvijek bili svjesni da su tlo, vrijeme, vegetacija i voda promjenjivi od mjesta do mjesta, ali prije nisu imali mogućnost da mjere i mapiraju podatke. Precizna poljoprivreda pomaže da se postigne održivost, zaštita okoliša, i povećana produktivnost uz bolje ekonomske pokazatelje. Geografski informacijski sustavi visoke preciznosti, automatsko upravljanje, mapiranje, senzori, integrirani elektronski sustavi, varijabilna primjena pesticida/gnojiva osnovni su koncept današnjeg pojma precizne poljoprivrede. Glavna uloga precizne poljoprivrede je bolja zaštita okoliša uz manji utrošak goriva, zaštitnih sredstava, vode i gnojiva, te krajnje smanjenje troškova proizvodnje. Primjenom precizne poljoprivrede u agrotehničkim operacijama kao što su obrada tla, sjetva, gnojidba, zaštita bilja i navodnjavanje omogućeno je postizanje strateškog cilja FAO-a: proizvesti više s manje.

**Ključne riječi:** *precizna poljoprivreda, mehanizacija, tehnologija, inovacije*



## Precision agriculture produce more with less

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### Summary

By the year 2050, should increase by 70% to keep up with the growth of world population. We will have to produce more food in the next 50 years than we produced in the last 10 000 years. Producing more food to meet demands of growing population, we need to build sustainable food production systems and learn how to implement smart farming methods. New technology to reach this goals is available right now. FAO has declared Sustainable Crop Production Intensification (or SCPI) as their first strategic objective. What in fact means producing more from the same area of land- while reducing negative environmental impacts. Innovative agricultural machinery and knowledge is needed to do that. Only recently, machinery revolutionised the farming and replaced horses with modern machines. Today we are adopting new technologies: high precision positioning systems, sensors, IT applications and high- tech engineering. Precision farming is doing the right thing, in the right place, the right way, at the right time. Farmers have always been aware that soil, weather, vegetation and water vary from place to place but before they did not have technology to measure and map these facts. Precision agriculture is helping farmers to achieve sustainability, environmental protection, higher productivity with greater economic benefits. High precision positioning systems, automated steering, geomapping, sensors and remote sensing, integrated electronic communications, variable rate technology are main concept of precision farming today. The key role of precision farming is better environmental protection with using less fuel, water and fertilizer, less crop damage and crop loss, and reducing production cost. Soil preparation, precision seeding, fertilisation, crop protection and irrigation is helping farmers to produce more with less.

**Key words:** *precision agriculture, machinery, technology, innovative*

## Agroekološki uvjeti uzgoja industrijske konoplje u Hrvatskoj

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### Sažetak

Brojni čimbenici ograničavaju poljoprivrednu proizvodnju, u prvom redu pedološke i klimatske prilike staništa. Ovim radom žele se utvrditi i analizirati agroekološki uvjeti uzgoja industrijske konoplje u Republici Hrvatskoj i to na primjeru dva OPG-a u okolici Varaždina (Biljevec) i Hrvatske Kostajnice (Unčani), odnosno njihov utjecaj na visinu i komponente prinosa industrijske konoplje, kao i kvalitetu ulja. Pedološke prilike su analizirane iz uzoraka tla u prirodnom i narušenom stanju za što su korištene standardne analitičke metode. Analiza klimatskih prilika provedena je temeljem višegodišnjih podataka o oborinama, temperaturi, insolaciji, brzini vjetra i relativnoj vlazi zraka za klimatske postaje Varaždin i Hrvatska Kostajnica. Evapotranspiracija je izračunata korištenjem programa CROPWAT, a potencijalni viškovi ili manjkovi vode modificiranom metodom Palmera. Sastav masnih kiselina u ulju konoplje određen je plinskom kromatografijom. U različitim pedološkim i klimatskim uvjetima uzgoja prinos sjemena na lokaciji Biljevec iznosio je 1,2 tha<sup>-1</sup>, a na Unčanima 0,5 tha<sup>-1</sup>. Veća masa 1000 sjemenki i broj biljaka po m<sup>2</sup>, utvrđeni su na lokaciji Unčani, dok na lokaciji Biljevec imamo dvostruko više sjemenki po biljci. Sastav masnih kiselina u ulju konoplje je zadovoljavajući na obje lokacije. Osim agroekoloških uvjeta tla i klime, visina prinosa sjemena i kvaliteta ulja konoplje ovise i o primijenjenim agrotehničkim mjerama, prvenstveno obradi, gustoći sjetve i gnojidbi.

**Ključne riječi:** konoplja, agroekološki uvjeti, tlo, klima, komponente prinosa

## Agroecological conditions related to industrial hemp breeding in Croatia

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### Summary

Numerous factors limit the agricultural production, pedological and climatic conditions of habitats primarily. This study was made to identify and analyze the agro-environmental conditions related to cultivation of hemp in the Republic of Croatia, the example of two family farms near Varaždin (Biljevec) and Hrvatska Kostajnica (Unčani), their impact on height and components of yield, as well as on quality of hemp oil respectively. Pedological conditions were analyzed from soil samples in natural and disturbed condition for which standard analytical methods were used. Climatic condition analysis was carried out based of long-term data on rainfall, temperature, insolation, wind velocity, and relative humidity for the climate stations Varaždin and Hrvatska Kostajnica. Evapotranspiration is calculated using the CROPWAT program and potential surpluses or shortages of water by modified Palmerš method. Fatty acid composition in hemp oil is determined by gas chromatography. In different pedological and climatic conditions the seed yield of hemp at the Biljevec site was 1.2 tha<sup>-1</sup> and at the Unčani 0.5 tha<sup>-1</sup>. The largest mass of 1000 seeds, as well as the number of plants per square meter, were determined at the location of Unčani, while at Biljevec location we have twice as many seeds per plant. The composition of fatty acids in hemp oil is satisfactory on both locations. Beside agroecological conditions of soil and climate, seed yield and the quality of the oil hemp depend also on applied agrotechnical measures, primarily on tillage practices, seed sowing density and fertilization.

**Key words:** *hemp, agroecological conditions, soil, climate, components of yield*

## Hiperspektralno snimanje kukuruza u svrhu procjene sadržaja ukupnog dušika i prinosa na razini lista i pokrova

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### Sažetak

Cilj istraživanja bio je razviti kalibracijske modele za sadržaj dušika u listu i prinos kukuruza na osnovi hiperspektralnih podataka dobivenih *in situ* te multispektralnih podataka dobivenih iz zraka s obzirom na razvojnu fazu biljke i sortu. Pokusna površina (9 varijanti mineralne gnojidbe dušikom/4 ponavljanja: 0-300 kg N ha<sup>-1</sup>) veličine 4 ha s kukuruzom u razvojnoj fazi brzog vegetativnog porasta (8-12 listova) snimljena je iz zraka multispektralnom kamerom (4 kanala) u vidljivom i blisko infracrvenom (VNIR) području spektra, dok je 180 uzoraka lista kukuruza skenirano (mreža uzorkovanja: 15×15 m) spektrometrom (350-1050 nm). Sadržaj ukupnog dušika u listu (n=90) određen je metodom suhog spaljivanja (HRN ISO 13878:2004), a prinos zrna nakon berbe (n=36). Značajne spektralne razlike između gnojidbenih tretmana i najviše korelacije s varijablama kukuruza utvrđene su u vidljivom dijelu spektra i „crvenom rubu“. Regresijom parcijalnih najmanjih kvadrata (PLSR) te izračunom vegetacijskog indeksa (NDVI) dobiveni su predikcijski modeli ukupnog dušika u listu kukuruza i prinosa zrna. Utvrđena je vrlo jaka korelacija (r) i niska srednja kvadratna pogreška (RMSE) između predviđenih i referentnih vrijednosti za kalibracijski, odnosno validacijski model. Ključna spektralna obilježja i algoritmi utvrđeni u ovom radu doprinijet će preciznom gospodarenju i praćenju sadržaja dušika u biljci u stvarnom vremenu te predviđanju prinosa kukuruza.

**Ključne riječi:** *spektralna refleksija, NDVI, dušik u listu, prinos kukuruza, multivarijatna analiza*

## Hyperspectral sensing of corn for assessment of N content and grain yield on leaf and canopy level

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### Summary

The objective of research was to develop calibration models for leaf nitrogen content and grain yield of corn using hyperspectral data measured *in situ* and multispectral data obtained from aerial sensing, considering crop developmental stage and variety. Experimental field (9 treatments of mineral nitrogen fertilization/4 replications: 0-300 kg N ha<sup>-1</sup>) size of 4 ha with corn in developmental stage of fast vegetative growth (8-12 leaves) was sensed using UAV equipped with multispectral camera (4 bands) in visible and near infrared (VNIR) spectral range, while 180 leaf samples (sampling grid: 15×15 m) were scanned with field spectroradiometer (350-1050 nm). Total nitrogen content in leaf (n=90) was determined by dry combustion method (HRN ISO 13878:2004), and grain yield during the harvest (n=36). The largest spectral differences between N fertilization treatments and the highest correlations with corn variables were found in visible and red edge region. Partial least square regression (PLSR) and normalized difference vegetation index (NDVI) were used to build prediction models of total nitrogen content in leaf and grain yield. Very strong correlation (*r*) and low root mean square error (RMSE) were obtained between predicted and measured values for the calibration and validation dataset, respectively. Key spectral features and algorithms defined in this study should help to support site-specific and real-time monitoring of plant N status and yield forecasting in corn production.

**Key words:** *spectral reflection, NDVI, leaf nitrogen content, corn yield, multivariate statistics*

## Klijavost korovne vrste *Ambrosia artemisiifolia* L. u ovisnosti o lokalitetu sazrijevanja sjemena

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### Sažetak

Mikroklimatski čimbenici geografskog područja mogu uvjetovati razlike u vremenu nicanja između korovnih populacija istih vrsta. Invazivne vrste adaptibilnije su u uvjetima varijabilnog okoliša te češće iskazuju tendenciju stvaranja različitih ekotipova, ovisno o staništu. Cilj istraživanja bio je utvrditi postojanje interpopulacijske varijabilnosti u viabilnosti sjemena i dinamici klijanja između dvije populacije ambrozije. Sjeme je sakupljeno s lokacija Popovača-P i Jastrebarsko-J. Provedbom testa klijavosti i TTC testa utvrđena je viabilnost sjemena populacije-J od 96%, dok je kod populacije-P utvrđeno 41% viabilnog sjemena. Značajna statistička razlika ( $P < 0.001$ ) utvrđena je između dvije populacije u vremenu potrebnom da 10% posijanog sjemena proklije ( $T_{10}$ ). Nasuprot tome, između dvije populacije nije utvrđena statistički značajna razlika u vremenu potrebnom da 50% ( $T_{50}$ ) i 90% ( $T_{90}$ ) posijanog sjemena proklije. U istraživanjima utvrđivanja bioloških parametara korovnih vrsta (biološki minimum- $T_b$  i biološki vodni potencijal- $\Psi_b$ ) potrebnih za izradu modela prognoze nicanja, koristi se vrijednost  $T_{50}$ . Rezultati ukazuju na mogućnost korištenja miješanog sjemena ambrozije ove dvije lokacije, unatoč utvrđenoj interpopulacijskoj varijabilnosti. To je značajno jer je za utvrđivanje  $T_b$  i  $\Psi_b$  potreban veliki broj sjemenki (pri različitim temperaturama i različitim uvjetima vodnog stresa) što ponekad nije moguće osigurati samo iz jedne populacije.

**Ključne riječi:** viabilnost, dinamika klijavosti, dormantnost, interpopulacijska varijabilnost, ambrozija

## Germination of *Ambrosia artemisiifolia* L. from different seed maturation environment

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### Summary

The microclimatic conditions of geographic area can cause differences in emergence timing between populations of the same species. Invasive species are more adaptable to the conditions of the variable environment and more often show the tendency to create interpopulation variability depending on the habitat. The aim of the study was to examine the existence of interpopulation variation in the seed viability and germination dynamics of common ragweed in two populations from Popovača-P and Jastrebarsko-J. Results of conducted germination and TTC test, showed 96% viability of the seed population-J, while the population-P had 41% of viable seed. Statistical difference ( $P < 0.001$ ) between two populations was found in the time required for 10% ( $T_{10}$ ) of sowed seed to germinate. However, no significant differences were found between the two populations in the time required for 50% ( $T_{50}$ ) and 90% ( $T_{90}$ ) of sowed seeds to germinate. The value of  $T_{50}$  is used for estimation of biological parameters (base temperature- $T_b$  and base water potential- $\Psi_b$ ) which are necessary for creating predictive weed emergence models. The results of the study indicate the possibility of using mixed seeds from this two locations, despite estimated interpopulation variation. This is important because large number of seeds (at different temperatures and different water stress conditions) are required for estimation of  $T_b$  and  $\Psi_b$ , which sometimes can not be provided by only one population.

**Key words:** *viability, germination dynamics, interpopulation variation, dormancy, common ragweed*

## Simultana inkapsulacija bioaktivnih komponenata za ishranu i zaštitu bilja

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### Sažetak

Trendovi inkapsulacije u poljoprivredi usredotočeni su na pripremu formulacija mikrokapsula koje uključuju dva bioaktivna sredstva. Unatoč brojnim metodama inkapsuliranja kemijskih sredstava, u literaturi se može naći samo nekoliko podataka o simultanoj inkapsulaciji i dostavi bioloških i kemijskih sredstava. Ciljevi istraživanja su: (i) odabir mikrokapsula koje mogu uključiti biološke i kemijske aktivne tvari i (ii) prisustvo bioaktivnih tvari u istom odjeljku ne smije umanjivati njihove aktivnosti. Zbog pogodnosti za zaštitu i ishranu bilja, kao i visoku kompatibilnost, *T. viride* i bakreni ili kalcijevi ioni uzeti su kao prikladni par bioaktivnog agensa. Istovremeno inkapsuliranje u mikrokapsule otkrilo je da inkapsuliranje u istom odjeljku ne inhibira aktivnost bioaktivnih komponenti. Kontrolirano otpuštanje, tj. uspješna dostava aktivnih tvari na pravom mjestu i pravom vremenu nužna je za sve sustave za isporuku bioaktivnih agensa. Da bi se dobile dobro oblikovane mikrokapsule učinkovite za istodobnu inkapsulaciju i isporuku aktivnih tvari biljkama brzinom koja je približna zahtjevima biljke, važno je optimizirati parametre tijekom pripreme mikrokapsule. Istraživanje je istaknulo da pravilan izbor formulacijskih varijabli pomaže u projektiranju mikrokapsule s bioaktivnim komponentama te njihovim kontroliranim otpuštanjem koje je važno za zaštitu i ishranu bilja.

**Ključne riječi:** *simultana inkapsulacija, Trichoderma viride, kemijski reagens, vremensko otpuštanje, zaštita bilja*



## Simultaneous encapsulation of bioactive agents for plant nutrition and protection

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### Summary

Trends of encapsulation in agriculture are focused on the preparation of microcapsule formulations involving two active agents. Despite numerous methods of chemical agent encapsulation, there are only a few data in the literature about simultaneous encapsulation and delivery of biological and chemical agents. The main aims of investigations are: (i) to choose microcapsules that can incorporate biological and chemically active agents and (ii) the presence of active agents in the same compartment should not diminish their activities. Due to benefits for crop protection and nutrition as well as high compatibility, *T. viride* and copper or calcium ions were taken as a suitable couple of the bioactive agent. Simultaneous encapsulation in microcapsules revealed that encapsulation in the same compartment does not inhibit activity of bioactive agents. Controlled release, that is the successful delivery of active agents at the right place and the right time is necessary characteristic for all bioactive agents' delivery systems. To obtain the well-designed microcapsules efficient for simultaneous encapsulation and delivering active agents to plants at the rate that closely approximates plant demand, it is important to optimize parameters during microcapsule preparation. The investigation pointed out that proper selection of formulation variables helps in designing microcapsules with the controlled release bioactive components for plant protection and nutrition.

**Key words:** *simultaneous encapsulation, Trichoderma viride, chemical agents, time releasing, plant protection*

## **Efficacy of silicon in the induction of tomato resistance against *Botrytis* stem canker**

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### **Summary**

Plant disease control is largely based on the use of pesticides. However, the extensive use of chemical compounds have some direct harmful effect on crops, environment, the health of farmers and consumers and leads to the selection of resistant pathogen strains. For these reasons alternative and sustainable disease management is required. In this context, the aim of this work was to evaluate the effectiveness of foliar silicon spraying to improve the resistance of tomato plants against stem canker caused by *Botrytis cinerea*. The incorporation of silicon in the culture medium (PDA) has significantly reduced the mycelial growth of *Botrytis cinerea* by over 43% depending on the increasing concentrations of potassium silicate. From a concentration 100 ppm of Si, the percentage of inhibition is almost constant. The inoculation of tomato stem by a mycelial plug of *B. cinerea* induced the same symptoms as observed in nature. The pathogen has invaded the entire stem for plants not treated with silicon accompanied by a dense mold and a gray coloration. In fact, a decrease of almost 50% in the percentage of necrosis diameter 19 dpi (day-post-inoculation) was observed in stem treated with silicon. The application of silicon has led to a significant reduction of tomato stem canker incited by *Botrytis cinerea*. The results suggested that elicitor such silicon played an important roles for increasing resistance in tomato plants against stem canker disease caused by *B. cinerea*.

**Key words:** *Botrytis cinerea*, stem canker, tomato, silicon, induction of defense

## Quercetin as green corrosion inhibitor of aluminium

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### Summary

Metal corrosion is a serious problem that causes damage especially in acid solutions. We are focused on the use of green inhibitors as a good choice for both: corrosion and environment protection. The use of corrosion inhibitors is one of the most practical and economic methods in corrosion inhibition studies. Green inhibitors are biodegradable, environmentally friendly and ecologically acceptable; they do not contain heavy metals or other toxic compounds. Quercetin has anti-inflammatory, anti-histamine, anti-cancer effects and other biological activities. In recent years, quercetin has been proved to be an efficient inhibitor against the corrosion of metals and alloys. Extracts of quercetin are studied as a green inhibitor for protection of Aluminium from corrosion in acid media (1M HCl). Quercetin is extracted by red onion. The corrosion inhibition efficiency was investigated using weight loss method and potentiodynamic polarization measurements. By weight loss method the inhibition efficiency (IE) increases with the increase of the inhibitors concentrations, IE is 44.4 % at 0.75 g/l quercetin. By the potentiodynamic polarization measurements the critical concentration is 1 g/l, IE is 75 %, for the further increase of the concentration the inhibition efficiency decrease.

**Key words:** *green corrosion inhibitor, quercetin, aluminium, weight loss, potentiodynamic polarization*

## Denitrification bioreactors application to order decrease nutrient losses via drained agricultural areas

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### Summary

In order to improve the agricultural productivity, in the second half of the last century too wet soils in Lithuania were intensively drained by various means of agricultural drainage. The draining of agricultural areas by means of tile drainage – is an effective tool for the removal of excess moisture from the soil, but while entering into drains water leaches various nitrogen compounds (NO<sub>3</sub> in particular) and other biogenic substances not assimilated by plants. The increased inflow of these substances into surface water bodies leads to their eutrophication. Research results indicate that the inflow of nitrogen from tile drained agricultural areas is a significant source of this pollution. The solution of the above mentioned problem using purely agronomic or severe economic activity limitation measures often does not reach the expected results due to the diversity of natural factors and changeable climatic conditions. It is obvious that technological innovations in tile drainage systems design and implementation are necessary. The first attempts to apply biotechnologies for the removal of nitrogen in tile drainage water were started in the US in 2001. The main idea of these technologies is based on the direct installation of bioreactors into the trenches of tile drainage systems. The performance of bioreactors is based on denitrification process which takes place under oxygen limited conditions in a specifically constructed trench filled with organic material where the tile water is diverted. At the time, the denitrifying bacteria utilize oxygen to process (oxidize) the available carbon and herewith converts nitrates being in a water into nitrogen gas. Laboratory scale tests have revealed, that during the analysed period of 235 days in bioreactor with deciduous woodchips the reduction of nitrate-nitrogen mass was reached 51% compared with the total amount observed in the inflow mass. During the same period the reduction of nitrate-nitrogen mass was reached, respectively, in the bioreactor with conifer woodchips – 64%, and with mixed woodchips filler – 63%.

This study was supported by the Lithuanian Ministry of Agriculture and Lithuanian Science Council according Baltic Sea EUSBSR programme.

**Key words:** *agricultural drainage, nitrate-nitrogen, denitrification bioreactors, water quality*





**Agroekonomika  
i ruralna sociologija**

**02**

**Agricultural Economics  
and Rural Sociology**



## Važnost brendiranja hrane za ruralni razvoj i turizam Hrvatske

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### Sažetak

U ovom radu analizira se važnost brendiranja hrane za razvoj ruralnih područja i poljoprivredne proizvodnje kroz stvaranje prepoznatljivosti hrane domaćeg podrijetla. Naime, hrana ima strateško značenje u gospodarstvu svake zemlje pa tako i u Republici Hrvatskoj. No, tržište hrane i poljoprivrednih proizvoda nije dovoljno razvijeno pa postoje problemi što se tiče plasiranja proizvoda na tržište dok s druge strane vanjsko trgovinska bilanca i dalje je nepovoljna jer se uvoz takvih proizvoda iz godine u godinu povećava. Potrebno je izgraditi tržišnu prepoznatljivost hrane kreiranjem jedinstvenog brenda. Stoga je cilj rada predstaviti važnost stvaranja identiteta i prepoznatljivosti domaće hrane te utjecaj na razvoj ruralnog turizma kroz povezivanje plave i zelene Hrvatske. Značajni mehanizam u dostizanju održivog ruralnog razvoja može postati jača povezanost između ljudi, mjesta i prehrambenih proizvoda. Iz tog razloga, posebna važnost pridaje se proizvodima s zaštićenim oznakama koje imaju veliko značenje za ruralni razvoj te njihovim posebnim definiranjem utječu na razvoj svih segmenata tržišta. Važnost ovog rada proizlazi iz činjenice kako hrvatska poljoprivreda još uvijek nema razvijenu konkurentsku sposobnost na razini europskih zemalja, a razvoj ruralnih područja vrlo je važan za održivost poljoprivrednih gospodarstava. Njihova održivost jedan je od ključnih ciljeva za održavanje konkurentnosti svih vrsta poljoprivrednih djelatnosti u svim regijama kao i promicanje organizacije u lancu prehrane, uključujući i preradu i trženje poljoprivrednih proizvoda. Sve su intenzivniji programi potpore i poticajne mjere za povećanje konkurentnosti proizvodnje. Proizvodi označeni zaštićenim oznakama ne samo da mogu doprinijeti održivom razvoju, već mogu utjecati na poljoprivredni rast i ruralni razvoj. Potrebno ih je zaštititi zbog stvaranja identiteta i prepoznatljivosti, više cjenovne vrijednosti, izravne veze proizvoda s određenim zemljopisnim područjem koja daje dodatnu vrijednost i prepoznatljivost tom području te u svrhu zajedničkog nastupa na tržištu, odnosno zajedničke promidžbe prehrambenih proizvoda.

**Ključne riječi:** ruralni razvoj, turizam, brendiranje hrane



## Importance of branding food for rural development and tourism in Croatia

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### Summary

This paper analyzes the importance of branded food for the development of rural areas and agricultural production through the creation of recognizable food of domestic origin. Food has a strategic significance in the economy of each country, as well as in the Republic of Croatia. But the market of food and agricultural products is not sufficiently developed, so there are major problems with placing product on the market while on the other side the external trade balance still doesn't support us because the yearly imports of such products increase. It's necessary to build market recognition food by creating a unique brand. Therefore, the aim of the paper is to present the importance of creating identity and recognizability of domestic food and the impact on the development of regional tourism through the linking of blue and green Croatia. A significant mechanism for achieving sustainable rural development can become a stronger link between people, places and food products. For this reason special importance is attached to products with protected designations that have great significance for rural development and their specific definition affects the development of all segments of the market. The importance of this work stems from the fact that Croatian agriculture still has not developed competitive capacity at European level, and rural development is very important for the sustainability of agricultural holdings. Their sustainability is one of the key goals to maintain the competitiveness of all types of agricultural activities in all regions, as well as to promote organization in the food chain, including processing and marketing of agricultural products. There are more intensive support programs and incentives to increase production competitiveness. Products labeled with protected labels can not only contribute to sustainable development but may also affect agricultural growth and rural development. They need to be protected because of the creation of identity and recognizability, more price values, direct links of products with a certain geographic area that gives added value and recognition to this area and for the purpose of joint market entry or joint marketing of food products.

**Key words:** *rural development, tourism, food branding*

## Production economics and marketing strategies of wine enterprises as a result of government policies implemented in Turkey

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### Summary

Tekirdağ province situated on the Northwest of Turkey, hosts several grape varieties for processing quality wine products. In recent years, grapevine growers in the region have changed their old and low-productive vineyards into vineyards of qualified and demanding grape varieties and have also widened their fields of production. The aim of this research is to study the economic structure and marketing strategies of small and medium sized wine enterprises via government policy about alcoholic beverages in Turkey. Findings were collected during 2013 production period. Wine producers, especially small family enterprises, suffer from high costs due to high SCT (Special Consumption Tax), VAT rates, and the compulsory banderol system for alcoholic beverages imposed by the government, which affects the enterprises' investments negatively. On the other hand, the current policies are seen to have beneficial effects on the region as well. According to results, in quality wines, total cost has been calculated as 3.8 ₺ per bottle; whereas, in table wines, it has been calculated as 2.7 ₺ per bottle. In quality wines net profit per bottle has been calculated as € 4.0; but in table wines, it has been calculated as € 1.1. Taxes have the biggest proportion with 42.4% for quality wines and 58.4 % for table wines in production costs (tax on luxury goods and income tax, value added tax excluded).

**Key words:** cost, profit, wine, grape, competition

## Povijesni pregled razvoja i procesa regulacije genetički modificiranih usjeva u Republici Hrvatskoj

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### Sažetak

Genetički modificirani usjevi od samog početka komercijalne sjetve, sredinom 1990-ih u SAD-u, izazivaju velike kontroverze u javnosti. Javnost je uplašena i nepovjerljiva prema novoj tehnologiji. Kontroverze oko tehnologije genetičkog modificiranja oslikavaju se i u djelovanju Bioetičkog povjerenstva koje je 1999. osnovala Vlada Republike Hrvatske radi praćenja problematike plasmana na tržište proizvoda koji sadrže ili se sastoje od genetski modificiranih proizvoda. Nakon prestanka rada Bioetičkog povjerenstva, a u skladu sa Zakonom o GMO-u iz 2005., osniva se Vijeće za GMO koje počinje s radom 2009. godine. Od jeseni 2017. djeluje treći saziv Vijeća za GMO. U radu je načinjen kratki povijesni pregled s osvrtom na ključne momente djelovanja Bioetičkog povjerenstva, kontroverze i suprotstavljena mišljenja članova Bioetičkog povjerenstva, te će biti vidljivo da tehnologija genetičkog modificiranja ostaje i jeste prijeporna tehnologija kako u javnosti tako i u znanstvenoj zajednici. Kontroverze, suprotstavljena mišljenja i postupci članova Vijeća za GMO određuju djelovanje prvog saziva Vijeća za GMO. Iz povijesnog pregleda djelovanja Bioetičkog povjerenstva i Vijeća za GMO moguće je zaključiti kako će problematika genetički modificiranih usjeva i dalje biti prijeporno pitanje snažnog suprotstavljanja protivnika i pobornika ove tehnologije.

**Ključne riječi:** *GMO, Bioetičko povjerenstvo, Vijeće za GMO, kontroverze, povijesni pregled*

## Historical overview of the development and process of regulating genetically modified crops in the Republic of Croatia

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### Summary

Genetically modified crops since the beginning of commercial sowing, in the mid 1990s in the United States, cause huge controversy in the public. The public is scared and distrustful of this new technology. Controversy over genetic modification technology is also reflected in the work of the Bioethics Commission established in 1999 by the Government of the Republic of Croatia to monitor the placement issue on the market of products that contain or consist of genetically modified products. After termination of the Bioethics Committee, and in accordance with the Law on GMOs in 2005, establishes the Council for GMOs which began operating in 2009. Since autumn 2017, operates the third convocation of the Council for GMOs. In this paper, we will be through a brief historical overview look at the key moments of action Bioethics Committee, controversy and conflicting opinions of members of Bioethics Committees, and will be apparent that the technology of genetic modification remains and is controversial technology to the public and the scientific community. Controversy, conflicting opinions and actions of members of the Council for GMOs determine the effect of the first session of the Council for GMOs. From the historical review of action Bioethics Commission and the Council for GMOs, we can conclude that the issues of genetically modified crops will continue to be a controversial issue of strong opposition to the opponents and drivers of this technology.

**Key words:** *GMO, Bioethics Commission, GMO Council, Controversy, Historical Review*

## **Food souvenirs: marketing research design**

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### **Summary**

The aim of this paper is to analyze existing research on food and tourism, with particular focus on food souvenirs and their potential to help developing Croatian tourism product. Existing research on food as a part of tourism product suggests that food is a significant tourist attraction. To our opinion developing food/gastro tourism can help avoiding the existing problems of current tourism development in Croatia: high seasonality and low per capita expenditure. Food souvenirs are closely related to food tourism and can be a significant extension in tourism product development. However, there is general lack of scientific research on the topic. Recent research in Croatia shows that various tourism service providers do not fully perceive the potential of food tourism and food souvenirs in particular. The major identified problems are monotonous food offerings in hotels, weak supply of local specialty food and discrepancy between tourists' expectations and satisfaction. On the other hand, international tourists in Croatia find that, although their general perception on food in Croatia is positive, there is significant lack on information and promotion on local specialty food and food souvenirs. These findings indicate the need for research on the topic: identifying foodies in Croatian tourism, identifying tourists' buying behaviour related to food and food souvenirs, and identification of major features of food souvenirs that could attract demand.

**Key word:** *tourism, Croatia, food souvenirs, marketing*

## Čepinski kupus u sinergiji znanosti, tradicije i lokalnih potencijala

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### Sažetak

Čepinski kupus je tradicionalna autohtona sorta koja potječe od populacija kupusa koje se već stoljećima uzgajaju na području Općine Čepin. Industrijalizacijom poljoprivredne proizvodnje proširile su se sorte i hibridi kupusa velikih sjemenskih tvrtki koje snabdijevaju glavinu proizvođača kupusa. Nove sorte su gotovo istisnule stare i domaće. Kod potrošača je ustanovljeno suprotno: porast interesa za kupusom autohtonih sorti. Prema rezultatima istraživanja preferencija kod potrošača kupusa, upravo je za čepinski kupus ustanovljen velik potencijal zadovoljavanja rastuće potražnje na tržištu. Udruga Čepinski kupus je prepoznala kao potencijal za povećanje poduzetničke aktivnosti, osobito malih poduzetnika – seljačkih gospodarstava na području Općine Čepin, s pozitivnim posljedicama koje uključuju povećanje zaposlenosti na selu, ostanak mladih u domovini i općenito razvoj ruralne sredine. Zbog toga je Udruga postavila ciljeve koji uključuju povećanje broja proizvođača Čepinskog kupusa, povećanje obima proizvodnje, izgradnju hale za kiseljenje, daljnje povećanje prepoznatljivosti i potražnje za Čepinskim kupusom te povećanje obima i stabilnosti prodaje na tržištima. Dosadašnja postignuća Udruge su registracija Čepinskog kupusa pri DZIV jamstvenim žigom i Pravilnikom o uzgoju čepinskog kupusa, te osnivanje tvrtke Čepinski kupus j.d.o.o. Trenutno se izrađuje projekt izgradnje hale za kiseljenje i znanstvena evaluacija proizvodnje čepinskog kupusa.

**Ključne riječi:** Čepinski kupus, tradicija, poduzetništvo, ruralni razvoj

## Čepin's cabbage in the synergy of science, tradition and local potentials

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### Summary

Cepin's cabbage is a traditional indigenous sorts derived from cabbage populations that have been grown for centuries in the Čepin municipality. The industrialization of agricultural production has expanded the sorts and cabbage hybrids of large seed companies that supply the majority of cabbage producers. New sorts have almost squeezed old and homemade. The opposite is true of the consumer: an increase in interest for the cabbage of autochthonous sorts. According to the research results of cabbage consumer preference, it is precisely for the Cepin's cabbage that a great potential for satisfying the growing demand in the market has been established. The Cepin's Cabbage Association has recognized it as a potential for increasing entrepreneurial activity, especially small entrepreneurs - peasant farmers in Čepin Municipality, with positive consequences including increased rural employment, youth retirement in the countryside, and generally rural development. For this reason, the Association set goals that include increasing the number of Cepin's Cabbage producers, increasing the production volume, building the salty hall, further increasing the recognition and demand for Čepin cabbage, and increasing the scale and stability of sales in the markets. Former achievements of the Association are the registration of Čepin's cabbage at the DZIV guarantee stamp and the Regulation on the cultivation of Cepin's cabbage and the establishment of Čepinski kupus j.d.o.o. At present, the project for the construction of a hall for the souring and the scientific evaluation of the production of Cepin's cabbage is being drafted.

**Key words:** *Čepin's cabbage, tradition, entrepreneurship, rural development*

## The economics of investment in a solar power plant

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### Summary

The European Union has set itself the objective of reducing greenhouse gas emissions by 40% by the year 2030. Renewable energy sources, including photovoltaics, are among the most pure and therefore crucial factors in achieving this goal. The share of renewable energy sources (RES) in gross final energy consumption in Slovenia was 21.9% in 2014 and it was by 5.9 percentage points higher than in 2005. We will need to increase RES by another 3.1 percentage points to reach 25% target by 2020. Solar energy is, following water and wind energy, the third most important source of renewable energy according to the capacity. The total power of all solar power plants in the world reached 100 GW at the end of 2013. We will present an example of a solar power plant, built on the roof of an outbuilding located in the area of the municipality of Šmarje pri Jelšah. The power plant has an area of 730 m<sup>2</sup>, with an installed power of  $P = 102$  kWh. The monocrystalline modules used work also in the diffused light. The average electricity production of approx. 1,100 kWh is predicted in climatic conditions, which means that the expected average annual production of this power plant is approx. 112,000 kWh.

**Key words:** *renewable energy sources, solar energy, solar power plants*



## Self-Sufficiency with Electrical Energy – Net Metering

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### Summary

The investments into solar power plants made a real boom due to the stimulative subsidies in 2011 and 2012. Although the subsidies have been decreasing since 2009, when they were the largest (the guaranteed price of energy from the power plant connected to the building-integrated modules was €470 per MWh), the running costs were decreasing also. The Government of the Republic of Slovenia adopted the Regulation on electricity self-sufficiency from renewable sources, the so-called net metering in December 2015. A measure enabling households and small business users to favour self-sufficiency in electricity has begun to revive investments in smaller solar power systems up to 11 kWh, which is the highest permissible power within this model. The system of electricity self-sufficiency, the net metering system, is defined by the Government regulation for smaller solar power plants (up to 11 kWh) for self-handling with the electrical power of a natural person or an owner of a small business. This model of self-sufficiency with electricity allows the user to discharge the excess amount of energy produced into the electricity grid or take it from the grid when the power plant does not produce electricity. We will present an example of electrical energy cost calculation by using a net metering system with a monthly consumption of 1000 kWh.

**Key words:** *self-sufficiency, electrical energy, net metering*

**Genetika,  
 oplemenjivanje bilja  
 i sjemenarstvo**

**03**

**Genetics,  
 Plant Breeding and  
 Seed Production**



## Antioksidacijski odgovor kukuruza izazvan viškom kadmija i smanjenom količinom vode

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### Sažetak

Višak kadmija i nedostatak vode pripadaju najsnažnijim abiotskim stresnim čimbenicima koji negativno utječu na rast i prinos usjeva. Cilj istraživanja bio je procijeniti oksidacijska oštećenja i antioksidacijski odgovor u listovima dviju inbred linija kukuruza (A: B84, B: Os6-2) i njihovom hibridu (AxB: B84xOs6-2) nakon izlaganja višku kadmija i/ili nedostatku vode u fazi cvatnje, u eksperimentu koji se provodio u plasteniku. U dobro navodnjavanim uvjetima, na toksičnost kadmija u A i AxB ukazuje porast razine lipidne peroksidacije (LP). Pojačana akumulacija prolina u B bi mogla biti razlog nepromijenjene razine LP. U A je porasla aktivnost gvajakol peroksidaze (POD), askorbat peroksidaze (APX) i katalaze (CAT) dok je u B zabilježen porast POD i APX. Nedostatak vode utjecao je na smanjenje RWC-a u A, B i AxB. Kombinacija stresnih čimbenika dodatno je smanjila RWC u A i B, no ne i u AxB. Porast razine LP, sadržaja prolina i aktivnosti enzima POD i APX uočena je u A. U B je zabilježen samo porast enzima POD i APX. Porast aktivnosti enzima APX i pojačana akumulacija prolina u AxB mogli bi biti razlog smanjene LP i nepromijenjene aktivnosti enzima POD. U A, B i AxB zabilježena je inhibicija aktivnosti enzima CAT. Rezultati pokazuju različite strategije antioksidacijskih mehanizama u ispitivanim inbred linijama kukuruza i hibridu u uvjetima istraživanih čimbenika stresa. Čini se da je hibrid tolerantniji od roditeljskih linija, vjerojatno zbog heterozisa i učinka razrjeđenja.

**Ključne riječi:** antioksidacijski enzimi, toksičnost kadmija, kukuruz, prolin, nedostatak vode

## Antioxidative response challenged by excess cadmium and water limitation in maize

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### Summary

Cadmium exposure and water deficit are among the most powerful abiotic stress factors affecting crop growth and productivity. Present study was conducted to evaluate the oxidative damage and the antioxidative response management in the leaves of two maize inbred lines (A: B84, B: Os6-2) and their hybrid (AxB: B84xOs6-2) subjected to excess Cd and or no water limitation in the greenhouse experiment during flowering phase. In well-watered conditions, the increase of lipid peroxidation level (LP) in A and AxB affected by Cd indicates its toxicity, while in B higher amount of accumulated proline could be the reason of maintained LP. In A increased activities of guaiacol peroxidase (POD), ascorbate peroxidase (APX) and catalase (CAT) were shown while in B POD and APX were increased. Water limitation caused decrease in RWC in A, B and AxB. Higher decrease of RWC was observed in combination of stress factors in A and B but not in AxB. The increase of LP and proline content as well as higher activity of POD and APX was observed in A. In B only POD and APX were increased. Increased APX and higher proline accumulation in AxB might be the reason of decreased LP and unchanged POD. Inhibition of CAT activity was observed in A, B and AxB. Obtained results showed different strategies of antioxidative mechanisms in maize inbred lines and their hybrid subjected to investigated stress factors. It seems that hybrid is more tolerant than its parental lines probably due to heterosis and dilution effect.

**Key words:** *antioxidant enzymes, cadmium toxicity, maize, proline, water deficit*

## Utjecaj suše i kadmija na sadržaj lignina u korijenu kukuruza

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### Sažetak

Prijašnja istraživanja pokazala su da manjak vode i teški metali, poput kadmija (Cd), imaju snažan učinak na biosintezu lignina u korijenu kukuruza. U ovom radu istraživan je utjecaj manjka vode i kadmija na sadržaj lignina u korijenu dvije roditeljske linije (B73, Mo17) i njihovog hibrida (B73xMo17). Biljke su bile izložene manjku vode, kadmiju (otprilike do 5 mg Cd/ kg tla) i kombiniranom tretmanu kadmija i manjka vode. U dobro navodnjavanim biljkama (kontrola), B73, Mo17 i B73xMo17, ukupni sadržaj lignina iznosio je 131,96, 103,19 i 212,56 mgg<sup>-1</sup> suhe tvari. U linijama B73 i Mo17 nije zamijećeno značajno smanjenje sadržaja ukupnog lignina u odnosu na kontrolu bez obzira na tretman. Međutim, u hibridu (B73xMo17) sadržaj lignina značajno se smanjio nakon tretmana kadmijem (182,26 mgg<sup>-1</sup> suhe tvari) u usporedbi s kontrolom. Najmanji sadržaj lignina izmjeren je u hibridu izloženom manjku vode (154,34 mgg<sup>-1</sup> suhe tvari), a također i u biljkama podvrgnutim kombiniranom tretmanu manjka vode i kadmija (162,98 mgg<sup>-1</sup> suhe tvari). Dobiveni rezultati pokazuju da korijen hibrida kukuruza (B73xMo17) ima generalno niži sadržaj lignina bez obzira na tretman u usporedbi s dobro navodnjavanim biljkama (kontrolom). Objašnjenje za ovo smanjenje ukupnog sadržaja lignina moglo bi se pripisati adaptivnom odgovoru hibrida budući da je sličan efekt zabilježen u listovima kukuruza izloženih suši.

**Ključne riječi:** kukuruz, lignin, suša, kadmij, korijen

## Effect of drought and cadmium on lignin content in maize root

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### Summary

It was shown before that water deficit and heavy metals, such as cadmium (Cd), have strong effect of lignin biosynthesis in maize roots. In this study we investigated the effect of water deficit and cadmium on lignin content in the root of two inbred lines of maize (B73, Mo17) and their hybrid (B73xMo17). Plants were exposed to water deficit, cadmium (approximately up to 5 mg Cd/ kg soil) and also combined treatment of limited water and cadmium. In well-watered plants (control), B73, Mo17 and B73xMo17, lignin content was 131.96, 103.19 and 212.56 mgg<sup>-1</sup> dry weight (DW), respectively. No significant decrease in total lignin content, compared to control, was observed in lines B73 and Mo17 regardless of the treatment. However, in hybrid (B73xMo17) the lignin content decreased significantly after the treatment with cadmium (182.26 mgg<sup>-1</sup> DW) in comparison to control. The lowest lignin content was measured in hybrid maize line in water limited plants (154.34 mgg<sup>-1</sup> DW) and also in plants subjected to combined treatment of water limitation and cadmium (162.98 mgg<sup>-1</sup> DW). In conclusion, the observed results show that the root of the hybrid (B73xMo17) contained generally lower lignin content regardless of treatment when compared to well-watered plants (control). Explanation for this decrease of total lignin content might be attributed to the adaptive response of hybrid since similar effect was observed in maize leaves exposed to drought.

**Key words:** *maize, lignin, drought, cadmium, root*

## Nakupljanje toplinskih jedinica u Hrvatskoj i Meksiku i oplemenjivanje kukuruza

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### Sažetak

Poznavanje suma toplinskih jedinica potrebnih za cvatnju inbred linija kukuruza važno je kako za oplemenjivanje tako i za sjemensku proizvodnju. Cilj ovoga rada je bio: 1) Usporediti sume toplinskih jedinica za Zagreb-Maksimir, Hrvatska (od 1. travnja do 30. rujna) i za Puerto Vallartu, Jalisco, Meksiko (od 1. studenog do 31. ožujka) i 2) Istražiti nakupljanje toplinskih jedinica i broj dana za razdoblje od sjetve do svilanja za set od 24 inbred linije kukuruza u Rugvici (Hrvatska) i Puerto Vallarti (Jalisco, Meksiko). Od 2007. do 2016. godine sume toplinskih jedinica za Zagreb-Maksimir (01.04.-30.09.) su se kretale od 1519.3 (2014.) do 1750.5 (2011.), dok je za Puerto Vallartu suma toplinskih jedinica (01.11.2016.-31.03.2017.) iznosila 1919. Nakupljene sume toplinskih jedinica (od sjetve do svilanja) u setu od 24 inbred linije u Puerto Vallarti (2016./2017.) kretale su se od 703 kod najranije inbred linije do 863.5 kod najkasnije inbred linije. Najmanje dana od sjetve do svilanja bilo je potrebno najranijoj inbred liniji u zimskoj generaciji u Puerto Vallarti (53), zatim u ekstremno toploj 2017. godini u Rugvici (75), a najviše u 2016. godini u Rugvici (89).

***Cljučne riječi:*** kukuruz, inbred linija, sume toplinskih jedinica



## Accumulation of heat units in Croatia and Mexico and maize breeding

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### Summary

Knowing sums of heat units necessary for flowering of maize inbred lines is important for breeding as well as for seed production. The aim of this study was: 1) To compare the sums of heat units for Zagreb-Maksimir, Croatia (from April 1 to September 30), and for Puerto Vallarta, Jalisco, Mexico (from November 1 to March 31), 2) To investigate accumulation of heat units and number of days for the period from planting to silking for set of 24 maize inbred lines in Rugvica (Croatia), and in Puerto Vallarta (Mexico). From 2007 to 2016 the sums of heat units for Zagreb-Maksimir (from April 1 to September 30) ranged from 1519.3 (2014) to 1750.5 (2011), while for Puerto Vallarta the sum of heat units (from November 1, 2016 to March 31, 2017) was 1919. The accumulated sums of heat units (from planting to silking) for the set of 24 maize inbred lines in Puerto Vallarta (2016/2017) ranged from 703 for the earliest inbred line to 863.5 for the latest inbred line. For the earliest inbred line, for the period from planting to silking it took a minimum of days in winter nursery in Puerto Vallarta (53), then in extremely warm 2017 in Rugvica (75), while the most days were needed in 2016 in Rugvica (89).

**Key words:** *maize, inbred line, sums of heat units*

## Svojstva klijanaca i biljaka engleskog ljulja nakon pet godina skladištenja na različitim temperaturama

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### Sažetak

Istraživanja su provedena s ciljem utvrđivanja kvalitete sjemena engleskog ljulja skladištenog pet godina na različitim temperaturama. Korišteno je sjeme dva kultivara (diploid Bartwingo i tetraploid Calibra) koje je skladišteno na sobnoj te na temperaturama 10, -20 i -80°C. Prije i nakon skladištenja u klima komori utvrđena su svojstva sjemena i klijanaca (klijavost, duljina korijena i stabljike klijanaca). Također, nakon skladištenja sjeme je posijano u kontejnere od stiropora. Određeno je nicanje, a nakon 2 mjeseca svojstva biljaka: visina, dužina korijena, svježja masa korijena i nadzemnog dijela. Dobiven je značajan utjecaj temperature na sva ispitivana svojstva sjemena, klijanaca i mladih biljaka. U prosjeku za kultivare najveće vrijednosti za klijavost sjemena, dužinu korijena i stabljike klijanaca dobivene su kod sjemena skladištenog na -80°C a najniže skladištenjem na sobnoj temperaturi. Najveće prosječne vrijednosti za nicanje, svježju masu korijena i nadzemnog dijela mladih biljaka dobivene su sjetvom sjemena skladištenog na -20°C; visina biljaka bila je najmanja od sjemena skladištenog na sobnoj temperaturi, a između ostalih vrijednosti nije bilo razlike. Duljina korijena bila najveća sjetvom sjemena skladištenog -80°C. Nicanje, duljina korijena, svježja masa korijena i nadzemnog dijela najniže na sobnoj temperaturi. Tetraploidni kultivar Calibra imao je značajno veće prosječne vrijednosti za sva ispitivana svojstva osim klijavosti sjemena i dužine stabljike klijanaca

**Ključne riječi:** engleski ljulj, sjeme, skladištenje, temperatura, kultivar

## Seed quality and plant traits of perennial ryegrass after five years of storage at various temperatures

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### Summary

Aim of the research was to investigate the seed quality of perennial ryegrass stored for five years at various temperatures. There were used the seeds of two cultivars of perennial ryegrass (diploid Bartwingo and tetraploid Calibra), and the storage treatment temperatures were: room temperature, 10°C, -20°C and -80°C. Seed quality traits (germinability and seedling root and leaf lengths) were determined before and after the storage treatments. Additionally, there were tested early development traits in mini-pots during two months of development (emergence, plant height, root length, freshweight of roots and shoots). The research has shown a significant effects of storage temperature to all the investigated traits of seed quality and plant development. The highest average values for germinability and seedling root and shoot lengths were obtained after storage at -80°C, and the lowest after the storage at room temperature. The highest average values for emergence and roots and shoots freshweights were obtained after the storage at -20°C. Plant height was lowest after the storage at room temperature, while the root length was greatest after the storage at -80°C. Emergence, root length, roots and shoots freshweights were lowest after the storage at room temperature. Tetraploid cultivar Calibra had significantly greater average values for all the investigated traits except for germinability and primary shoot length.

**Key words:** *perennial ryegrass, seed, storage, temperature, cultivar*

## New resistant potato varieties at the Agricultural Institute of Slovenia

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### Summary

Potato breeding has a long tradition at the Agricultural Institute of Slovenia. New breeding programme started in 1993 due to high virus infection pressure of extreme resistance to PVY. The main focus of the new programme is breeding of varieties adapted to Slovenian and Balkan growing conditions and customer demands. Crossings with selected parents are done in greenhouse on plants grown on the brick. Mass selection against potato virus Y is performed after artificial inoculation at the seedling stage, followed by selection for important qualitative and quantitative traits, in subsequent 10 field generations. Healthy plant material was transferred in *in vitro* conditions for multiplication before registration trials starts. Extreme resistance genes against potato virus Y from *Solanum stoloniferum* (*R<sub>ysto</sub>*) and *Solanum chacoense* (*R<sub>yche</sub>*) were utilized in the programme. Major *R* late blight resistance genes were introduced from species *Solanum demissum*, *S. bulbocastanum* and *R* genes of Sarpov variety group. Eleven new varieties were released in the last 24 years. They have high yielding potential, excellent quality performance, high resistance level. KIS Sora is a leading high yielding multipurpose variety in a main crop white flesh variety group in Slovenia, with high quality and firm flesh, excellent for pre pack. KIS Krka is a main crop variety tolerant to drought and heat stress, suitable for shallow soils. The late blight resistant early main crop variety KIS Kokra is used by organic growers. KIS Vipava is an early, purple skin and white flesh variety with very long dormancy. Two new potato varieties have been bred at Agricultural Institute of Slovenia (AIS) in 2015 and 2016. The first one was very early variety KIS Slavnik. It gives high yield of less numerous, very large, long oval and uniform tubers with shallow eyes, smooth yellow skin and light yellow flesh. First harvests can be very early, less than 60 days after planting. It is multipurpose early variety suitable for cooking, baking and home-made french fries, it can be used until the new year. The second variety is medium early KIS Savinja. The regular harvest can start around 80 days after planting. It forms medium number of large round-oval tubers with light skin and white flesh. It is suitable for cooking and baking until April. It is resistant to late blight on leaves.

**Key words:** *potato, resistance breeding, PVY, late blight*

## Broj izvornih oplemenjivačkih populacija u germplazmi kukuruza Poljoprivrednoga instituta Osijek

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### Sažetak

Najčešća metoda mjerenja genetičke diferencijacije populacija je Wrightova F statistika. Njen nedostatak je što je za izračun potrebno unaprijed definirati populacije. Ukoliko to nije moguće potrebno je koristiti metode koje ne zahtijevaju unaprijed određenu strukturu. Jedna od tih metoda je korištenje softvera STRUCTURE koji razgraničava grupe jedinki na temelju njihovih genotipova na multiplim lokusima koristeći Bayesovski Markov Chain Monte Carlo pristup (5000 uhadavanja, 10000 prohoda). Cilj ovog istraživanja bio je odrediti broj izvornih oplemenjivačkih populacija u germplazmi kukuruza Poljoprivrednog instituta Osijek na temelju genotipizacije 343 primke (inbred linije) s 47430 SNP markera dobivenih pomoću MaizeSNP50 BeadChip čipa. Rezultati su pokazali da je najviša razina hijerarhije populacijske strukture koja je detektirana prema Evanno metodi jednaka 7 ( $\Delta K = 5078.512$ ). Prema rezultatima populacije su podijeljene na: BSSS, Iodent, Lancaster, Oh43, Oh07, kokičar – tvrdunac i šećerac.

***Ključne riječi:*** populacija, genetika, SNP, STRUCTURE, genotipizacija

## Number of founder breeding populations in maize germplasm of Agricultural institute Osijek

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### Summary

Most widely used method for measure of population structure is Wright's F statistic. Shortcoming of this method is that a predefined number of populations is needed for calculations. If it is not possible to predefine populations it is necessary to use methods that do not require predefined structure. One of these methods is the use of STRUCTURE software that delineates clusters of individuals on the basis of their genotypes at multiple loci using a Bayesian Markov Chain Monte Carlo approach (burn in 5000, 10000 runs). Aim of this research was to determine the number of founder breeding populations in maize germplasm of Agricultural institute Osijek by genotyping 343 accessions (inbred lines) for 47430 SNP markers obtained by MaizeSNP50 BeadChip chip. Results have shown that the uppermost hierarchical level of population structure is 7 by Evanno method ( $K = 5078.512$ ). Based on the results original breeding populations are: BSSS, Iodent, Lancaster, Oh43, Oh07, popcorn – flint and sweet corn.

**Key words:** *population, genetics, SNP, STRUCTURE, genotyping*

## **Klijanje i rani rast genotipova soje u različitim uvjetima trajanja osmoprininga**

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### **Sažetak**

Osmoprining, kao jednostavan i okolišno prihvatljiv tretman sjemena kojim je moguće ublažiti posljedice abiotskog stresa na rast, razvoj i realizirani prinos soje, generira više fizioloških i biokemijskih promjena ovisno o genotipu i osmotskim uvjetima tijekom tretmana. Cilj ovog rada bio je procjena učinka vremena trajanja osmoprininga (12, 24 i 48 sati) osmotskom otopinom polietilen glikola 6000 i vodnog potencijala  $-0,295$  MPa na klijanje (energiju klijanja i klijavost) i rani rast (duljinu petog i osmog dana rasta te prinos svježe i suhe mase korjenčića i stabljike klijanaca) pet genotipova soje (Ika, Korana, Sonja, Sunce i Toma). Rezultati analize varijance ukazali su na značajnost učinka vremena trajanja osmoprininga i genotipa, kao i na značajnost njihove interakcije za istraživana svojstva. Značajno više vrijednosti većine promatranih svojstava ostvarili su genotipovi u uvjetima 12 i/ili 24 satnog osmoprininga. Interakcija genotipa s vremenom trajanja osmoprininga bila je različita za svaki genotip u istraživanju. Korelacije između većine svojstava bile su značajno pozitivne. Rezultati naglašavaju kompleksnost procesa inicijalnog rasta i razvoja biljaka i potvrđuju učinkovitost osmoprininga u povećanju brzine i robusnosti rasta klijanaca.

***Ključne riječi:*** soja, osmoprining, genotip, klijanje, rani rast

## Germination and early growth of soybean genotypes under different conditions of osmopriming duration

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### Summary

Osmopriming, as a simple and environment friendly seed treatment by which is possible to decrease consequences of abiotic stress on growth, development and realised soybean yields generates a number of physiological and biochemical changes that depend on genotype and osmotic conditions during treatment. The aim of this study was to evaluate the effect of priming duration (12, 24 and 48 hours) by polyethylene glycol 6000 osmotic solution with -0.295 MPa of water potential on germination (germination energy and germination) and early growth (radicle and hypocotyl length on fifth and eight day of growth and fresh and dry mass yield of seedling radicle and hypocotyl) of five soybean genotypes (Ika, Korana, Sonja, Sunce and Toma). Results of analysis of variance indicated that osmopriming duration, genotype and their interactions significantly affected all investigated traits. Significantly higher values of most investigated traits of genotypes under 12 and/or 24 hours of osmopriming were recorded. Interaction of genotype by osmopriming duration was specific for each genotype investigated. Significant positive correlations for the most of traits investigated were found. Results emphasize complexity of processes of initial growth and plant development and confirm the efficiency of osmopriming in enhancement of speed and robustness of seedling growth.

**Key words:** *soybean, osmopriming, genotype, germination, early growth*



## Učinak GxO interakcije i stabilnost uroda zrna ozime pšenice u Republici Hrvatskoj

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### Sažetak

Učinak okoline na urod zrna te interakcija genotipa s okolinom najvažniji su izvor varijacije realiziranih uroda zrna ozime pšenice (*Triticum aestivum* L.). Stoga identifikacija genotipova koji realiziraju visoke urode zrna u različitim okolinskim uvjetima ima važnu ulogu kako u izboru roditelja za stvaranje nove genetske varijabilnosti tako i u povećanju stabilnosti prihoda poljoprivrednih proizvođača. Cilj ovog rada bio je ispitati učinak tri agrokološki različite lokacije (Osijek, Zagreb i Poreč) i dvije razine prihrane dušikom (0 i 100 kg N) na urod zrna 64 domaće i inozemne sorte ozime pšenice u vegetacijskoj sezoni 2016./2017. te procijeniti interakciju sorti s okolinom, kao i parametre stabilnosti sa svrhom identifikacije sorti visokih uroda zrna postojanih u različitim okolinskim uvjetima rasta i razvoja. Rezultati analize varijance ukazali su na značajnost učinka genotipa, lokacije i gnojidbe, kao i na značajnost njihovih interakcija za istraživano svojstvo. Prosječni urod zrna varirao je od 5,04 do 9,05  $\text{tha}^{-1}$ . Značajno više vrijednosti uroda zrna ostvarile su sorte na lokaciji Osijek (8,44  $\text{tha}^{-1}$ ). Značajnost učinka gnojidbe na urod zrna ispitivanih sorti ovisila je o lokaciji. Različiti parametri stabilnosti opisali su sorte različito. Rezultati ukazuju na potrebu daljnjeg testiranja GxO interakcija i primjenu više parametara u procjeni stabilnosti uroda zrna genotipova ozime pšenice.

Financijska potpora za ovo istraživanje osigurana je kroz znanstveni projekt HRZZ IP-2016-06 2178 Hrvatske zaklade za znanost.

**Ključne riječi:** ozima pšenica, urod zrna, GxO interakcija, parametri stabilnosti

## Effect of GxE interaction and grain yield stability of winter wheat in Republic of Croatia

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### Summary

Effects of environment on grain yields, as well as interaction of genotype by environment are the most important source of variation in grain yields production of winter wheat (*Triticum aestivum* L.). Therefore, identification of genotypes that realise high grain yields in different environmental conditions has important role not only in parental selection for the induction of novel genetic variation but also in increasing stability of farms incomes. The aim of this study was to investigate the effect of three different agro-ecological locations (Osijek, Zagreb and Porec) and two levels of nitrogen top-dressing (0 and 100 kg of N) on grain yields of 64 domestic and foreign varieties of winter wheat in the 2016-17 growing season, and to evaluate the GxE interaction and stability parameters in order to identify high grain yielding varieties stable in different environmental conditions of growth and development. Results of analysis of variance indicated that genotype, location, top-dressing and their interactions significantly affected investigated trait. Average grain yields varied from 5.04 to 9.05  $\text{tha}^{-1}$ . Significantly higher values of grain yields were recorded at location Osijek (8.44  $\text{tha}^{-1}$ ). Significance of top-dressing effect depended on location. Different stability parameters described genotypes differently. Results suggest that further testing of GxE interactions and combining of stability parameters for the evaluation of winter wheat grain yield genotype stability is required.

Financial support for this study has been provided by the Croatian Science Foundation research grant No. 2016-06-2178.

**Key words:** winter wheat, grain yield, GxE interaction, stability parameters

## Distribucija Dreb 1 gena u germplazmi ozime pšenice

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### Sažetak

Tolerantnost na abiotski stres važan je pravac u oplemenjivanju pšenice posebice u uvjetima ubrzanih klimatskih promjena. Budući da se radi o svojstvima kvantitativne prirode, koja su uvjetovana velikim brojem gena, razumijevanje njihove molekularne i genetske osnove predstavlja veliki izazov. DREB (Dehydration Responsive Element Binding) proteini predstavljaju veliku skupinu transkripcijskih faktora koji reguliraju ekspresiju gena i prijenos signala tijekom odgovora biljke na stres. Dreb 1 grupa gena sudjeluje u odgovoru biljke na abiotski stres, posebice osmotski i temperaturni pa je stoga zanimljiva u kontekstu povećanja tolerantnosti pšenice na sušu. Cilj ovoga istraživanja bio je ispitati distribuciju Dreb 1 gena u germplazmi ozime pšenice. U istraživanje je bilo uključeno 96 kultivara ozime pšenice iz deset europskih zemalja. PCR analiza je provedena korištenjem funkcionalnih markera specifičnih za A, B i D genom pšenice. Početnice P18F/P18R korištene su za identifikaciju Dreb 1 gena na kromosomu 3B, početnice P20F/P20R za identifikaciju Dreb 1 gena na kromosomu 3D, a početnice P21F/P21R za identifikaciju Dreb 1 gena na kromosomu 3A. Prisutnost Dreb-B1 gena utvrđena je kod 15,62 % ispitivanih kultivara pšenice, Dreb-D1 gena kod 94,79 % kultivara, a Dreb-A1 gena kod 82,29 % kultivara. Kod većine ispitivanih kultivara pšenice utvrđena je prisutnost kombinacije Dreb-A1 i Dreb-D1 gena (65,62 %), dok je prisutnost sva tri Dreb 1 gena utvrđena kod 13,54 % ispitivanih kultivara.

***Ključne riječi:*** Dreb geni, pšenica, distribucija

## Distribution of Dreb 1 genes in winter wheat germplasm

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### Summary

Abiotic stress tolerance is an important direction in wheat breeding, especially in conditions of increased climate changes. Since these are quantitative traits, regulated by a great number of genes, understanding of their molecular and genetic basis represents a great challenge. DREB (Dehydration Responsive Element Binding) proteins represent a large family of transcription factors that regulate gene expression and signal transmission during the plant stress response. The Dreb 1 group of genes is involved in plant abiotic stress response, especially osmotic and temperature stress and is therefore interesting in the context of increasing wheat drought tolerance. The aim of this study was to determine the distribution of Dreb 1 genes in winter wheat germplasm. The study included 96 winter wheat varieties from ten European countries. PCR analysis was conducted using functional markers specific for A, B and D genome of wheat. Primers P18F/P18R were used to identify Dreb 1 gene on chromosome 3B, primers P20F/P20R to identify Dreb 1 gene on chromosome 3D and primers P21F/P21R to identify Dreb 1 gene on chromosome 3A. The presence of Dreb-B1 gene was determined in 15.62 % of varieties, Dreb-D1 gene in 94.79 % of varieties and Dreb-A1 gene in 82.29 % of varieties. Most of the examined varieties (65.62 %) had the combination of Dreb-A1 and Dreb-D1 gene, while the presence of all three Dreb 1 genes was determined in 13.54 % of varieties.

**Key words:** *Dreb genes, wheat, distribution*

## Razlike u morfološkim i agronomskim svojstvima heljde u različitim uvjetima uzgoja

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### Sažetak

Zaboravljene odnosno zapostavljene kulture, kao što je heljda, postaju sve značajnije u biljnoj proizvodnji. Može se uzgajati uz vrlo niska ulaganja, kao glavna ili dopunska (postrna) kultura nakon uzgoja ozimih žitarica, a kao takva posebno je interesantna u sustavu ekološkog uzgoja. Prosječni urod heljde kao glavne kulture u Hrvatskoj (konvencionalna proizvodnja) je oko 1,5-2 t ha<sup>-1</sup>, a kao postrnog usjeva oko 1 t ha<sup>-1</sup> što je vrlo nisko stoga je nužno popraviti tehnologiju uzgoja heljde. Zbog povećanog interesa za konzumiranjem i proizvodnjom heljde, problem je nedostatak odgovarajućega sjemenskog materijala. Stoga se javila potreba za prikupljanjem postojećih lokalnih populacija heljde preostalih na području Hrvatske. Cilj ovog istraživanja bio je utvrditi razlike u morfološkim i agronomskim svojstvima kod šest populacija heljde sakupljenih na području sjeverozapadne Hrvatske te dvije sorte Darje i Novosadske u različitim uvjetima uzgoja. Poljski pokus sijan u tri sjetvene norme (60, 80 i 100 kg ha<sup>-1</sup>) postavljen je u 2017. godini na dvije lokacije Varaždin i Sveta Marija. Sijan je u dva roka sjetve (kao glavni i postrni usjev) te dva načina proizvodnje (konvencionalna i ekološka). Populacije heljde međusobno se nisu značajno razlikovale u morfološkim i agronomskim svojstvima, dok je utvrđena razlika između sorata. Značajne razlike u morfološkim i agronomskim svojstvima kod ispitivanih populacija i sorti utvrđene su za rok sjetve te za gustoću sjetve. Obzirom na način proizvodnje nisu utvrđene značajne razlike među promatranim svojstvima.

**Ključne riječi:** heljda, norma sjetve, rok sjetve, konvencionalni i ekološki uzgoj

## Differences in morphological and agronomic traits of buckwheat in diverse breeding conditions

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### Summary

Forgotten or neglected crops, such as buckwheat, are becoming increasingly important in crop production. Buckwheat can be grown with very low investment as the main or supplementary (stubble) crop after winter crops harvest, and as such is particularly interesting for organic farming. In Croatia the average yield of buckwheat as the main conventional crop is 1.5-2 t ha<sup>-1</sup>, and as a stubble crop is about 1 t ha<sup>-1</sup> which is very low. It is therefore necessary to improve its agrotechnology. Due to the increased interest in the consumption and production of buckwheat, there are shortages of appropriate seed material. Therefore it was necessary to collect remaining local buckwheat populations in Croatia. The aim of this study was to determine the differences in morphological and agronomic properties in six populations of buckwheat collected in northwestern Croatia and two varieties of Darja and Novosadska in different growing conditions. A field trial sown in three seeding rates (60, 80 and 100 kg ha<sup>-1</sup>) was set up in 2017 at two sites Varaždin and Sveta Marija. It was sown in two sowing dates (main and stubble crop) and two cropping systems (conventional and organic). Buckwheat populations did not differ significantly in morphological and agronomic traits, while the difference between the varieties was determined. Significant differences in morphological and agronomic traits in examined populations and varieties were determined for sowing time and density. Type of production system had no significant effect on the average traits values.

**Key words:** buckwheat, seeding rate, sowing date, conventional and organic cropping system

## Procjena parametara pecivne kakvoće pšenice tijekom 2015. i 2016. godine

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### Sažetak

U radu je analizirano 6 kultivara pšenice uzgojenih na Poljoprivrednom institutu Osijek tijekom 2 vegetacijske sezone 2014./2015. i 2015./2016. Udio proteina u obje se godine nije značajno razlikovao (13,4% i 13,3%). U 2015. zabilježena je veća moć upijanja vode (58,0%) u odnosu na 2016. (56,2%) te su se kultivari u obje godine u prosjeku svrstali u A2 grupu kvalitete. Općenito, prema reološkim pokazateljima, u 2015. zabilježena je bolja pecivna kakvoća. Što se tiče analiziranih proteinskih frakcija RP-HPLC metodom, kultivari su u prosjeku 2015. ostvarili veći udio AG, ukupnih GLU, te HMW i LMW gluteninskih podjedinica, odnosno manji udio GLI što je značajno pozitivno utjecalo na smanjenje GLI/GLU omjera. U prosjeku su kultivari Kraljica (14,2%) i Olimpija (15,0%) ostvarile najveći udio ukupnih proteina vrlo dobre kakvoće obzirom na postignuta reološka svojstva tijesta i udio vrlo važnih polimernih GLU (34,0% i 35,0%) i HMW podjedinica (10,2% i 10,0%).

Ovaj rad djelomično je financiran od strane Hrvatske zaklade za znanost (HRZZ-UIP-2014-9188).

**Ključne riječi:** pšenica, pecivna kakvoća, proteinske frakcije

## Assessment of wheat bread-making quality during 2015 and 2016

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### Summary

Six wheat cultivars grown at the Agricultural Institute Osijek during 2 vegetation seasons 2014/2015 and 2015/2016 were evaluated in this study. The proportion of protein in both years did not differ significantly (13.4% and 13.3%, respectively). In 2015 a higher water absorption capacity (58.0%) was recorded compared to 2016 (56.2%). On average, in both years cultivars are ranked in A2 quality group. According to the obtained dough rheological properties, in 2015 a better bread-making quality has been recorded. As regards the analyzed protein fractions by RP-HPLC method, the cultivars on average had a higher proportion of AG, total GLU and HMW and LMW glutenin subunits and a lower GLI proportion which significantly contributed to the reduction of the GLI/GLU ratio. On average, cv. Kraljica (14.2%) and Olimpija (15.0%) achieved the highest proportion of total proteins with excellent quality in terms of dough rheological parameters and proportion of very important polymer GLU (35.0% and 35.9%, respectively) and HMW glutenin subunits (10.0% and 10.4%, respectively).

Acknowledgments: This work has been supported in part by Croatian Science Foundation (HRZZ-UIP-2014-9188).

**Key words:** *wheat, cultivars, bread-making quality, protein fractions*



## Prinos i kakvoća zrna najzastupljenijih sorti pšenice u Republici Hrvatskoj

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### Sažetak

Sortiment ozime pšenice u Republici Hrvatskoj čine domaće i strane sorte s različitim tržišnim udjelom. Tijekom 2017. godine zasijano je 105.000 ha ozime pšenice sa 73 različite sorte. Pokus je postavljen po blok metodi sa slučajnim rasporedom (RCBD) u HCPHS - Zavodu za sjemenarstvo i rasadničarstvo na lokaciji Osijek (N 45°31', E 18°40') uz primjenu standardne agrotehnike za pšenicu tijekom tri vegetacijske godine (od 2014./2015. do 2016./2017. godine) sa 16 sorata koje zauzimaju preko 70% ukupno zasijanih površina u Republici Hrvatskoj u dvije repeticije. Na temelju dobivenih rezultata utvrđene su statistički opravdane razlike ( $P < 0,01$ ) između sorata, godina i interakcije sorta x godina za svojstvo prinosa i sadržaja proteina. Najveći prosječni prinos ostvarile su sorte Sofru (11,61 t/ha), Kraljica (11,13 t/ha) i Apache (11,08 t/ha) te između njih nema statistički opravdane razlike (n.s.). Sorte koje su imale najveći prosječni postotak proteina su Viktorija (13,52%), Kraljica (13,5%) i Bologna (13,5%) između kojih nema statistički opravdane razlike (n.s.). Navedene sorte prema sadržaju proteina i kodeksu za otkup žitarica i uljarica spadaju u prvu klasu. Dobiveni rezultati ukazuju na mogućnost povećanja dobiti odabirom prinosa i kvalitete.

**Ključne riječi:** ozima pšenica, sorta, prinos i postotak proteina

## Grain yield and quality of most common wheat varieties in Croatia

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### Summary

Assortment of winter wheat varieties in Croatia contains domestic and foreign varieties with different market share. Total of 73 winter wheat varieties, including 16 varieties covering 70% of total arable areas in Croatia, were sown during 2017 on 105 000 ha. The experiment was set up by RCBD in CCAFRA – Institute for Seed and Seedlings on location Osijek (N 45°31', E 18°40'). Standard agrotechnics was applied during three vegetation years (2014/2015; 2015/2016 and 2016/2017) in two repetitions. Based on the results statistically justified differences were established ( $P < 0.01$ ) between varieties, years and genotype x year interaction for yield and protein content. Three varieties achieved the statistically highest average yield: Sofru (11.61  $\text{tha}^{-1}$ ), Kraljica (11.13  $\text{tha}^{-1}$ ) and Apache (11.08  $\text{tha}^{-1}$ ), among which no statistically differences (n.s.) were found. The varieties that had the statistically highest average percentage of protein were Viktoria (13.52%), Kraljica (13.5%) and Bologna (13.5%). The specified varieties according to the protein content and codex for cereals and oilseeds belonged to the first class. The obtained results indicate the possibility of increasing profit by selecting high yielding varieties with good quality.

**Key words:** winter wheat, variety, yield and percentage of protein

## Vrijednosti uroda i pokazatelji kvalitete ozime pšenice u proizvodnoj 2016./2017. godini

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### Sažetak

Visok, stabilan urod ozime pšenice kao i visoka kvaliteta zrna ciljevi su oplemenjivačkih programa unutar Bc Instituta d.d. Ispitivanje stabilnosti uroda i kvalitete Bc sorata ozime pšenice provodi se na velikom broju lokacija diljem Republike Hrvatske (RH) (obiteljska poljoprivredna gospodarstva - OPG) kao i u komparativnim pokusima zajedno sa sortama ozimih pšenica drugih oplemenjivačkih kuća prisutnih na tržištu RH. Stupanjem na snagu Kodeksa otkupa žitarica i uljarica, sadržaj proteina nametnuo se kao najvažniji pokazatelj kvalitete zrna. Ozima pšenica BC Anica u žetvi 2017., u pokusu postavljenom na jednom OPG-u, ostvarila je rekordan urod zrna od 10,95  $\text{tha}^{-1}$  uz istovremeni sadržaj proteina od 13,78%. Time je pokazala visoki proizvodni potencijal te potvrdila status najbolje pšenice u regiji. Vrlo visoki urod zrna (10,93  $\text{tha}^{-1}$ ) uz istovremeno visoki sadržaj proteina u zrnu (13,90%) također u pokusu OPG-a, ostvarila je još jedna BC pšenica - BC Lorena. Visokoprinosna ozima pšenica BC Mandica u žetvi 2017. ostvarila je urod zrna veći od 11  $\text{tha}^{-1}$  što ju svstava u kategoriju naprinosnijih hrvatskih sorti. U nezavisnom, komparativnom pokusu u konkurenciji sa 43 sorte ozime pšenice, novopriznata pšenica Bc Instiuta - BC Ljepotica ostvarila je najveći urod zrna (10,12  $\text{tha}^{-1}$ ) i tako postala apsolutni šampion pokusa. Unatoč manjem broju zasijanih hektara u vegetacijskoj godini 2016./2017., BC pšenice zabilježile su rast čime su potvrdile svoju vrijednost.

***Ključne riječi:*** ozima pšenica, urod, kvaliteta

## Grain yield and quality indicators of winter wheat in 2016/2017 production

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### Summary

High, stable yield of winter wheat as well as high grain quality are main objectives in breeding programs at the Bc Institute. Testing the yield stability and grain quality of the Bc winter wheat is set at numerous locations throughout the Republic of Croatia (on a family farms) as well as in comparative trials together with cultivars another breeding Institutes present on the Croatian market. Due to the Code of Cereals and Oilseeds, grain protein content (GPC) was imposed as the most important indicator of grain quality. Winter wheat BC Anica in harvest 2017, in the trail set on one family farm, achieved the best yield of 10,95 t ha<sup>-1</sup> at the same time with GPC of 13.78%. This showed high production potential and confirmed the status of the best wheat in the region. A very high grain yield (10.93 t ha<sup>-1</sup>) at the same time with high GPC (13.90%) also on a family farm trail was made by another BC wheat - BC Lorena. The winter wheat, Bc Mandica in harvest 2017 achieved a grain yield more than 11 t ha<sup>-1</sup> and was between the highyielding Croatian varieties. In an independent, comparative trial in competition with 43 wheat cultivars, new winter wheat of Bc Institute - BC Ljepotica achieved the highest grain yield (10.12 t ha<sup>-1</sup>) and thus became the absolute champion of the trail. Despite a smaller number of sown hectares in the vegetative year 2016/2017, BC wheat recorded growth, thus confirming their value.

**Key words:** *winter wheat, grain yield, quality*

## Ispitivanje eksperimentalnih BC hibrida kukuruza u sušnoj 2017. godini

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### Sažetak

Za stvaranje novih inbred linija i hibrida kukuruza, koji će davati odlične urode u povoljnim godinama kao što su bile 2014. i 2016., odnosno zadovoljavajuće prinose u sušnim godinama kao što su bile 2015. i 2017. potrebno je testiranje istih na što više različitih okolina. Cilj ovog istraživanja je bio testirati 14 novih, eksperimentalnih hibrida u uvjetima intenzivne agrotehnike na prinos zrna i sadržaj vode u zrnu. Pokusi su postavljeni na četiri lokacije u Mađarskoj (Boly, Dalmand, Bekescsaba i Cegled) po slučajnom blok rasporedu u tri repeticije. Testirano je 14 hibrida kukuruza FAO grupe 300 i 400, te jedan standard FAO grupe 300. Na lokaciji Dalmand najrodniji je bio standard ( $12,51 \text{ tha}^{-1}$ ), na lokaciji Cegled najrodniji je bio hibrid BC15 ( $13,86 \text{ tha}^{-1}$ ). Na preostale dvije lokacije najbolji su bili hibridi BC10 (Bekescsaba,  $14,11 \text{ tha}^{-1}$ ) i hibrid BC7 na lokaciji Boly ( $13,00 \text{ tha}^{-1}$ ).

***Ključne riječi:*** kukuruz, prinos zrna, okoline

## Testing of experimental BC maize hybrids in drought 2017

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### Summary

For developing new maize inbred lines and hybrids, with excellent yield performance during optimal vegetation years such it was in 2014 and 2016, and with good yield performance in drought season like it was in 2015 and 2017, it is necessary to test it in many different environments. The aim of this study was to test 14 new experimental maize hybrids in intensive agrotechnical conditions for grain yield and grain moisture. The trials were set up at four locations in Hungary (Boly, Dalmand, Bekescsaba and Cegled) in randomized block design in 3 repetitions. Fourteen hybrids were tested from FAO group 300 and 400 and one control hybrid from FAO 300. At the Dalmand location the best yielding hybrid was standard hybrid (12.51  $\text{tha}^{-1}$ ) and on location Cegled the best yielding hybrid was BC15 (13.86  $\text{tha}^{-1}$ ). At the other two locations, the best hybrids were BC10 in Bekescsaba (14.11  $\text{tha}^{-1}$ ) and BC7 in Boly (13.00  $\text{tha}^{-1}$ ).

**Key words:** *maize, grain yield, environments*

## Development of oleic type sunflower inbred lines resistant to broomrape and downy mildew using molecular markers

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### Summary

Sunflower (*Helianthus annuus* L.) is one the main oil crops in the Eastern Europe and oleic type sunflowers increase market shares year by year. The biggest problems in sunflower production are broomrape (*Orobanche cumana* Wallr.) and downy mildew (*Plasmopara halstedii* (Farlow) Berlese & de Toni)). Developing new inbred lines and hybrids combining all desired traits, such as resistance to diseases, higher yield, quality and adaptation, take many years and numerous generations. New molecular tools, such as molecular markers, will lead to efficient selection and accelerate breeding programs. Recently, occurrence of new races of broomrape and downy mildew in Turkey and in other Eastern European countries, lead to domination of IMI herbicide resistant hybrids. Besides broomrape and downy mildew new sunflower inbred lines need to have high oleic acid content. This research covers developing high oleic type sunflower inbred lines (property of National Sunflower Hybrid Breeding Project conducted by Trakya Agricultural Research Institute). Over 800 genetic materials were evaluated in summer of 2015 summer for broomrape, downy mildew and other desired traits in the breeding nursery. After fatty acids analysis, high oleic type genetic materials were selected and also marker analysis for oleic types were conducted. Based on the broomrape and downy mildew test results, 239 F<sub>3</sub> high oleic individuals were selected in 2016. These genetic materials were confirmed by marker analysis having homozygous oleic gene. The selected high oleic and having other desired traits were selected for further generations in 2017.

This study was supported by the Scientific and Technological. Research Council of Turkey (TUBITAK) under the Project 1003- 114O971.

**Key words:** sunflower, inbred lines, hybrid breeding, resistance, broomrape parasite, oleic acid

## Učinak selekcije u F<sub>3</sub> razdvajajućoj generaciji na dormantnost F<sub>7</sub> potomstava kod pšenice

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### Sažetak

Dormantnost zrna pšenice je glavna komponenta otpornosti na priježetveno proklijavanje, koja osigurava stabilnost pekarske kakvoće zrna u vlažnim uvjetima tijekom žetve. Cilj rada bio je procijeniti učinak selekcije, provedene u F<sub>3</sub> generaciji nakon križanja nedormantnog (linija brkulja) i dormantnog (linija golica) roditelja, na dormantnost zrna kod F<sub>7</sub> potomstva te utvrditi učinak provedene selekcije na visinu biljke i duljinu vegetacije proizvedenih potomstva. Za procjenu dormantnosti zrna korišten je test klijavosti s ovršenim zrnima. Rezultati su pokazali da je selekcija dovela do signifikantnog povećanja razine dormantnosti i kod golica i kod brkulja, pri čemu je učinak selekcije bio znatno veći kod golica nego kod brkulja. U skupini golica opaženo je pozitivno transgresivno razdvajanje rezultirajući s nekoliko F<sub>7</sub> potomstava s razinom dormantnosti većom od dormantnog roditelja. Korelacije između indeksa klijanja i broja dana do klasanja za sva F<sub>7</sub> potomstva, F<sub>7</sub>-golice i F<sub>7</sub>-brkulje (kontrola) bile su slabe i kretale su se u apsolutnim vrijednostima od 0,04 do 0,39. Korelacije između indeksa klijanja i visine biljke u tri skupine F<sub>7</sub> linija bile su također slabe i kretale su se od -0,01 do -0,28. Ipak, selekcija na povećanu dormantnost zrna dovela je do signifikantnog smanjenja visine biljke i kasnijeg klasanja kod izabranih F<sub>7</sub> potomstava.

**Ključne riječi:** pšenica, dormantnost zrna, selekcija, visina, klasanje



## The effect of selection in F<sub>3</sub> segregating generation on grain dormancy of F<sub>7</sub> progenies in wheat

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### Summary

Dormancy of wheat grain is the main component of pre-harvest sprouting resistance, which ensures the stability of bread-making quality of the grain in humid conditions during harvest time. The aim of this study was to estimate the effect of selection, conducted in F<sub>3</sub> generation after crossing of nondormant (awned) and a dormant (awnless) parent, on grain dormancy of F<sub>7</sub> progenies and to determine the effect of selection on plant height and number of days to heading in produced progenies. To evaluate grain dormancy, a germination test with threshed grain was used. It was found that the selection resulted in a significant increase of the dormancy level in F<sub>7</sub> progenies, whereby the selection was more effective in awnless compared to awned progenies. In the awnless group, positive transgressive segregation was observed, resulting in several F<sub>7</sub> progenies with dormancy level higher compared to the dormant parent. Correlations between germination index and number of days to heading for all F<sub>7</sub> progenies, F<sub>7</sub>-awnless and F<sub>7</sub>-awned (control) progenies were low ranging in absolute values from 0.04 to 0.39. Correlations between germination index and plant height in the three groups of F<sub>7</sub> progenies were also low ranging from -0.01 to -0.28. Nevertheless, the selection for increased grain dormancy led to a significant decrease of plant height and a significant increase of number of days to heading in selected F<sub>7</sub> progenies.

**Key words:** *wheat, grain dormancy, selection, plant height, heading*

## Dialelna analiza otpornosti ozime pšenice na fuzarijsku palež klasa

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### Sažetak

U ovom radu su prikazani rezultati dialelne analize otpornosti na fuzarijsku palež klasa (FHB) kod osam europskih genotipova ozime pšenice i njihovih F<sub>1</sub> križanaca. Genotipovi su uzgojeni tijekom dvije uzastopne godine na lokaciji Botinec u uvjetima umjetne FHB infekcije i u prirodnim uvjetima (kontrola). Intenzitet zaraze ocijenjen je putem vizualne ocjene u polju (VRI) i postotka fusariumom oštećenih zrna (FDK). Smanjenje broja zrna po klasu (BZK), mase 1000 zrna (MTZ) i mase zrna po klasu (MZK) korišteni su za procjenu gubitka prinosa nastalog uslijed umjetne infekcije u odnosu na kontrolu. Učinci za opću (GCA) i specifičnu (SCA) kombinacijsku sposobnost bili su značajni za sva svojstva. Heterozis je je opažen za sva svojstva, što ukazuje da genotipovi roditelja posjeduju različite gene koji kontroliraju analizirana svojstva. Intenzitet zaraze u prirodnim uvjetima bio je znatno niži (variranje između genotipova 0,1-3,4% za VRI i 0,1-1% za FDK) u usporedbi s umjetnom inokulacijom (0,9-58% za VRI i 1,4-45% za FDK). Korelacija između VRI i FDK bila je niža u prirodnim uvjetima ( $r=0,62$ ) nego u umjetnoj infekciji ( $r=0,90$ ). Umjetna infekcija smanjila je BZK, MTZ i MZK u prosjeku za 15,12 i 25%, varirajući u rasponu od 2 do 28%, 2 do 29%, odnosno 2 do 46%. Korelacije s dvijema ocjenama bolesti (VRI i FDK) u uvjetima FHB infekcije bile su znatno veće kod MTZ nego kod BZK ukazujući na važnost stabilne MTZ kao ključne komponente otpornosti na FHB.

**Ključne riječi:** *Triticum aestivum L., Fusarium graminearum Schwabe, otpornost, prinos*

## Diallel analysis of Fusarium head blight resistance in winter wheat

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### Summary

In this study we present the results of an diallel analysis of Fusarium head blight (FHB) resistance involving eight European winter wheat genotypes and their F<sub>1</sub> crosses. Genotypes were grown over two consecutive years at location Botinec under artificial FHB infection and in natural conditions (control). Disease severity was scored as visual rating index (VRI) and percentage of fusarium damaged kernels (FDK). The reductions of grain number per spike (GNS), 1000-grain weight (TGW), and grain weight per spike (GWS) were used to evaluate the grain yield loss under FHB infection relative to the control. Both general (GCA) and specific (SCA) combining ability effects were significant for all examined traits. Heterosis was common for all traits, indicating that the parental genotypes possess different genes controlling the traits. The incidence of the disease in the control varied in much lower range (0.1-3.4% for VRI and 0-1.1% for FDK) than under FHB infection (0.9-58% for VRI and 1.4-45% for FDK). The correlation between VRI and FDK was also lower in the control ( $r=0.62$ ) than under FHB infection ( $r=0.90$ ). The FHB infection reduced GNS, TGW and GWS in average by 15, 12 and 25%, ranging from 2 to 28%, 2 to 29%, and 2 to 46%, respectively. Correlations of the two disease ratings (VRI and FDK) under FHB infection was much higher with TGW than with GNS indicating the importance of stable TGW as the key component of the FHB resistance.

**Key words:** *Triticum aestivum L*, *Fusarium graminearum Schwabe*, resistance, yield

## Varijabilnost sadržaja izoflavona u domaćim genotipovima soje

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### Sažetak

Soja je poznata kao bogat izvor fitokemikalija izoflavona za koje se smatra da imaju ulogu u prevenciji i liječenju raka i osteoporoze. Cilj ovog trogodišnjeg pokusa (2010.-2012.) je bio dati uvid u sastav izoflavona kod 19 domaćih genotipova soje. Rezultati pokusa i proizlazeće statističke analize ukazuju na postojanje varijabilnosti ( $P < 0,01$ ) u fenotipskoj ekspresiji testiranih genotipova za ukupne izoflavone, daidzein, glicitein i genistein. Divergentnost je utvrđena i u fenotipskoj reakciji genotipova na različite uvijete okoline za sve testirane parametre što je rezultiralo u značajnoj varijabilnosti ( $P < 0,01$ ) prosječnih vrijednosti po godinama. Prosječna vrijednost za ukupne izoflavone, koje čini suma daidzeina, gliciteina i genisteina, iznosila je 166,34 mg/100 g AST. Od tri istraživana izoflavona, genistein je imao najveći prosječni sadržaj (96,61 mg/100 g AST) dok je prosječni sadržaj gliciteina bio najniži (20,53 mg/100 g AST). Prosječna vrijednost za sadržaj daidzeina iznosila je 49,19 mg/100 g AST. Istovremeno, koeficijent varijacije je bio najviši za genistein (33,98 %), zatim za ukupne izoflavone (24,61 %) i daidzein (21,16 %), dok je najniži bio za glicitein (19,69 %). Rezultati ovog istraživanja mogu biti korisni za određivanje i planiranje budućih strategija oplemenjivačkih programa čiji je cilj korekcija sadržaja izoflavona u domaćoj germplazmi soje. Na taj način bi se mogla povećati krajnja vrijednost proizvoda od soje za prerađivačku industriju i potrošače, čineći kvalitetnu sirovinu sastavni dio održive proizvodnje.

**Ključne riječi:** soja, izoflavoni, varijabilnost, oplemenjivanje

## Variability of isoflavone content in domestic soybean genotypes

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### Summary

Soybean is known as a concentrated source of isoflavones which are phytochemicals with a potential role in preventing and treating cancer and osteoporosis. The aim of this three-year trial (2010-2012) was to give insight into isoflavone composition of 19 domestic soybean genotypes. The experimental and biometrical results indicate the existence of variability ( $P < 0.01$ ) in phenotypic expression of the tested set of genotypes for total isoflavones as well as daidzein, glycitein and genistein. Divergence was also observed in the phenotypic reaction of genotypes to different environments for all tested parameters which resulted in significant variability ( $P < 0.01$ ) between average year values. The average value for total isoflavones, as a sum of daidzein, glycitein, and genistein contents was 166.34 mg/100 g ADM. Among the three determined isoflavones, genistein had the highest average content (96.61 mg/100g ADM), while glycitein had the lowest (20.53 mg/100 g ADM). The average value for daidzein was 49.19 mg/100g ADM. At the same time, the coefficient of variation was the highest for genistein (33.98 %), followed by total isoflavones (24.61 %), daidzein (21.16 %) and glycitein (19.69 %). Results obtained in this research should be beneficial in determining and planning future breeding strategies for altering isoflavone content values in domestic soybean germplasm, thus enhancing the added value properties of final soybean products for industry and end consumers, making it an integral part of the sustainable production.

**Key words:** *soybean, isoflavones, variability, breeding*

## Nenamjerna selekcija na kasniju cvatnju i segregacijska distorzija kod dihaploidnih populacija kukuruza

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### Sažetak

Tehnologija udvostručenih haploida (dihaploida-DH) je globalno priznata kao učinkovita i brza metoda dobivanja homozigotnih linija u programima oplemenjivanja kukuruza. Međutim, primijetili smo kod tri ne BSSSxLancaster DH populacije da cvatu značajno kasnije od njihovih paralelnih F<sub>2</sub> populacija. Cilj ovoga rada je istražiti povezanost između ove nenamjerne selekcije na kasniju cvatnju i segregacijske distorzije prethodno utvrđene genotipizacijom pomoću Illumina MaizeSNP50 čipa. Kod sve tri DH populacije ustanovljena je segregacijska distorzija na skoro svim kromosomima. Jedino jedna regija s segregacijskom distorzijom na kromosomu 3 (bin 3.9) detektirana statistički visoko značajnim zajedničkim Wald testom mogla se nedvosmisleno dovesti u vezu s nenamjernom selekcijom na kasniju cvatnju gdje su SNP biljezi bili ekstremno distorzirani prema kasnijem roditelju. U prosjeku, DH linije koje posjeduju alel od kasnijeg roditelja cvale su (polinacija i svilanje) više od 10 GDD jedinica (growing degree days) kasnije u usporedbi s DH linijama koje posjeduju alel od ranijeg roditelja. Ovo predstavlja manje od 20% fenotipske razlike u cvatnji između linija DH populacija i odgovarajućih F<sub>2</sub> populacija. Naši rezultati ukazuju da segregacijska distorzija ne objašnjava u potpunosti pomicanje vremena cvatnje kod DH populacija sugerirajući potrebu za daljnjim istraživanjima fenotipske i molekularne karakterizacije DH populacija.

**Ključne riječi:** kukuruz, udvostručeni haploidi, nenamjerna selekcija, cvatnja, segregacijska distorzija

## Inadvertent selection for late flowering and segregation distortion in doubled haploid maize populations

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### Summary

Doubled haploid (DH) technology is recognized globally as an efficient and rapid method for development of homozygous lines in maize breeding programs. Still, we observed in three DH non BSSSxLancaster populations that they flower significantly later than their respective F<sub>2</sub> populations. The objective of this study was to examine associations between this inadvertent selection for late flowering and segregation distortion previously identified by genotyping of the three DH populations using the Illumina MaizeSNP50 BeadChip. Across all three populations, several segregation distortion regions were detected on almost all chromosomes. A segregation distortion region on chromosome 3 (bin 3.9) detected by highly significant joint Wald test statistics was the only region unequivocally associated with the inadvertent selection for late flowering where SNP markers were extremely distorted towards respective later parents. In average, the DH lines possessing the allele of the later parent flowered (both for pollen shedding and silking) later for more than 10 growing degree days (GDD) compared to the DH lines possessing the allele of the earlier parent. It explained less than 20% of phenotypic difference between DH population and respective F<sub>2</sub> populations for flowering time. Our results indicate that segregation distortion cannot fully explain shifting of flowering time suggesting further investigation on phenotypic and molecular characterization of DH populations.

**Key words:** *maize, doubled haploids, inadvertent selection, flowering, segregation distortion*

## Utjecaj kadmija i suše na fotosintetsku učinkovitost u kukuruзу

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### Sažetak

Kadmij u tlu i suša uzrokuju značajne probleme u prirodnim i poljoprivrednim ekosustavima. Cilj ovog istraživanja bio je istražiti utjecaj stresa uzrokovanog kadmijem i/ili sušom na fotosintetsku učinkovitost kukuruза. Dvije linije kukuruза (B84 i Os6-2) te njihov hibrid (B84xOs6-2) bili su izloženi stresu uzrokovanom kadmijem (Cd), suši (D) te kombinaciji stresa uzrokovanog kadmijem i sušom (Cd+D). Kako bi se procijenila fotosintetska učinkovitost mjerena je fluorescencija klorofila *a*. Totalni indeks fotosintetske učinkovitosti ( $PI_{tot}$ ) najosjetljiviji je parametar JIP-testa koji uključuje učinkovitost fotosustava II (PSII), fotosustava I te elektronskog transporta između oba sustava. Linija Os6-2 pokazala je značajan pad  $PI_{tot}$  parametra nakon izlaganja tretmanima D i Cd+D. Oba tretmana pokazala su pozitivne vrijednosti L i K-koraka koji ukazuju na smanjenu stabilost PSII, odnosno na destabilizaciju kompleksa koji katalizira oksidaciju vode smještenog na PSII. Linija B84 pokazala je pad  $PI_{tot}$  parametra samo na tretmanu D uz istovremeni porast L i K-koraka. Hibrid je pokazao smanjenje  $PI_{tot}$  parametra na Cd+D tretmanu kao i pozitivne L i K-korake. Smanjenje  $PI_{tot}$  parametra ukazuje da je vodni stres glavni razlog fotoinhibicije u linijama B84 i Os6-2. Fotoinhibicija uslijed izlaganja kombiniranom stresu javila se kod hibrida i linije B84. Obje istraživane linije kukuruза i njihov hibrid imaju različite strategije da se nose sa stresom uzrokovanim kadmijem i/ili sušom.

**Ključne riječi:** fluorescencija klorofila *a*, JIP-test,  $PI_{total}$ , L-korak, K-korak



## The effect of cadmium and water stress on photosynthetic performance in maize

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### Summary

Cadmium (Cd) toxicity in soil and water deficit are causing serious problems in natural and agricultural ecosystems. The aim of this study was to investigate the influence of Cd and/or drought on photosynthetic performance of maize. Two maize lines (B84 and Os6-2) as well as their hybrid (B84xOs6-2) were subjected to Cd-induced stress (Cd), drought (D) and combined stress (Cd+D). To evaluate photosynthetic performance, chlorophyll *a* fluorescence was measured. Total performance index ( $PI_{tot}$ ) is the most sensitive parameter of JIP-test that includes functional activity of photosystem II (PSII), photosystem I and intersystem electron transport chain. The line Os6-2 showed significant decline of  $PI_{tot}$  subjected to D and Cd+D treatments. In addition, both treatments showed positive L and K-bands, indicating lower PSII stability and destabilization of oxygen evolving center of PSII, respectively. The  $PI_{tot}$  in the line B84 declined only at D treatment with parallel increase in L-band and positive inflection of K-band. The hybrid showed decrease of  $PI_{tot}$  at Cd+D treatment with corresponding positive L and K-bands. Decline of the  $PI_{tot}$  parameter indicated that drought is the main reason for photoinhibition in Os6-2 and B84 lines. Photoinhibition due to the combination of Cd and drought occurred in hybrid and also in line B84. Our results suggested that both investigated maize lines and their hybrid have different strategies to cope with Cd-induced stress and/or drought.

**Key words:** *chlorophyll a fluorescence, JIP-test,  $PI_{total}$ , L-band, K-band*

## Vremenski uvjeti u mikropokusima sa kukuruzom i sojom na 19 lokacija širom Hrvatske u 2017. godini

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### Sažetak

Brojna recentna istraživanja potvrđuju postupni porast prosječnih dnevnih temperatura u zadnjih nekoliko decenija te povećanu učestalost ekstremnih godina u smislu količine i rasporeda oborine, a brojne simulacije upućuju da će se ovaj trend nastaviti i u narednim decenijama. Zbog velikih površina na kojima se uzgajaju i dominantnom uzgoju bez navodnjavanja, proizvodnji kukuruza i soje u Hrvatskoj prijete snižavanje prosječnih uroda i velike štete u ekstremnim godinama, posebno onim s obilježjima suše. Među inim agrotehničkim mjerama kojima se mogu ublažiti utjecaji suše, svakako najekonomičniji i najpoželjniji je razvoj novih sorata s povećanom tolerancijom na sušu. U cilju procjene adaptabilnosti i tolerantnosti na sušu tijekom 2017. godine proveden je poljski pokus na 19 lokacija širom RH u kojemu je u mikropokusima testirano po 32 komercijalna genotipa, a na svakoj pokusnoj lokaciji prikupljani su od sjetve pa do žetve u satnom režimu sljedeći meteorološki podaci: temperatura i vlaga zraka, količina oborina, jačina, brzina i smjer vjetrova, te vlažnost tla na dubini od 30 cm na dnevnoj bazi. U ovom radu detaljno prikazujemo vremenske prilike utvrđene izravno u usjevima za 8 lokacija u Slavoniji, 6 u zapadnoj Hrvatskoj, 3 u Istri i 2 u Dalmaciji. U radu se analizira intenzitet i trajanje razdoblja nepovoljnih uzgojnih uvjeta u 2017. spram višegodišnjih prosjeka, kao i razlike među lokacijama i posljedice na prosječne prinose kukuruza i soje.

**Ključne riječi:** suša, temperatura zraka, oborina, kukuruz, soja

## Weather conditions in maize and soybean field micro trials at 19 locations across Croatia in 2017

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### Summary

Numerous recent studies confirm the gradual rise of average daily temperatures over the last few decades and the increased frequency of extreme years in terms of precipitation and rainfall patterns, and numerous simulations indicate that this trend will continue in the coming decades. Because of its significance and the dominant non-irrigation practice, the production of maize and soybean in Croatia is threatening to average yield reduction and great damage in extreme years, especially dry ones. To mitigate the effects of drought, it is certainly the most economical and most desirable development of new cultivars with increased drought tolerance. To assess the adaptability to drought in 2017, field trials with maize and soybean, consisted of 32 commercial genotypes each, were performed on 19 locations across the country. At each location from sowing up to harvest in the hourly regimen following meteorological data were collected: air temperature and humidity, rainfall, wind speed and direction, as well as soil humidity at 30 cm depth (daily). Here we show in detail the weather conditions determined directly within the crops for 8 locations in Slavonia, 6 in western Croatia, 3 in Istria and 2 in Dalmatia. The paper analyzes the intensity and duration of the period of unfavorable growing conditions in 2017 in comparison to multiyear average values, as well as differences between locations and the consequences on average yields of maize and soybean.

**Key words:** *drought, air temperature, precipitation, maize, soybean*

## Common bean core collection development using Central and South Eastern European germplasm

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### Summary

Common bean is a major and the most important grain legume for direct human consumption in the world. Thousands of landraces, old and modern cultivars are maintained in gene banks across the European continent. According to basic multi-crop passport descriptors and seed characteristics, we selected over 800 accessions with distinct genotypes, covering diverse environments from different parts of the European continent following the line East to West and East to South. Altogether, we managed to obtain 782 accessions from 9 gene banks and 12 different geographic origins. To evaluate their genetic diversity, we applied 33 species-specific SSR markers covering all linkage groups among *Phaseolus vulgaris* genome. Four strategies were used to construct core collection combining different parameters of genetic variability with the selection of the most, the least and proportionally equally arranged significant representatives of each specific genetic cluster regarding to Bayesian approach. Out of the entire collection, 63 highly diverse accessions were selected for core collection on the basis of their genetic structure, without the geographic origin preference. Additionally, we selected 14 representatives as standard genotypes for their specific agronomically important traits. Final core collection represents valuable source of important traits and (multiple) alleles with potential to carry biotic and abiotic stress resistance, having a great value for common bean breeding programmes.

**Key words:** *Phaseolus vulgaris*, grain legumes, core collection, genetic markers

## Analiza prinosa hibrida kukuruza u mikropokusima širom Hrvatske u sušnoj 2017. godini

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### Sažetak

Sušni uvjeti i ekstremno visoke temperature kao posljedica klimatskih promjena se sve češće pojavljuju u jačem intenzitetu na području Hrvatske i postaju glavni uzrok niskih prinosa najznačajnijih usjeva, osobito jarih čije se najosjetljivije vegetacijsko razdoblje podudara s pojavom suše. Kukuruz je najzastupljeniji usjev u Republici Hrvatskoj i uzgaja se na oko 300 000 ha što čini gotovo 35 % udjela na oranica. U razdoblju od 2000. do 2016. godine zabilježeno je nekoliko ekstremnih godina (2000., 2003., 2007., 2012.) u kojima je prosječan prinos kukuruza bio manji od 4,5 t ha<sup>-1</sup>. Najučinkovitiji i ujedno najjeftiniji način prevladavanja negativnog utjecaja suše je stvaranje hibrida tolerantnih na sušu. U Hrvatskoj ne postoji sustavni oplemenjivački program kukuruza kojim bi se poboljšala tolerantnost na sušu niti je provođeno ciljano testiranje postojećih hibrida na ovo svojstvo. Stoga je cilj ovog istraživanja utvrditi adaptabilnost najzastupljenijih hibrida kukuruza u Hrvatskoj glede tolerantnosti na sušu radi identifikacije superiorne germplazme i razvoja novih tolerantnih genotipova. Poljski pokusi postavljeni su u proljeće 2017. godine na 14 lokacija u kontinentalnom dijelu Hrvatske u glavnim proizvodnim područjima kukuruza i na 5 lokacija u primorskom dijelu Hrvatske, suši sklonim okolinama. Uzgajala su se 32 komercijalna domaća i inozemna hibrida kukuruza FAO grupa od 300 do 600 u ukupno 22 poljska pokusa. Na svim pokusnim lokacijama provedeno je prikupljanje preciznih mikrometeoroloških podataka kao i sustavna opažanja i mjerenja niza agronomskih svojstava uz analizu simptoma suše. Prvi rezultati analize prinosa zrna ukazuju na velike razlike između lokacija među kojima su neke bile izrazito sušne, ali i između FAO grupa, odnosno pojedinih genotipova. Statistički opravdane razlike između genotipova u pogledu njihove razine tolerantnosti na sušu omogućit će njihovo daljnje testiranje i korištenje u stvaranju hibrida kukuruza prilagođenih uzgoju u sušnim uvjetima.

**Ključne riječi:** kukuruz, prinos, suša, tolerantnost, genotip

## Analysis of maize hybrids yield in field micro trials throughout Croatia in dry 2017

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### Summary

Drought stress conditions and extremely high temperatures as a result of climate change are increasingly occurring in Croatia causing yield reduction of the most important crops, especially the spring crops whose most sensitive vegetation period coincides with the occurrence of droughts. Maize is the most common crop in the Republic of Croatia and is grown on about 300,000 ha, which makes almost 35% of the arable land for field crops production. Between 2000 and 2016, there were several extreme years (2000, 2003, 2007, 2012) in which the average maize yield was less than 4.5 t ha<sup>-1</sup>. The most efficient and at the same time the cheapest way to overcome the negative impact of drought is the creation of drought-tolerant hybrids. There is no systematic maize breeding program in Croatia for improving the drought tolerance. Moreover, no targeted testing of existing hybrids has been carried out on this trait. Therefore, the aim of this study is to determine the adaptability of the most common maize hybrids in Croatia regarding tolerance to the drought in order to identify the superior germplasm and to develop new tolerant genotypes. Field trials were set up in the spring of 2017 at 14 locations in the continental part of Croatia in the main production areas of maize and at 5 locations in the coastal part of Croatia representing the environments prone to the drought. In total 32 commercial domestic and foreign maize hybrids belonging to FAO groups 300 – 600 were grown in 22 field trials. At all sites, precision micrometeorological data was collected as well as systematic observations and measurements of a number of agronomic traits along with the analysis of drought symptoms. The first results of grain yield analysis point to the large differences among locations of which some were extremely dry, but also among FAO groups and individual genotypes as well. The statistically proved difference between genotypes regarding their drought tolerance level will enable their further testing and use in the creation of maize hybrids adapted for growing under drought stress conditions.

**Key words:** maize, yield, drought, tolerance, genotype

## Ovlaštenje za DUS tehničko ispitivanje pšenice i ječma na razini EU

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### Sažetak

Sustav oplemenjivačkog prava Europske zajednice osigurava pravo intelektualnog vlasništva za nove biljne sorte koje vrijedi na području cijele Europske unije. Sustavom se nastoji poticati i promicati stvaranje novih sorti te poboljšati kvaliteta proizvoda u korist potrošača. Zaštita nove biljne sorte podrazumijeva jamstvo isključivog prava na iskorištavanje te sorte. Sustav zaštite Zajednice kojim upravlja Ured Zajednice za biljne sorte (CPVO) osigurava dodanu vrijednost u smislu da oplemenjivači mogu dobiti povrat ulaganja na području cijele Europske unije te se mogu zaštititi svi botanički taksoni. Do danas najveći broj zahtjeva odnosi se na ukrasne vrste (oko 44 %), slijede poljoprivredne vrste (oko 28 %) te vrsta povrća (oko 20 %) i voća (oko 6 %). Tehničko ispitivanje je imperativ u postupku zaštite sorte i svrha ovog ispitivanja jest utvrditi da su zadovoljeni kriteriji različitosti, ujednačenosti i postojanosti (DUS). Hrvatski centar za poljoprivredu, hranu i selo - Zavod za sjemenarstvo i rasadničarstvo u Osijeku provodi DUS tehničko ispitivanje za potrebe postupka priznavanja sorti poljoprivrednog bilja i sustava zaštite biljnih sorti u R.Hrvatskoj te je podnio zahtjev CPVO-u za dodjelu ovlaštenja odnosno „Entrustment“ za biljne vrste pšenicu, ječam i kukuruz. Odlukom Administrativnog vijeća Ureda Zajednice za biljne sorte od 4. listopada 2017. godine, Hrvatskom centru za poljoprivredu, hranu i selo – Zavodu za sjemenarstvo i rasadničarstvo u Osijeku dano je ovlaštenje za DUS tehničko ispitivanje pšenice i ječma, što je ujedno i potvrda kvalitete rada naših tehničkih stručnjaka na europskoj razini kao i otvaranje mogućnosti hrvatskim oplemenjivačima pšenice i ječma da ostvare svoje oplemenjivačko pravo s europskom dimenzijom.

**Ključne riječi:** DUS ispitivanje, pšenica, ječam, Europska zajednica

## Entrustment of DUS technical examination for wheat and barley on EU level

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### Summary

The Community plant variety rights system provides an intellectual property right for new varieties of plants which is valid throughout the European Union. The objective is to encourage and promote the creation of new varieties and to improve the quality of products for the benefit of consumers. Protecting a new plant variety entails granting exclusive rights for the exploitation of the variety. The Community protection system managed by Community plant variety office (CPVO) provides an added value in the sense that breeders can get return on investment throughout the entire European Union and all botanical taxa are eligible for protection. To date, ornamental species account for the largest number of applications (around 44 %), ahead of agricultural species (around 28 %), vegetable species (around 20 %) and fruit (around 6%). The technical examination is an imperative in process of plant variety protection and it is crucial that the variety submitted meets conditions of distinctness, uniformity and stability (DUS). The Croatian centre for agriculture, food and rural affairs – Institute for seed and seedlings in Osijek carries out DUS technical examination for purpose of plant variety registration and protection in Republic of Croatia and application for Entrustment was submitted to CPVO for plant species wheat, barley and maize. By decision of the Administrative council of the community plant variety office from October 4<sup>th</sup> 2017, the Croatian center for agriculture, food and rural affairs – Institute for Seed and Seedlings in Osijek has been entrusted for DUS technical examination of wheat and barley, which is also a confirmation of the quality of work our technical experts at European level as well as opening the opportunities for Croatian wheat and barley breeders to realize their plant breeder's rights with a European dimension.

**Key words:** *DUS examination, wheat, barley, European Union*



## Varijabilnost prinosa zrna soje u ovisnosti o genotipu i okolini uzgoja u sušnoj 2017. godini

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### Sažetak

Od svih ekstremnih vremenskih nepogoda izazvanih klimatskim promjenama suša ima najveći ekonomski utjecaj. Negativni utjecaj suše moguće je smanjiti raznim agrotehničkim mjerama, ali je najučinkovitiji pristup razvoj sorti tolerantnih na sušu. Stoga, postoji potreba za razvojem germplazme soje tolerantne na sušu, a adaptabilne na različite uvjete uzgoja. Cilj ovog istraživanja je procijeniti adaptabilnost hrvatskog sortimenta soje u funkciji oplemenjivanja za tolerantnost na sušu. Mreža poljskih pokusa soje postavljena je u 2017. godini na 19 lokacija širom Hrvatske, a uključivala je 32 genotipa soje (17 domaćih sorti, 7 introdukcija, 8 oplemenjivačkih linija) različitih grupa zriobe. Na svim lokacijama obavljena su mjerenja meteoroloških podataka te niza agronomskih svojstava. S obzirom na vremenske uvjete, 2017. godina je definirana na mnogim lokacijama kao sušna godina. Prikupljeni i analizirani podaci za prinos zrna ukazuju na razlike: (1) između lokacija što je pokazatelj različitosti uzgojnih područja s obzirom na vremenske uvjete i tip tla; (2) između genotipova unutar lokacije što pokazuje genetsku divergentnost testiranog materijala te (3) između lokacija unutar genotipa što je pokazatelj stupnja prilagodbe genotipa uvjetima uzgoja, odnosno njegove interakcije s okolinom. Rezultati iz poljskih pokusa u 2017. godini pokazuju razlike između genotipova u stupnju prilagodbe na utvrđenu razinu suše u proizvodnji.

**Ključne riječi:** soja, prinos zrna, suša, okolina, adaptabilnost

## Variability of soybean grain yield in relation to genotype and growing environment in dry 2017 year

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### Summary

Among all extreme weather disasters caused by climate change, drought has the largest economic impact. The negative effect of drought can be reduced by various agrotechnical measures, but the most efficient approach is the development of tolerant varieties. Therefore, there is a need for the development of soybean germplasm tolerant on the drought and adaptable to the various growing conditions. The aim of this study is to evaluate the adaptability of the Croatian soybean cultivars in the function of breeding for drought tolerance. Soybean field trials network was set up in 2017 on 19 locations across Croatia, including 32 soybean genotypes (17 national and 7 foreign varieties, 8 elite breeding lines) of different maturity groups. At all locations meteorological data and many agronomic traits were collected. Regarding weather conditions, 2017 was at many locations defined as a dry year. Results for grain yield indicate on differences: (1) among locations which is an indicator of the diversity of growing areas considering weather conditions and soil type; (2) among genotypes within the location showing the genetic divergence of the tested material, and (3) among locations within genotype, indicating the degree of adaptation, i.e. genotype x environment interaction. Results from the field trials in 2017 show the differences among genotypes in the degree of adaptability to the determined level of drought in the production.

**Key words:** *soybean, grain yield, drought, environment, adaptability*

## Stupanj modifikacije zrna ječma ozimih i jarih sorti tijekom slađenja

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### Sažetak

Slađenje je proces tijekom kojeg se u kontroliranim uvjetima zrno ječma kao i zrno drugih žitarica pretvara u slad. Proces započinje močenjem zrna u vodi za vrijeme kojeg apsorbirana voda aktivira enzime prirodno prisutne u zrnu te stimulira stvaranje novih. U ovoj fazi zrno se priprema za klijanje te dolazi do razvijanja korjenčića. Oslobođeni i aktivirani enzimi reguliraju niz različitih biokemijskih promjena koje će rezultirati modifikacijom samog zrna ječma. Modifikacija endosperma obuhvaća strukturne promjene i enzimsku razgradnju proteinskih i ugljikohidratnih rezervi zrna kao i građevnih sastojaka staničnih stijenki. Kao preduvjet dobre modifikacije mikroslađenjem traže se određene karakteristike zrna te laboratorijski procesni parametri koji se moraju ispuniti u cilju dobivanja zadovoljavajuće kvalitete slada. Cilj ovog rada bio je analizirati indikatore modifikacije endosperma zrna sorti ozimog i jarog ječma podvrgnutih procesu mikroslađenja. Uzorci zrna ječma za slađenje prikupljeni su iz pokusnih polja Poljoprivrednog instituta Osijek tijekom tri godine. Dobiveni parametri kvalitete slada indiciraju postojanje različitosti u sveukupnoj modifikaciji između ozimih i jarih sorti ječma. Te razlike vidljive su iz rezultata za količinu ekstrakta slada, friabilnost, razliku u količini ekstrakta između fino i grubo samljevenog slada te viskoznost sladovine.

Ključne riječi: ječam, slađenje, kvaliteta, friabilnost, viskoznost

## **Extent of modification of winter and spring barley grain during malting**

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### **Summary**

Malting is the process in which barley and other cereal grains are converted into malt under controlled conditions. It begins with hydration of the grain during which the absorbed water activates the enzymes naturally present in the grain and stimulates the creation of new ones. At this phase grain is prepared to germinate and germ and rootlets are developing. The liberated and activated enzymes are controlling diverse biochemical changes that will result in modification of the barley grain itself. Endosperm modification refers to structural changes and enzyme degradations of the protein and carbohydrate reserves as well as structural cell wall constituents. Good modification requires certain barley characteristics and laboratory processing parameters to be fulfilled to produce the quality malt. In this work winter and spring type barley varieties were subjected to malting process in order to analyse their overall endosperm modification indicators. Barley grains were collected from the field trials conducted at the Agricultural Institute Osijek during three years. Malting characteristics indicated existing variability in grain modification patterns during malting between winter and spring barley varieties. These differences were evident from results of malt extract content, friability, extract difference between fine and coarse ground malt, and viscosity.

**Key words:** *barley, malting, quality, friability, viscosity*

## Mikotoksini Fusarima u sladu pšenice

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### Sažetak

Pšenica (*Triticum aestivum* L.), uz ječam, je uobičajena kultura koja se koristi u industriji pivarstva. Mnogi ljudi vole pšenično pivo zbog posebnog okusa koji nema jak intezitet kao u ječma. Međutim, mikotoksini u sladu pšenice nisu dobro istraženi. Problem je porast koncentracije ili transformacije tijekom postupka proizvodnje piva, a onečišćenje može smanjiti kvalitetu slada. Općenito, jedno od glavnih pitanja sigurnosti hrane za usjeve je onečišćenje mikotoksinima *Fusarium* vrstama. Mikotoksini mogu dovesti do različitih zdravstvenih problema, a jedno od glavnih ograničenja u procjeni rizika je nedostatak razumijevanja razvoja mikotoksina i transformacije tijekom procesa slađenja. U prethodnim istraživanjima dokazano je da su *Fusarium* toksini prešli u pivo, ako su prethodno bili prisutni u ječmu koji se koristio za proizvodnju ili ako je došlo do pojave *Fusarium* vrsta tijekom slađenja. U našem istraživanju istraženi su učinci *Fusarium* vrsta na proizvodnju različitih mikotoksina u zrnju i sladu nakon *Fusarium* inokulacije. Analiza mikotoksina uzoraka pšenice pomoću LC-MS/MS pokazala je da su dominantni mikotoksini deoksinivalenol (DON), 3-acetil deoksinivalenol (3-ADON) i nivalenol (NIV). DON je smanjen tijekom procesa slađenja, dok je 3-ADON povećan u sladu u odnosu na zrno. T-2 i HT-2 toksini pojavili su se zajedno i pronađeni su u malom broju samo u prirodno zaraženim uzorcima. Zearelenon (ZEN) je mikotoksin koji se pojavio samo u pšeničnom sladu kao posljedica onečišćenja slada. Ovi podaci upućuju na to da *Fusarium* vrste koje zagađuju materijal zrna mogu imati ogroman utjecaj na mikotoksine u sladu. Također njihova koncentracija može rasti tijekom slađenja, iako je to teško predvidjeti i bit će istraživano i nadalje.

Ovaj rad djelomično je financiran od strane Hrvatske zaklade za znanost (HRZZ-UIP-2014-9188).

**Ključne riječi:** FHB, kvaliteta, fotosinteza, pšenica

## Fusarium mycotoxin on wheat malt

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### Summary

Wheat (*Triticum aestivum* L.), beside barley, is a common crop used in the beer malting industry. Many people prefer wheat beer due to special taste that contributes less flavor than barley. However, mycotoxins in the wheat malt are not very well explored. The colossal issue is the ability of mycotoxins to endure, increase or transform during the brewing process, and contamination can decrease the malting quality of the crop. In general, one of the major food safety issues for cereal crops is mycotoxin contamination by *Fusarium* species. Mycotoxins are critical components in a diverse array of health concerns, and one of major limitation in risk assessment has been the lack of understanding of the mycotoxin development and transformation during malting process. In previous researches, it was proven that *Fusarium* toxins were transferred to the beer, if they have previously been present in the barley used for brewing, or if the growth of *Fusarium* species has occurred during the barley malt preparation. In our research, the effects of *Fusarium* species on the production of different mycotoxins in the grain and corresponding malts after *Fusarium* artificial inoculation of winter wheat varieties in the field were investigated. The mycotoxin analysis of the wheat samples by LC-MS/MS revealed that the predominant mycotoxins were deoxynivalenol (DON) followed by 3-acetyl deoxynivalenol (3-ADON) and nivalenol (NIV). DON decreased during the malting process, while 3-ADON was increased in malt in comparison to grain. T-2 and HT-2 toxins occurred together and were only found with low incidence only in naturally infected grains produced by native *Fusarium* species. Zearelenone (ZEN) is a mycotoxin that occurred only in wheat malt as a result of malting contamination. These data suggest that *Fusarium* species that contaminate the grain material might have huge impact on mycotoxins in malt. *Fusarium* mycotoxins can grow during malting, although exact behavior is difficult to predict and will be focus of the further research.

Acknowledgments: This work has been supported in part by Croatian Science Foundation (HRZZ-UIP-2014-9188).

**Key words:** FHB, malt, mycotoxins, wheat

## **Uloga i značaj Laboratorija za ispitivanje sjemena, ZSR, HCPHS u sjemenarstvu Republike Hrvatske**

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### **Sažetak**

Laboratorij za ispitivanje sjemena ustrojen je kao odjel Zavoda za sjemenarstvo i rasadničarstvo (ZSR), Hrvatskog centra za poljoprivredu, hranu i selo (HCPHS). Područja djelatnosti laboratorija su ispitivanje kvalitete sjemena, utvrđivanje prisutnosti GMO-a, te pružanje znanstveno stručne potpore nadležnim upravama Ministarstva poljoprivrede i Ministarstva zdravstva. Od 2015. godine laboratorij provodi monitoring svih certificiranih partija sjemena soje na prisutnost GMO-a. Laboratorij provodi nadzor nad radom ovlaštenih laboratorija i ovlaštenih uzorkivača kroz postupak naknadne kontrole ponovljenim ispitivanjem i uzorkovanjem 5-10% već ispitanih partija sjemena, a radi provjere ispravnosti rezultata ispitivanja i uzorkovanja. Prateći potrebe tržišta RH za provođenjem kemijskih analiza zrna žitarica (sadržaj proteina, udio vlage, sadržaj ulja, sedimentacijska vrijednost itd.) HCPHS je u postupku nabave NIR uređaja koji će se koristiti za potrebe tržišta te potrebe postupka priznavanja novih sorti poljoprivrednog bilja. Kako bi ostvario zadane ciljeve i osigurao kvalitetu rada laboratorij ima uspostavljen sustav kvalitete koji ispunjava uvjete ISTA Akreditacijskog standarda, ISO norme HRN EN ISO/IEC 17025, te važećih ISTA Međunarodna pravila za ispitivanje sjemena. Laboratorij provodi neovisna uzorkovanja i ispitivanja, te širi svoje aktivnosti nastojeći zadovoljiti zahtjeve i očekivanja domaće i međunarodne industrije sjemena.

***Ključne riječi:*** laboratorij, kvaliteta sjemena, GMO, kvaliteta zrna poljoprivrednog bilja, akreditacija

## **Role and significance of seed testing Laboratory, ISS, CCAFRA in Croatian seed production**

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### **Summary**

The Seed Testing Laboratory is one of the departments of the Institute for Seed and Seedlings (ISS), Croatian Centre for Agriculture, Food and Rural Affairs (CCAFRA). Fields of activities of laboratory are testing of seed quality, determination of the presence of GMOs and the provision of scientific and professional support to the competent directorates of the Ministry of Agriculture and the Ministry of Health. From 2015, the laboratory is monitoring all certified seed lots of soybean for the presence of GMOs. The laboratory performs supervision of the work of other authorized laboratories and authorized seed samplers through a post control procedure by repeated testing and sampling of 5-10% of seed lots already tested to verify the accuracy of the testing and sampling results. Following the Croatian market needs for chemical analysis of cereal grains (protein content, moisture content, oil content, sedimentation value, etc.) CCAFRA is in the process of procurement of NIR (near-infrared) device to be used for market needs as well as the needs for registration of new varieties of agricultural plants. In order to achieve set goals and ensure the quality of work laboratory has organized and implemented quality system that meets the requirements of the ISTA Accreditation Standard for Seed Testing and Seed Sampling, ISO Standard HRN EN ISO/IEC 17025 and the current ISTA International Rules for Seed Testing. The laboratory conducts independent sampling and testing and expanding activities striving to meet the requirements and expectations of the domestic and international seed industry.

***Key words:*** *laboratory, seed quality, GMO, grain quality, accreditation*



## Procjena parametara kvalitete višegodišnjih krmnih leguminoza

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### Sažetak

Lucerna i crvena djetelina su najpoznatije višegodišnje leguminoze, bogat izvor visoko nutritivne voluminozne krme za ishranu stoke. Danas je zbog niske razine i nedostatne proizvodnje biljnih bjelančevina za životinjsku i ljudsku ishranu u većini zemalja EU poboljšanje kvalitete leguminoza jedan od strateških ciljeva brojnih oplemenjivačkih programa. Cilj rada bio je utvrditi variranje udjela bjelančevina (SB) te neutralnih i kiselih detergent vlakana (NDV, KDV) kod 47 sorti i populacija lucerne (L) i crvene djeteline (CD), procijeniti relativnu hranidbenu vrijednost (RHV) i identificirati poželjne superiorne materijale za daljnje poboljšanje svojstava kvalitete. Uzorci zelene mase svake populacije/sorte uzeti su u drugom otkosu druge godine uzgoja (2016.) iz tri ponavljanja ranije zasnovanog poljskog pokusa na Poljoprivrednom institutu Osijek. Kemijska analiza provedena je prema standardnom protokolu (FOSS Tecator Kjeltex 2300 i FOSS Tecator FiberCup 2021/2023). Utvrđene su značajne razlike ( $p=0,01$ ) između populacija/sorti za sva promatrana svojstva. Variranje se kretalo od 21,2-23,1% (L) i 18,5-21,8% (CD) za SB, od 38,2-44,6% (L) i 40,4-47% (CD) za NDV, od 28,4-32,7% (L) i 24,6-31,5% (CD) za KDV. Kod obje biljne vrste RHV se kretala u rasponu od 129,9-161,3, što ih prema standardima kvalitete za krmne leguminoze svrstava u kategoriju visoko kvalitetnih do izvrsnih krmiva. Identificirano je nekoliko superiornih populacija koje će se koristiti za daljnje poboljšanje nutritivne vrijednosti krmnih kultura.

**Ključne riječi:** lucerna, crvena djetelina, kvaliteta krme, populacije, oplemenjivanje

## Assessment of quality properties of perennial forage legumes

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### Summary

Alfalfa and red clover are the most popular perennial forage legumes and rich sources of high nutritional voluminous forage for livestock feed. Today, due to low level and insufficient production of plant proteins for both animal and human nutrition, in most EU countries the improvement of the quality of legumes is one of the strategic goals of numerous breeding programs. The aim of the study was to determine the variation of protein content (PC) and neutral and acid detergent fiber (NDF, ADF) in 47 alfalfa (A) and red clover (RC) cultivars/populations, to estimate relative feed value (RFV) and to recognize desirable superior materials for further improvement of quality properties. Samples of the green mass of each population/cultivar were taken in the second cut of the second growth season (2016) from three repetitions of an established field experiment at the Agricultural Institute Osijek. The chemical analysis was performed according to standard protocol (FOSS Tecator Kjeltec 2300 and FOSS Tecator FiberCup 2021/2023). Significant differences ( $p=0.01$ ) between populations/cultivars were found for all observed traits. The variation ranged from 21.2-23.1% (A) and 18.5-21.8% (RC) for PC, 38.2-44.6% (A) and 40.4-47% (RC) for NDF and 28.4-32.7% (A) and 24.6-31.5% (RC) for ADF. In both plant species RFV ranged from 129.9 to 161.3, which, according to the quality standards for forage legumes, is classified as a category of high quality to excellent fodder. Several superior populations were identified and will be used to further improve the nutritional value of forage crops.

**Key words:** *alfalfa, red clover, forage quality, populations, breeding*

## Izrada sržnih kolekcija hrvatskih genetskih izvora graha

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### Sažetak

Cilj istraživanja bio je analizirati genetsku raznolikost i strukturu 299 primki graha u svrhu izrade sržnih kolekcija hrvatskih genetskih izvora graha. Sržne su kolekcije uspostavljene pomoću dva algoritma (PowerCore i MSTRAT) koji koriste maksimizacijsku (M) strategiju na temelju rezultata genetske analize pomoću 26 mikrosatelitnih biljega. Analize skupina na temelju matrice udaljenosti kao i na temelju modela ukazale su na postojanje triju skupina u skladu s rezultatima analize tipa fazeolina. Primke graha su svrstane u 10 skupina koje predstavljaju najčešće morfortipove (tradicijske kultivare) u Hrvatskoj, te u miješanu skupinu manje zastupljenih morfortipova. Utvrđeno je postojanje 245 jedinstvenih genotipova. Sržna kolekcija odabrana upotrebom algoritma PowerCore sastojala se od 40 genotipova predstavljajući tako najmanji podskup primki u kojem su sadržani svi aleli zapaženi u cjelokupnoj kolekciji. Algoritmom MSTRAT utvrđen je podskup od 20 genotipova koji je imao nesignifikantno manje alelno bogatstvo u odnosu na cjelokupnu kolekciju. Maksimiziranjem genetske raznolikosti u reduciranom skupu genotipova, sržna kolekcija od 20 primki će olakšati buduća istraživanja raznolikosti graha upotrebom fenotipizacije visoke propusnosti kao i genotipizacije pomoću sekvenciranja nove generacije.

***Ključne riječi:*** sržna kolekcija, grah, tradicijski kultivari, mikrosatelitni biljezi

## Development of core collections of Croatian common bean genetic resources

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### Summary

The aim of this study was to analyze genetic diversity and structure of 299 common bean accessions to construct core collections that represent the Croatian common bean germplasm with minimum repetitiveness. A total of 26 microsatellites markers were used to construct a set of core collections using two algorithms (PowerCore and MSTRAT) based on maximization (M) strategy. Distance- and model-based analyses based on microsatellite markers revealed the presence of three clusters in congruence with the results of phaseolin type genotyping. Accessions were classified into 10 groups representing the morphotypes (landraces) most frequently found in Croatia and in a mixed group of less common morphotypes. Microsatellite analysis revealed a total of 245 unique genotypes. The core collection obtained by the PowerCore was composed of 40 genotypes, representing the smallest set of accessions with the full coverage of the alleles present in the entire collection. MSTRAT algorithm selected a subset of 20 accessions with insignificantly smaller allelic richness as compared to the entire collection. By maximizing genetic diversity in a reduced set of genotypes, the core subset of 20 accessions could facilitate future efforts in assessing common bean diversity by high-throughput phenotyping and genotyping using next-generation sequencing approaches.

**Key words:** core collection, common bean, landraces, microsatellite markers



**Povrćarstvo,  
ukrasno, aromatično  
i ljekovito bilje**

**04**

**Vegetable Growing,  
Ornamental, Aromatic  
and Medicinal Plants**



## **Antioxidative effects of *Bauhinia acuminata* water extract in rat**

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### **Summary**

The aim of this study was to determine the antioxidant effects of aqueous leaves extract of *Bauhinia acuminata* (BA) in rat. The extract was screened for its phytochemical contents and antioxidant activity *in vitro*. Moreover, the extract was studied in rats to evaluate its effects *in vivo*. Rats were orally administered with the extract at the dose of 50, 100 and 200 mg/kg for 28 days. Phytochemical screening of the extracts showed the presence of saponin, alkaloid, cardiac glycosides, flavonoids, tannin and steroid compounds. The extract contained phenolic compounds  $53.36 \pm 1.01$  mg of gallic acid equivalents per gram BA extract. The free radical scavenging activity assessed by DPPH assay gave  $IC_{50}$  of  $44.47 \pm 2.83$   $\mu$ g/mL, which is relatively lower than that of BHT with  $IC_{50}$  of  $12.34 \pm 1.14$   $\mu$ g/ml. In the animals, the extract was well tolerated by the animals throughout the 28 days of study as shown by normal serum levels AST, ALP, ALT, BUN and Cr as well as normal histology of liver tissue. Significantly reduction of serum oxidative stress markers malondialdehyde (MDA) was found in rat treated with BA extract compared with control. The study provides evidence that *Bauhinia acuminata* (BA) extract exhibits direct antioxidant properties and induces cytoprotective enzyme *in vivo*.

**Key words:** *Bauhinia acuminata*, antioxidant, malondialdehyde (MDA), oxidative marker



## Evaluation of papaya extract on DNA damage and cell signaling in keratinocytes exposed to ultraviolet radiation

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### Summary

Ultraviolet (UV) radiation is one of major causes of skin cancer, especially non-melanoma skin cancer. Therefore, protection of skin cells from the damaging effect of UV radiation would be a promising way to prevent the development of skin cancer. *Carica papaya* has been reported to possess several pharmacological properties; however it has not been elucidated for its capability in skin protection from UV radiation. Thus, this study was aimed to investigate the protective effect of unripe *C. papaya* aqueous extract (CPW) on UV radiation-induced cellular damage. The human keratinocyte cell line (HaCaT) was exposed to UVB at 40 mJ/cm<sup>2</sup> in the presence or absence of CPW pretreatment. The cytoprotective effect of CPW was evaluated by MTT assay. The intracellular ROS generation was detected by DCF using flow cytometry. The alteration in cyclobutane pyrimidine dimer (CPD) and PGE<sub>2</sub> was evaluated by ELISA. The number of apoptotic cells was measured by Hoechst staining. Western blot analysis was used to determine the expression of COX-2 and signaling of p38, Akt, and NFκB. Pretreatment with CPW significantly increased cell viability after cells were exposed to UVB irradiation. The reduction in apoptotic cells were in concordance with MTT assay. Cellular oxidative stress was attenuated by CPW pretreatment both with and without UV exposure. CPW markedly decreased COX-2 expression and activation of NFκB in UV treated cells. The production of PGE<sub>2</sub> was also decreased with CPW pretreatment. There are certain parameters that were not altered by CPW pretreatment, including CPD levels, p38 and Akt signaling. These findings suggest that CPW could effectively protect human keratinocyte damage induced by UV radiation through reductions of intracellular ROS, apoptosis, PGE<sub>2</sub>, NFκB, and COX-2. Thus, CPW may be a candidate for the development of skin protection products.

**Keywords:** antioxidants, papaya, epidermis, keratinocytes, ultraviolet ray, prostaglandin

## **Biološke, ekološke i ukrasne karakteristike javora negundovca (*Acer negundo* L.) s primjenom na krajobraznim površinama grada Knina**

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### **Sažetak**

Javor negundovac (*Acer negundo* L.) je listopadno drvo iz Sjeverne Amerike, a u Hrvatsku je uvezen početkom 20. stoljeća. Cijenjen je u pčelarstvu, šumarstvu, krajobraznom uređenju te je vrlo invazivna vrsta. Od ukrasnih karakteristika vrste mogu se izdvojiti deblo, kora, habitus, grane, listovi, cvjetovi i plodovi. Zbog svoje velike prilagodljivosti podnosi vrlo siromašna tla te položaje koji su izloženi suncu, suši, hladnoći i sjeni. Najrasprostranjeniji je u kontinentalnom i submediteranskom dijelu Hrvatske. *A. negundo* se s vremenom dosta raširio tako da je na području Hrvatske svrstan u invazivnu alohtonu vrstu. Prema literaturnim izvorima navedena vrsta za sada ne pričinjava ozbiljnije štete autohtonoj vegetaciji. Negundovac (*Acer negundo* L.) slabo je zastupljena dendrološka vrsta na gradskim krajobraznim površinama Knina, kao soliter, u drvoredu ili u skupinama. Metodom promatranja je također uočeno da u pogledu održavanja i njege stabala *A. negundo* na krajobraznim površinama nužno posvetiti više pažnje u formiranju krošnje. Nisu uočena njegova stabla van gradskih krajobraznih površina. Anketno istraživanje je provedeno tijekom druge polovice 2017. godine na uzorku od 50 ispitanika s područja grada Knina i okolice. Temeljem anketnog istraživanja ispitanici su dodijelili vrlo dobre ocijene ukrasnim karakteristikama i ugodnosti prisustva *A. negundo* na krajobraznim površinama Knina. Ponešto su lošije ocijenili ulogu navede vrste u pčelarstvu, šumskim melioracijama i urbanom šumarstvu. Veći broj ispitanika ne zna da je *A. negundo* vrlo invazivna vrsta.

**Ključne riječi:** *Acer negundo* L., biologija, ekologija, krajobrazna valorizacija, Knin

## Biological, ecological and ornamental characteristics of ash-leaf maple (*Acer negundo* L.) with application on landscape surfaces of the city of Knin

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### Summary

Ash-leaf maple or boxelder (*Acer negundo* L.) is a deciduous tree that originates from North America. It was imported into Croatia at the beginning of the 20<sup>th</sup> century. It is highly valued in bee-keeping, forestry and landscape architecture and it is a highly invasive species. Amongst the ornamental characteristics it is important to highlight its tree trunk, tree bark, habitus, branches, leaves, flowers and fruits. Due to its high adaptability it tolerates very poor soils and positions exposed to the sunlight, drought, cold and shade. It is the most widespread in the continental and sub-Mediterranean parts of Croatia. In time *A. negundo* became considerably widespread and hence, it was considered as an invasive alien species in Croatia. According to the references provided from professional literature, the previously mentioned tree species does not currently do any serious damage to the autochthonous vegetation. Ash-leaf maple (*Acer negundo* L.) is a sparsely distributed woody species in urban landscape surfaces of Knin, as a solitary tree, in tree lines or in groups of trees. Moreover, using the observation method concerning maintenance and care of *A. negundo* on landscape surfaces, it was noted that more attention needs to be paid to the formation of the tree top. These trees have not been found outside the urban landscapes. The survey research was conducted in the second half of 2017 on a sample comprising of 50 respondents originating from the city of Knin and its outskirts. Based on the findings of the survey research the respondents gave very good grades to ornamental characteristics and the comfort of the presence of *A. negundo* on the landscape surfaces of Knin. The role of the previously mentioned tree species received slightly lower grades in bee-keeping, forest meliorations and urban forestry. A considerable number of those surveyed was unaware of the fact that *A. negundo* is a highly invasive tree species.

**Key words:** *Acer negundo* L., biology, ecology, landscape valorisation, Knin

## Percepcije i stavovi o ukrasnim karakteristikama i primjeni submediteranskog listopadnog drveća u zimskom razdoblju

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### Sažetak

Kod projektiranja različitih krajobraznih površina odabir prikladnog drveća vrlo je važan jer ono često određuje izgled i ugodu otvorenom prostoru. Potrebno je uzeti u obzir ukrasne vrijednosti vrste tijekom cijele godine. I u zimskom razdoblju neko listopadno drveće može pokazati svoje dekorativne vrijednosti. U submediteranskom klimatu, kojem pripada i grad Knin može se izdvojiti 10-tak vrsta drveća s jednom ili više ukrasnih karakteristika (habitus, kora, deblo, grane, grančice i plodovi) u zimskom razdoblju. To su sljedeće vrste: *Celtis australis* L., *Ulmus pumila* L., *Tilia cordata* Mill., *Morus nigra* L., *Aesculus hippocastanum* L., *Acer negundo* L. i dr. Slijedom navedenog cilj rada je bilo istraživanje percepcija i stavova o ukrasnim karakteristikama i primjeni listopadnog submediteranskog drveća u zimskom razdoblju. Anketno istraživanje je provedeno tijekom travnja i svibnja 2017. godine na uzorku od 50 ispitanika s područja grada Knina i okolice. Temeljem navedenih istraživanja došlo se do spoznaja da ispitanici sa područja grada Knina i njegove okolice s prosječnom ocjenom dobar vrednuju ukrasne karakteristike i primjenu za osam od devet odabranih vrsta drveća. Najbolje ocjene su dodijelili hibridnoj platani *Platanus x hispanica* Münchh. Vrsta im se najvjerojatnije dopada zbog njenog neobičnog izgleda (habitus, plod, deblo itd.) i manje primjene u parkovima i krajobraznim površinama. Rezultati ovog istraživanja mogu biti iskorišteni kod projektiranja različitih krajobraznih površina u smislu povećanja ugone i zadovoljstva korisnika.

**Ključne riječi:** listopadno drveće, zimsko razdoblje, estetika, percepcija, Knin

## Perceptions and attitudes about ornamental characteristics of sub-mediterranean deciduous trees during the winter season

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### Summary

The selection of appropriate trees is extremely important whilst designing different landscape surfaces, since it frequently defines both the appearance and the comfort of the open space. Ornamental values of the tree species throughout the year need to be considered. Some deciduous trees can show their ornamental value even during the winter season. Due to one or more ornamental characteristics (habitus, tree bark, tree trunk, branches, twigs and fruits) during the winter season, around 10 species of trees can be highlighted in the sub-Mediterranean climate, which is also the climate in the city of Knin. They include the following tree species: *Celtis australis* L., *Ulmus pumila* L., *Tilia cordata* Mill, *Morus nigra* L., *Aesculus hippocastanum* L., *Acer negundo* L. etc. Consequently, the objective of this paper was to conduct research on perceptions and attitudes about ornamental characteristics and the use of deciduous sub-Mediterranean trees during the winter season. The survey research was conducted in April and May of 2017 on a sample of 50 respondents originating from the area of the city of Knin and its outskirts. Based on the findings of the previously mentioned research, the conclusion was reached that the respondents originating from the city of Knin and its outskirts evaluated the ornamental characteristics for the use of eight out of nine selected tree species with the average grade good. The hybrid plane tree referred to as London plane or *Platanus x hispanica* Münchh received the highest grade. They most probably liked this species due to its unusual appearance (habitus, fruit, tree trunk etc.) and its less frequent use in parks and landscape surfaces. The findings of this research can be used for the purpose of design of different landscape surfaces aimed at increasing user comfort and satisfaction.

**Key words:** *deciduous trees, winter season, aesthetics, perception, Knin*

## Repelentno djelovanje biljnih pripravaka na puževe golaće u salati i kupusu

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### Sažetak

Puževi golaći roda *Arion* važni su štetnici salate i kupusa. Osim što ishranom uzrokuju direktne štete, onečišćuju proizvode svojom sluzi i izmetom. Suzbijanje puževa najčešće se temelji na uporabi limacida. Ta mjera često nije dovoljno učinkovita, a istovremeno onečišćuje proizvode i okoliš. Cilj ovoga istraživanja bio je istražiti repelentno djelovanje biljnih pripravaka na osnovu lavande, češnjaka, koprive, listova rajčice na salati te ružmarina, majčine dušice, aloa vere i bazge na kupusu. Laboratorijsko istraživanje provedeno je u svibnju 2015. Varijante biljnih pripravaka primijenjene su potapanjem listova salate i kupusa u pripremljene čajeve, u četiri repeticije. Po jedna jedinka puža postavljena je na prethodno izmjereni list salate ili kupusa. Vrijednosti oštećenja lisne površine izmjerene tijekom pokusa statistički su analizirane pomoću programa ARM 2014.7. U istraživanju provedenom na salati, varijante se nisu statistički razlikovale međusobno, niti u odnosu na kontrolu. Prema izmjerenim vrijednostima oštećenja, biljni pripravak na osnovu bazge ispoljio je najjače repelentno djelovanje. U pokusu provedenom na kupusu najjače repelentno djelovanje ispoljio je biljni pripravak na osnovu listova rajčice, a potom lavanda. Iako je u oba pokusa izmjerena slabija ishrana puževa na svim varijantama u odnosu na kontrolu, niti jedan od biljnih pripravaka nije u potpunosti spriječio ishranu puževa te je njihovu primjenu potrebno kombinirati s ostalim mjerama suzbijanja puževa.

**Ključne riječi:** puževi golaći, repelentni učinak, biljni pripravci, salata, kupus

## **Repelling effect of herbal preparations on slugs in salad and cabbage**

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### **Summary**

Slugs of the genus *Arion* are important pests of lettuce and cabbage. In addition to causing direct damage, they pollute products with their mucus and feces. Slug control is most often based on the use of the limacides. This measure is rarely efficient enough and at the same time pollutes products and the environment. The aim of this study was to investigate the repelling effect of herbal preparations on the basis of lavender, garlic, nettle and tomato leaf on salad and rosemary, thyme, aloa vera and elder on cabbage. Laboratory research was conducted in May 2015. Treatments of herbal preparations were applied by dipping salad and cabbage leaves into prepared teas, in four repetitions. One specimen of slug was placed on a previously measured leaf of lettuce or cabbage. Leaf damage values were statistically analyzed using ARM 2014.7. In the research conducted on salad, the treatments did not differ statistically either in relation to each other or to the control. According to the measured values of damage, the herbal preparation based on the elder expressed the strongest repelling effect. In the experiment carried out on cabbage, the strongest repelling effect was expressed by herbal preparations on the basis of tomato leaves and lavender. Although in both experiments the weaker feeding of slugs was measured in all variants with respect to control, none of the herbal preparations completely prevented slug feeding so their use have to be combined with other control measures.

**Key words:** *slugs, repelling effect, herbal preparations, salad, cabbage*

## Utjecaj mikorize i gnojidbe na rast i razvoj vrste pelargonija (*Pelargonium zonale*)

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### Sažetak

Pelargonije zauzimaju značajno mjesto u proizvodnji cvjetnih vrsta za uređenje vanjskih prostora. Tijekom uzgoja, uz uobičajene agrotehničke zahvate, pozitivan učinak na rast i razvoj može imati i primjena mikoriznih gljiva. Cilj ovog istraživanja bio je utvrditi utjecaj mikorize gljivicom *Glomus intraradices* i prihrane tekućim mineralnim gnojivom na rast i razvoj vrste *Pelargonium zonale*. Pokus je proveden u plasteniku rasadnika „Dives“ iz Labina, Istra, u periodu 15.6.2015. do 11.10.2015. na sadnicama pelargonije sorte ‘Anthony’ koja se odlikuje ranom cvatnjom, crvenim cvatovima, zelenim listovima sa slabo izraženim zonama. U pokusu je korišten mikorizni prah MYC 4000, koji sadrži gljivice *Glomus intraradices*, a dodan je u količini 2,25 g ili 100 spora po uzgojnoj posudi. Korišteno je vodotopivo gnojivo s hranjivima u kelatnom obliku, formulacije 15-11-29 s mikroelementima kojim se prihranjivalo dva put tjedno tijekom istraživanog razdoblja. Tijekom istraživanja provedeno je 7 mjerenja u razmacima od po 10 dana za svojstva: visina biljke (cm), broj listova, broj cvjetnih pupova i broj cvatova. Na kraju pokusa napravljena je kemijska analiza supstrata, utvrđena težine čitave biljke, težina korijena te težina nadzemnog djela biljaka prije i poslije sušenja. Ukupni podaci dobiveni mjerenjem obrađeni su analizom varijance. Temeljem dobivenih rezultata utvrđeno je da je mikoriza pozitivno utjecala na težinu mase korijena gdje je varijacija bez gnojidbe s mikorizom imala veću masu korijena od varijacije bez gnojidbe i bez mikorize. Za ostala mjerena svojstva nije bilo značajne razlike između varijanata sa i bez mikorize. Vidljiv je bio pozitivan utjecaj gnojidbom u odnosu na kontrolnu varijantu u svim mjerenim svojstvima. Između varijanata gnojjenih s koncentracijom 1 ili 2 g/L, s mikorizom ili bez nje, nisu utvrđene signifikantne razlike.

**Ključne riječi:** *Pelargonium zonale*, mikoriza, gnojidba, rast i razvoj



## **Influence of mycorrhizae and fertilization on the growth and development of the pelargonium species (*Pelargonium zonale*)**

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### **Summary**

Pelargoniums are one of the major flower species produced for decorating outdoor spaces. Application of mycorrhizal fungi during cultivation, besides the usual agro-technical interventions, can have a positive effect on growth and development of the plants. The aim of this study was to determine the effect of mycorrhizal fungi *Glomus intraradices* and treatment with liquid mineral fertilizer on growth and development of species *Pelargonium zonale*. The experiment was carried out in the "Dives" nursery in Labin, Istria, in period from 15<sup>th</sup> June 2015 to 11<sup>th</sup> October 2015 using seedlings of species *Pelargonias* 'Anthony' which is characterized by early flowering, red blooms and green leaves with poorly distinguishable zones. The micronized powder used in the experiment was MYC 4000 that contains fungi *Glomus intraradices* and it was added in a quantity of 2.25 g or 100 spores per breeding container. A water-soluble chelated fertilizer with microelements was used in the 15-11-29 composition, and was applied twice a week during the course of this experiment. The following characteristics were measured at 10 days intervals: plant height (cm), number of leaves, number of flower buds and number of inflorescences. At the end of the experiment a chemical analysis of the substrate was performed, as well as measurements of the weight of the whole plants, the weight of the roots and the weight of the plants' overhead before and after drying. The total data obtained through measurements was processed by applying variance analysis. Based on the results of analysis, a positive influence of mycorrhizae on the weight of root mass was proven. The results also showed that the variation with mycorrhizae and without fertilization had a greater rootstock mass than the variation without mycorrhiza and without fertilization. For other measured characteristics there was no significant difference between variants with and without mycorrhizae. There was a visible positive effect of fertilization compared to control variant in all measured characteristics. No significant differences were found between the variants using fertilizer with 1 or 2 g/L, with or without mycorrhizae.

**Key words:** *Pelargonium zonale*, mycorrhizae, fertilization, growth and development

## Utjecaj natrijevog hidrogensulfida na fiziološke pokazatelje solnog stresa kod paprike (*Capsicum annuum* L.)

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### Sažetak

Mnogobrojnim istraživanjima do sada su potvrđeni pozitivni učinci niskih koncentracija sumporovodika ( $H_2S$ ) na fiziološki odgovor biljaka u uvjetima različitih tipova abiotskog stresa. Međutim, djelovanje natrij hidrogensulfida (NaHS) kao donora  $H_2S$  u biljnom organizmu još uvijek nije dovoljno razjašnjeno. U ovom istraživanju ispitivan je utjecaj otopina NaHS (0, 50, 100, 200 i 500 mM) apliciranih u supstrat, na biljke paprike (*Capsicum annuum* L.) uzgajane pri 150 mM NaCl. U prosjeku za obje varijante solnog stresa, primijenjeni tretmani NaHS nisu utjecali na sadržaj klorofila, dok je najviša koncentracija NaHS značajno smanjila sadržaj karotenoida. U uvjetima solnog stresa, primjena otopina NaHS koncentracije 50 i 100 mM značajno je smanjila intenzitet lipidne peroksidacije u listovima paprike. Također, NaHS (50 i 100 mM) je smanjio sadržaj prolina u listu bez obzira na solni stres. Površina listova biljaka tretiranih s 50 i 100 mM NaHS se nije značajno smanjila uslijed solnog stresa. Dobiveni rezultati upućuju na pozitivni fiziološki učinak niskih koncentracija  $H_2S$  na biljke paprike u uvjetima solnog stresa.

**Ključne riječi:** paprika, sumporovodik, NaHS, solni stres

## **Influence of sodium hydrosulfide on physiological indicators of salt stress in pepper (*Capsicum annuum* L.)**

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### **Summary**

Numerous studies so far confirmed the positive effects of low concentrations of hydrosulfide ( $H_2S$ ) on the physiological response of plants, in the conditions of various types of abiotic stress. However, the effect of sodium hydrosulfide (NaHS) as donor of  $H_2S$  in plant organism is still not clarified enough. Here, the influence of NaHS solutions (0, 50, 100, 200 i 500 mM) applied into the substrate, on the pepper plants (*Capsicum annuum* L.) grown in the presence of 150 mM NaCl was evaluated. On average, in both variants of NaCl stress, chlorophyll content was unaffected by the applied NaHS treatments, whereas the highest NaHS concentration significantly reduced the carotenoid content. In salt stress conditions, the application of 50 as well as 100 mM NaHS significantly reduced lipid peroxidation rate in pepper leaves. Also, NaHS application lowered proline content regardless of salt stress. Leaf area of the plants treated with 50 and 100 mM NaHS was not significantly reduced in salt stress conditions. The obtained results suggest the positive effect of low  $H_2S$  concentrations on pepper plants grown under salt stress conditions.

**Key words:** *pepper, hydrosulfide, NaHS, salt stress*

## Anti-inflammatory activity of *Thunbergia laurifolia* Lindl. Extract

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### Summary

*Thunbergia laurifolia* (or Rang Jued), a local Thai plant belonging to the *Acanthaceae* family, is commonly consumed in the form of herbal tea and widely used by Thai folk medicine. Fresh and dried forms of this plant including its leaves, barks and roots are mainly used as an antidote for insecticide, drugs, treating food poisoning and chemical toxicity. This research aimed to investigate the anti-inflammatory of *T. laurifolia* water extract by using animal models. Three experiments including ethyl phenylpropiolate (EPP)-induced ear edema, carrageenan or arachidonic acid-induced paw edema and cotton pellet-induced granuloma formation were conducted in animal models. Our results show that the administration of *T. laurifolia* extract possesses acute anti-inflammatory effects in EPP-induced ear edema and carrageenan or arachidonic acid-induced paw edema. Its anti-inflammatory activity was found to be mediated via inhibition of COX pathway and partly inhibition of LOX pathway. In conclusion, this study indicates that the *T. laurifolia* extract exhibits the anti-inflammatory in animals.

**Keywords:** *Thunbergia laurifolia* extract, anti-inflammatory activity

## Wound healing activity of *Allium ascalonicum* Linn. extract in rats

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### Summary

*Allium ascalonicum* Linn. (*Liliaceae*), commonly called shallot, is an annual herbaceous plant widely found in Thailand. It is commonly used as a flavor food. It is also used as a traditional medicine for the relief of earache, fever and antimicrobial potentials. The aims of this study are to validate wound healing activity in rats by use *Allium ascalonicum* Linn. extract. The results show that the topical application of 20 % ethanolic extract indicated a significantly increased percentage of wound contraction (78.61 %) on day 14 compared with the control group (71.9 %). Histological studies showed the complete epidermis and found the collagen fibers and hair follicles in the dermis. The results of histological evaluation have confirmed remarkable wound healing activities of *Allium ascalonicum* Linn.. The wound contraction of this extract may be due to stimulation of interleukin-8, an inflammatory a-chemokine which affects the function and recruitment of various inflammatory cells, fibroblasts and keratinocytes. In addition, this plant may induce a more rapid maturation of granulation tissue.

**Key words:** *Allium ascalonicum* Linn, wound healing

## Utjecaj udjela herbe i duljine ekstrakcije na sastav vodenog ekstrakta koprive

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### Sažetak

Cilj provedenog istraživanja bio je odrediti varijabilnost u sastavu i djelatnim tvarima vodenog ekstrakta koprive ovisno o udjelu herbe u otopini te duljini ekstrakcije, a sve kako bi se razvile standardizirane procedure za ekstrakciju i primjenu pripravka vodenog ekstrakta koprive kao sredstva za zaštitu bilja i/ili gnojiva. U istraživanje je uključeno 5 udjela suhe herbe koprive: 10, 20, 40, 50 i 60 g/L. Proučavane su dvije duljine ekstrakcije – 24 sata i 14 dana. U vodenim ekstraktima su određeni sljedeći parametri: pH, EC, količina nitratnog i amonijskog iona te ukupnih fenola. Rezultati ukazuju da udio herbe nije utjecao na pH otopine, ali je utjecao na EC vrijednost, gdje je povećanjem udjela herbe linearno rasla i EC vrijednost. Ekstrakti s udjelima od 10 i 20 g/L su nakon 24 sata ekstrakcije bili pogodni za folijarnu primjenu, dok je kod drugih udjela herbe EC vrijednost otopine bila previsoka. Svi su istraživani udjeli bili pogodni za primjenu kao gnojivo putem tla. Vodeni ekstrakti bili su bogati dušičnim spojevima, gdje je nakon 24 sata ekstrakcije prevladavao nitratni oblik, dok nakon 14 dana ekstrakcije amonijski oblik. Količina dušičnih spojeva čini vodene ekstrakte koprive izrazito kvalitetnim organskim gnojivom. Količina ukupnih fenola pri 24 satnoj ekstrakciji linearno raste povećanjem udjela herbe. Udio herbe u vodenom ekstraktu i duljina ekstrakcije utječu na činjenicu može li se isti primijeniti sa ili bez prethodnog razrjeđenja.

**Ključne riječi:** *Urtica dioica L., pesticid, gnojivo, hraniva, fenoli*

## Effect of herb content and extraction length on stinging nettle water extract composition

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### Summary

The aim of the study was to determine the variability in composition and active compounds of stinging nettle water extract depending on herb concentration and extraction length, in order to develop standardized procedures for extraction and application of stinging nettle water extract as a pesticide and/or fertilizer. The study included 5 herb contents: 10, 20, 40, 50 and 60 g/L. Two extraction lengths were studied – 24 hours and 14 days. The following parameters were measured: pH, EC, amount of nitrate and ammonia ions and total phenols. Results indicate that herb concentration did not affect extract pH value, but affected extract EC value and it was linearly increased by increasing herb content. Extracts with 10 and 20 g/L of herb were suitable for foliar application after 24 hours of extraction, while at other concentrations the extract EC value was too high. All investigated concentrations were suitable for application as soil fertilizer. Water extracts were rich in nitrogenous compounds, where the nitrate form prevailed after 24 hours of extraction, and ammonia form prevailed after 14 days of extraction. The amount of nitrogen compounds makes the extracts high quality organic fertilizer. The amount of total phenols at 24 hours of extraction was linearly increased by increasing herb concentration. Herb concentration and extraction length determine whether stinging nettle water extract can be applied with or without prior dilution.

**Key words:** *Urtica dioica L., pesticide, fertilizer, nutrients, phenols*

## Utjecaj gnojidbe i primjene mikoriznih gljiva na prinos i kvalitetu industrijske rajčice

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### Sažetak

U Hrvatskoj se najveće površine pod industrijskom rajčicom nalaze u dijelu Istre na kojem prevladava crvenica „Terra rossa“ i poznat je kao „Crvena Istra“. Prirodne karakteristike crvenice povezane su s niskom razinom organske tvari, ali i nedovoljnom količinom biološki dostupnog fosfora. Fosfor je bitan biogeni element neophodan za optimalnu kvalitetu plodovitog povrća te ima pozitivan utjecaj na sadržaj likopena. Organska tvar u tlu, ima snažan utjecaj na kemijske, fizikalne i mikrobiološke aspekte plodnosti tla i u optimalnim odnosima doprinosi prinosu i kvaliteti povrća. Cilj ovog rada bio je utvrditi učinkovitost primjene arbuskularnih mikoriznih gljiva (AMG) i gnojidbe na prinos i kvalitetu plodova industrijske rajčice na crvenici. Poljski pokus je postavljen po split-plot shemi u četiri ponavljanja. Glavni faktor „gnojidba“ imao je četiri varijante (100% organsko gnojivo, 100% mineralno gnojivo i 50:50 omjer organskog i mineralnog gnojiva). Podfaktor je imao dvije stepenice: presadnice sa ili bez AMG. Nisu utvrđene statistički značajne razlike između gnojidbe, mikorize ili interakcije primjene gnojidbe i mikorize za sadržaj likopena, suhu tvar ili čvrstoću plodova rajčice. Prinos je bio statistički značajno veći u svim gnojidbenim tretmanima u odnosu na kontrolu, dok primjena mikoriznih gljiva nije pokazala statistički značajan utjecaj na prinos u odnosu na nemikorizirane biljke.

**Ključne riječi:** Red Valley, crvenica, AMG, likopen, prinos



## Impact of fertilization and mycorrhizal fungi application on yield and quality of processing tomato

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### Summary

In Croatia the main growing area of processing tomatoes is located in the part of Istria with "Terra rossa" soil commonly known as "Red Istria". The natural characteristics of Terra Rosa are associated with a low level of organic matter, but also with insufficient amount of biologically available phosphorus. Phosphorus is essential nutrient for the optimal quality of fruit vegetable and has a positive effect on lycopene content. The organic matter in the soil has a strong influence on the chemical, physical and microbiological aspects of soil fertility and in optimal relationships contributes to the yield and quality of the vegetables. The aim of this paper was to determine the effectiveness of arbuscular mycorrhizal fungi (AMF) and fertilization on the yield and quality of industrial red tomato fruits. The experiment was set as split-plot field trial in four repetitions. The main factor "fertilization" had four variants (control, 100% organic fertilizer, 100% mineral fertilizer and 50:50 organic and mineral fertilizer ratio). The sub factor had two levels: seedlings with or without AMF. The results did not show any statistically significant differences between fertilization, mycorrhizae application or interaction between fertilizer and mycorrhizal application on tomato fruit thickness as well as lycopene and dry matter content. The yield was significantly higher in all fertilizer treatments compared to control, while the use of mycorrhizal fungi did not show a statistically significant effect on the yield of mycorrhizal plants.

**Key words:** Red Valley, Terra Rosa, AMF, lycopene, yield

## Utjecaj kompostirane komine masline i komunalnog mulja na vegetativne pokazatelje kineskog kupusa

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### Sažetak

Zbrinjavanje organskog otpada iz poljoprivrede i urbanih sredina predstavlja veliki problem te se pozornost pridaje mogućnosti njihova ponovnog korištenja. Prihvatljiv način zbrinjavanja, obrađene komine masline i komunalnog mulja, mogao bi biti korištenje u poljoprivredi. Istraživali smo utjecaj komposta dobivenog iz komine masline i komunalnog mulja na vegetativne pokazatelje kineskog kupusa (*Brassica rapa* L. ssp. *pekinensis*) u plasteničkom uzgoju. Kompost komine masline i komunalnog mulja pomiješani su s crvenicom u omjerima 0, 25, 50, 75 i 100 % komposta. Dvadeset dana nakon sadnje presadnica u lonce, izmjerena je duljina i promjer lista, promjer rozete i broj listova. Ručnim mjeracem relativnog sadržaja klorofila (N-tester) praćen je klorofil u listu, a ručnim senzorom za usjev (Greenseeker) izmjeren je vegetacijski indeks. Kupus uzgajan na višim koncentracijama mulja (75 i 100 %) imao je veće vrijednosti vegetativnih porasta u usporedbi s kupusom na 0 % mulja. Sadržaj klorofila i vegetacijski indeks bili su veći kod uzgoja na mulju u usporedbi s uzgojem u čistoj crvenici (0 %). Kod kupusa uzgajanog na komini masline, niže vrijednosti vegetativnih porasta, sadržaja klorofila i vegetacijskog indeksa imao je kupus uzgajan pri koncentracijama 25, 50 i 75 %, a više vrijednosti pri koncentracijama 100 % i 0 % komposta komine. Rani porast kineskog kupusa uzgajanog na kompostima dobivenim iz komunalnog mulja i komine masline ovisio je o ulaznom supstratu i njegovom udjelu u tlu.

**Ključne riječi:** *N-tester, Greenseeker, kompost, kineski kupus, komunalni mulj*

## **Olive pomace and sewage sludge compost affect Chinese cabbage vegetative parameters**

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### **Summary**

Sewage sludge and olive pomace are waste materials problematic for disposal. Reusing above materials in agriculture could be a way of waste management. The following experiment was to determine how agricultural application of composted sewage sludge and olive pomace affect Chinese cabbage early vegetative growth parameters in greenhouse production. Both sewage sludge and olive pomace were composted and incorporated in terra rossa in ratios 0, 25, 50, 75 and 100 % of compost. Twenty days after cabbage transplants were planted in pots we measured leaf length and diameter, rosette diameter and leaf number. With leaf nitrogen measurement (N-tester) we tested chlorophyll leaf content and using handheld crop sensor (Greenseeker) we tested cabbage normalized difference vegetation index. Higher vegetative parameters were found in cabbage grown on higher compost concentrations (75 and 100 %) compared to cabbage grown on pure sewage sludge (0 %). Chlorophyll content and vegetation index were again higher in cabbage grown on sewage sludge compared to pure terra rossa (0 %). Cabbage grown with 25, 50 and 75 % olive pomace compost had all vegetative parameters lower. When cabbage was grown on 0 and 100% olive pomace compost concentrations, all vegetative parameters were higher compared to cabbage grown on 25, 50 and 75 % compost. Early Chinese cabbage growth was affected by type of compost used (sewage sludge or olive pomace) and by compost concentration.

**Key words:** *N-tester, Greenseeker, compost, Chinese cabbage, sewage sludge*

## Različite lisne buhe na biljnim vrstama iz porodice Fabaceae u Hrvatskoj

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### Sažetak

Lisne buhe (*Hemiptera: Psylloidea*) su sitni fitofagni kukci koji se hrane sisanjem biljnih sokova biljaka domaćina. Vrste su uglavnom monofagne ili oligofagne, odnosno hrane se na samo jednoj ili nekoliko različitih, ali srodnih biljnih vrsta. Polifagnih je vrsta vrlo malo. Lisne buhe svojim domaćinima izravno štete sisanjem biljnih sokova iz floema, dok neizravne štete nastaju uslijed obilnog izlučivanja medne rose i posljedične pojave gljiva čađavica, a pojedine su vrste vektori vrlo štetnih fitoplazmi. Faunističko istraživanje lisnih buha u Hrvatskoj započelo je 2015. godine i još je u tijeku. Cilj ovog istraživanja je sastaviti popis („check“ listu) lisnih buha u Republici Hrvatskoj i njihovu rasprostranjenost te pregled biljaka domaćina i šteta koje neke vrste lisnih buha na njima uzrokuju. Provedenim istraživanjem u periodu od 2015. do 2017. godine tri su monofagne vrste lisnih buha zabilježene na biljkama iz porodice *Fabaceae*. *Acizzia jamatonica* (Kuwayama, 1908) utvrđena je na albiciji (*Albizia julibrissin* Durazz.), alohtonju vrsti istočnoazijskog porijekla, *Cacopsylla pulchella* (Löw, 1877) pronađena je na judiću (*Cercis siliquastrum* L.), dok je *Livilla spectabilis* (Flor, 1861) zabilježena na mediteranskom grmu brnistri (*Spartium junceum* L.). Sve tri biljne vrste česte su u primorskoj Hrvatskoj i prepoznatljiv su dio primorske flore, dok je albiciju i judić moguće pronaći i u kontinentalnoj Hrvatskoj. S obzirom da su sve tri vrste lisnih buha usko vezane uz jednog biljnog domaćina, areal njihovog pronalaska usko je vezan uz staništa na kojima rastu njihovi biljni domaćini. Štete na albiciji i judiću, koje uzrokuju ličinke i odrasli stadiji sisanjem biljnih sokova, zabilježene su na brojnim lokalitetima duž jadranske obale. Populacije štetnika na domaćinima bile su vrlo visoke te je na jednoj biljci istovremeno bilo moguće pronaći sve razvojne stadije: jaja, svih pet stadija ličinki i odrasle lisne buhe. Uslijed napada biljke su izgubile svoju ukrasnu vrijednost zbog obilnog izlučivanja medne rose i pojave gljiva čađavica, dok je na nekim lokacijama, kao posljedica jakog napada, došlo do promjene boje listova i defolijacije. *A. jamatonica* je, osim u primorskoj Hrvatskoj, zabilježena i na dva lokaliteta u središnjoj Hrvatskoj, međutim u vrlo niskim populacijama. *L. spectabilis* rijede je pronalazena vrsta, pri čemu su na brnistri zabilježene vrlo niske populacije ili pojedinačne jedinke odraslih stadija, dok ličinke nisu pronalazene. Štete na brnistri nisu zabilježene.

**Ključne riječi:** lisne buhe, *Fabaceae*, faunističko istraživanje, štete, Hrvatska

## Different psyllids on plant species from family Fabaceae in Croatia

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### Summary

Jumping plant-lice or psyllids (*Hemiptera: Psylloidea*) are very small, phytophagous sap-sucking insects. Generally, they are highly host specific, with most species being monophagous and feeding on only one host plant, or oligophagous, feeding on several closely related host plants. Very few species are polyphagous. Some species cause direct damages by feeding on their host plants, while others cause indirect damages by abundant excretion of honeydew and subsequent occurrence of sooty mould or by transmission of harmful phytoplasma diseases. Systematic faunistic research on psyllids in Croatia began in 2015 and is still ongoing. The objective of this research is to compose a comprehensive check-list of psyllid species occurring in Croatia, their distribution, list of host plants and overview of damages some species cause to their hosts. During this research, three monophagous psyllid species were detected on plants from family *Fabaceae*. *Acizzia jamatonica* (Kuwayama, 1908) was found on Persian silk tree (*Albizia julibrissin* Durazz.), allochthonous species of Eastern Asian origin, *Cacopsylla pulchella* (Löw, 1877) on Judas tree (*Cercis siliquastrum* L.) and *Livilla spectabilis* (Flor, 1861) on Mediterranean species Spanish broom (*Spartium junceum* L.). All three plant species are commonly found in coastal part of Croatia and are a recognizable part of coastal flora, while *A. julibrissin* and *C. siliquastrum* can occasionally be found in continental part as well. Since these psyllid species are host specific, their finding locations are closely related to areas where their host plants are grown. Damages on *A. julibrissin* and *C. siliquastrum* trees caused by feeding of adults and nymphs of *A. jamatonica* and *C. pulchella* respectively, were recorded on numerous locations throughout Croatian coast. Population density of *A. jamatonica* and *C. pulchella* on their host plants was usually high, very often with simultaneous presence of eggs, all five nymphal stages and adults on one host plant. Damages included decreased ornamental value of host plants due to excretion of wax and honeydew and in some locations, where severe infestations were recorded, discoloration of the leaves and defoliation. *A. jamatonica* was also found in central part of Croatia, but only in low population densities. *L. spectabilis* was found less often, in low population densities, with few locations where only one or two adults were found, and with no visible damages to its host plant *S. junceum*. So far, only adults of *L. spectabilis* have been recorded.

**Key words:** jumping plant-lice, *Fabaceae*, faunistic research, damage, Croatia

## **A histological study of pancreatic beta cells in streptozotocin –induced diabetic rats treated with *Ocimum americanum***

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### **Summary**

The present study aimed to investigate histological characters of pancreatic beta cells in streptozotocin (STZ)-induced diabetic rats after treated with various doses of *Ocimum americanum* aqueous leave extract. Thirty male Sprague-Dawley rats were divided into six groups: the nondiabetic control group, the diabetic untreated group, the diabetic treated with glibenclamide and three diabetic groups treated with 100, 200 and 400 mg/kg of *Ocimum americanum*. After 28 days of treatment, blood glucose and serum insulin levels were measure. Their pancreatic tissues were collected for histological staining with hematoxylin and eosin. The histological study of pancreas showed that STZ-induced degenerative changes of islets of Langerhans in all group of diabetic rats led to irregular shaped islets and reduces in the number of islets of Langerhans distributed in pancreas. However in diabetic group treated with the extract revealed some improvement in shape and number of islets of Langerhans in dose dependent manner. In conclusion, this present data suggests that *Ocimum americanum* may have a cytoprotective effect in the histological change in pancreatic beta cells in STZ-induced diabetic rats.

**Key words:** *Ocimum americanum, pancrease, histological study, beta cells*

## Učinak mehanički izazvanog stresa na presadnice nevena i kadifica

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### Sažetak

Cilj rada bio je istražiti učinak mehanički izazvanog stresa na morfološke karakteristike i vrijeme cvatnje presadnica nevena (*Calendula officinalis* L.), niske kadifice (*Tagetes patula* L.) i visoke kadifice (*T. erecta* L.). Presadnice su tretirane jednom dnevno, višekratnim povlačenjem pamučne tkanine po površini biljaka (četkanje). U vrijeme početka cvatnje, kod svih je istraživanih vrsta visina tretiranih i netretiranih presadnica bila statistički podjednaka. Kod niske kadifice tretman nije utjecao niti na ostale mjerene morfološke parametre. Međutim, tretirane presadnice visoke kadifice imale su nešto veći promjer stabljike te veći broj bočnih ogranaka i listova nego netretirane presadnice, dok su u nevena tretirane presadnice imale uspravnije stabljike nego netretirane. Osim toga, u obje su ove vrste tretirane presadnice imale veći broj cvatnih pupova. Iako je u tretiranih presadnica visoke kadifice došlo do malog pomaka u vremenu početka cvatnje, tretman niti kod jedne vrste nije utjecao na datum cvatnje 50 % biljaka. Provedeno istraživanje pokazalo je da tretman četkanjem može poboljšati neke komercijalno važne karakteristike presadnica nevena i visoke kadifice. Međutim, u obje vrste su se prilikom tretmana u nekih biljaka oštetili listovi, osobito u nevena. Stoga je u ovih vrsta potrebno istražiti učinkovitost drugih metoda izazivanja mehaničkog stresa, posebice onih u kojih je fizički kontakt s biljkama smanjen ili se izbjegava.

**Ključne riječi:** mehanički izazvan stres, *Calendula officinalis*, *Tagetes patula*, *Tagetes erecta*

## The effect of mechanically-induced stress on *Calendula officinalis*, *Tagetes patula* and *Tagetes erecta* transplants

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### Summary

The aim of this work was to investigate the effect of mechanically-induced stress on morphological characteristics and flowering time of *Calendula officinalis* L., *Tagetes patula* L. and *T. erecta* L. transplants. The plants were subjected to daily brushing treatment with a cotton cloth. At the time of anthesis, the plant height was not statistically significantly different between treated and untreated group, in none of the investigated species. In *T. patula*, the treatment also did not influence other measured morphological parameters. However, in *T. erecta*, treated transplants had slightly higher stem diameter and also higher numbers of lateral branches and leaves than untreated ones, while in *C. officinalis*, the treatment resulted in more erect stems. Besides, treated plants in both species had a higher number of inflorescence buds. Although the treatment slightly shifted the date of flowering onset in *T. erecta*, the number of days to 50 % flowering was not affected by brushing in the investigated species. The results of this study show that mechanically-induced stress may improve some of the commercially important characteristics of *C. officinalis* and *T. erecta*. However, brushing also caused damage on some leaves, especially in *C. officinalis*. For these species, further research is needed to find out the effectiveness of other methods of applying mechanical stress, in particular those in which physical contact with plants is reduced or avoided.

**Key words:** mechanically-induced stress, *Calendula officinalis*, *Tagetes patula*, *Tagetes erecta*



## Primjena infracrvene termografije u detekciji vodnog stresa kod presadnica rajčice

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### Sažetak

Praćenje ponašanja biljke i pouzdano određivanje potrebe za navodnjavanjem ekonomski je, agronomski i inženjerski izazov te je predmet istraživanja koja se temelje na mjerenju brojnih pokazatelja (temperatura lista, temperatura i vlažnost tla te temperatura i vlažnost zraka). U tom pogledu se infracrvenoj termografiji kao beskontaktnoj metodi mjerenja i bilježenja temperature i njezine raspodjele na površinama objekata, pridaje se sve veća pažnja. S obzirom da svako tijelo emitira infracrveno (IC) zračenje, ovisno o njegovoj temperaturi, postoje razlike vidljive IC kamerom što omogućuje primjenu infracrvene termografije u detekciji vodnog stresa biljaka. U ovome radu provedeno je istraživanje na presadnicama industrijske rajčice (*Lycopersicon esculentum* Mill.). Mjerenja temperature su provedena termoparovima i IC termografskom kamerom. Istovremeno su provedena i mjerenja vodnog potencijala lista (LWP). Analizirana je promjena temperature i indeksa vodnog stresa biljaka (CWSI) tijekom dana. Na osnovu vrijednosti CWSIa dobivenih pomoću više modela analize i mjerenih vrijednosti LWPa, izrađeno je više modela koji opisuju vezu tih dviju vrijednosti. Dobiveni modeli su pokazali statistički značajan stupanj korelacije između tih vrijednosti. Vrijednosti CWSIa dobivene ručnom obradom termograma su dale najveći stupanj korelacije, no i neke automatske metode obrade su pokazale rezultate usporedive s ručnima.

**Ključne riječi:** navodnjavanje, termografija, rajčica, presadnice, daljinska istraživanja

## Application of infrared thermography for determination of water stress in tomato seedlings

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### Summary

Plant behavior monitoring and reliable scheduling irrigation are an economic, agronomic and engineering challenge and are the subject of research that is based on the different variables (leaf temperature, soil temperature and humidity, air temperature and humidity). In this respect, infrared thermography, contactless method of measuring and recording the temperature and its distribution on the surfaces of objects, is paying increasing attention. Since each body emits infrared (IC) radiation, depending on its temperature, there are differences in the visible IC camera, which enables the use of infrared thermography in detecting the water stress of the plants. Research was conducted on tomato (*Lycopersicon esculentum* Mill.) seedlings. Temperature measurements were carried out using thermocouples and an infrared thermal imaging camera. Biological properties of the plant, such as the leaf water potential (LWP), were measured as well. An analysis of the change of temperature and crop water stress index (CWSI) during the day was conducted. The obtained CWSI values and the measured LWP values were used to create multiple models describing their relationship. The obtained relationships showed a statistically significant degree of correlation. Values of CWSI obtained by manual analysis of thermal images produced the highest degree of correlation, but some of the automatic analysis methods produced results comparable to those obtained using the manual methods of analysis.

**Key words:** irrigation, thermography, tomato, seedlings, remote sensing

## Rasprostranjenost i molekularna identifikacija kupusne cistolike nematode (*Heterodera cruciferae*) u Varaždinskoj županiji

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### Sažetak

Kupusna cistolika nematoda, *Heterodera cruciferae* Franklin, 1945, nije štetnik od velikog značaja, ali je široko rasprostranjena na površinama na kojima se intenzivno uzgajaju kupusnjače. Osim u Europi rasprostranjena je u Rusiji, Iranu, Kaliforniji i južnoj Australiji. U Hrvatskoj je identifikacija vrste sa značajnim štetama na usjevima glavatog kupusa zabilježena 1965. godine na području Varaždina. Glavni domaćini kupusne cistolike nematode su biljke iz porodice *Brassicaceae* (skoro svi rodovi) i neki korovi iz porodice *Lamiaceae*. Ova vrsta može u određenim uvjetima (nedostatak plodoreda, visoka populacija, sušni period) uzrokovati značajno smanjenje prinosa. Simptomi parazitacije na biljkama su venuće, žućenje donjih listova, slabije oblikovanje glave kupusa sa oštećenjima i zakržljanim rastom glavnog korijena. Na korijenu se tijekom sezone mogu uočiti i ciste (uginule ženke). U Hrvatskoj kupusna cistolika nematoda može razviti dvije generacije godišnje. Varaždinska županija (sjeverozapadni dio Hrvatske) je tradicionalno područje proizvodnje *varaždinskog zelja* od istoimene autohtone sorte Varaždinski kupus danas zaštićene izvornosti i oznake zemljopisnog podrijetla. U razdoblju od 2013.-2017. sa različitih lokaliteta Varaždinske županije iz uzoraka tla zaprimljenih tijekom provođenja programa posebnog nadzora krumpirove cistolike nematode izolirane su ciste roda *Heterodera* spp. Tradicionalna dijagnostika nematoda roda *Heterodera* spp. temeljena na morfologiji i morfometriji je dugotrajna i zahtjeva vrlo usku specijalizaciju dijagnostičara. Razvojem molekularnih metoda identifikacije vrsta (PCR, RFLP, sekvenciranje) otvorene su nove mogućnosti u rješavanju problema povezanih s tradicionalnim metodama identifikacije. U radu će biti prezentirani sveukupni rezultati laboratorijskih analiza prikupljenih uzoraka tla i molekularna identifikacija kupusne cistolike nematode u Varaždinskoj županiji.

**Ključne riječi:** cistolike nematode, kupus, molekularna identifikacija

## Distribution and molecular identification of the cabbage cyst nematode (*Heterodera cruciferae*) in the Varaždin county

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### Summary

The cabbage cyst nematode, *Heterodera cruciferae* Franklin, 1945, is not a major pest but its widespread on the areas in which brassicas are frequently grown. Except for Europe, the nematode is widespread in Russia, Iran, California and South Australia. In Croatia, the first record of this species was recorded in 1965 on the area of Varaždin with significant damage on the head of cabbage. The main hosts of the cabbage cyst nematode are plants in the family *Brassicaceae* (nearly all genera) and some weeds and members of *Lamiaceae*. This species may cause significant yield loss in the certain conditions (lack of crop rotation, high population, dry season). Symptoms of this pathogen are wilting, yellowing of the lower leaves, formation of the small head of cabbage and the root development may be severely stunted and damaged. On the root during the season can be observed cysts (dead females). In Croatia, the cabbage cyst nematode can develop two generations per year. The Varaždin County (northwestern part of Croatia) is a traditional area of the cabbage production “*varaždinsko zelje*”, that is an authentic vegetable variety of Varaždin cabbage which is today protected by its origin and geographical designation. In the period 2013-2017 from different locations of the Varaždin County from soil samples received during the implementation of the special control program of potato cyst nematode, the cysts of *Heterodera* spp. were extracted. The traditional diagnosis of nematode genera *Heterodera* spp. based on morphology and morphometrics can be time consuming and requires considerable skills. By developing molecular methods of identification of species (PCR, RFLP, sequencing) have been opened new opportunities in solving problems associated with traditional identification methods. In the paper will be presented overall results of laboratory analysis of collected soil samples and the molecular identification of cabbage cyst nematode in the Varaždin County.

**Key words:** *cyst nematode, cabbage, molecular identification*

## Effects of *Allium ascalonicum* Linn. extract on antimicrobial activity in rats

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### Summary

Antimicrobial activity accelerates the wound-healing process by protecting the wound against the microbial infections. The purposes of this study are to evaluate antimicrobial properties of aqueous and ethanolic extracts of *Allium ascalonicum* Linn. against common microbes causing skin infections. The antimicrobial activity of *Allium ascalonicum* Linn. extracts were tested against six selected bacterial strains and two fungal strains using the disc diffusion method and a broth micro-dilution technique to determine the minimal inhibition concentrations (MIC) and the minimal microbicidal concentrations (MMC). The ethanolic extract of *Allium ascalonicum* Linn. showed potential antimicrobial by inhibiting gram positive bacteria *Staphylococcus aureus* ATCC25923, *Staphylococcus epidermidis* and *Bacillus subtilis* ATCC 6633. MIC and MMC varied from 25-50 mg/ml and 25-200 mg/ml, respectively. The results have confirmed the antimicrobial activities of *Allium ascalonicum* Linn extract. The future study should be about the wound healing activities of this plant.

**Key words:** *Allium ascalonicum* Linn., antimicrobial activity

## Identification and quantification of nutritionally important compounds in different legume species

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### Summary

Legume seeds belonging to the *Fabaceae* (*Leguminosae*) family are of prime importance for human and animal nutrition. Within the framework of current studies at the Agricultural Institute of Slovenia, several nutritionally important compounds were measured in grains of common bean (*Phaseolus vulgaris*) as dry seeds and pods, runner bean (*Phaseolus coccineus*), soybean (*Glycine max*), lentil (*Lens culinaris*), pea (*Pisum sativum*), broad bean (*Vicia faba*), chickpea (*Cicer arietinum*), blue lupin (*Lupinus angustifolius*), yellow lupin (*Lupinus luteus*) and white lupin (*Lupinus albus*). Homogenised dried samples were analysed for the following parameters: moisture content (8 – 20 % dry weight, DW), proteins (14 – 43 % DW), fats (0.6 – 18.5 % DW), phytic acid content (113 – 2566 mg/100 g DW), multi-mineral fingerprint (a total of 7 macro-, 14 micro- and 8 trace minerals) and phenolic profile (a total of 28 phenolic compounds belonging to phenolic acids, isoflavones, flavones, flavonols, flavanones and flavanols). In addition to standard methods the following techniques, i.e. LC-MS/MS, X-ray fluorescence (XRF) and ICP-MS, were applied. The results show significant differences between analysed legume species and as well between different varieties for investigated nutritional compounds.

**Key words:** legumes, nutritional parameters, minerals, phenolics, phytic acid

## Study on antiproliferative and apoptotic effects of high dose vitamin C in Cholangiocarcinoma cell line

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### Summary

High dose vitamin C has been purposed as a therapeutic option for cancer treatment. It was our interest to evaluate antiproliferative and apoptotic effects of high dose vitamin C in cholangiocarcinoma cell line (CCA). The human K100-CCA cell line was used in this study. Cell proliferation was determined by sulforhodamine B colorimetric assay. The expression of anti-apoptotic Bcl-2 protein/pro-apoptotic Bax protein was determined by Western blot analysis. In the present study, ascorbic acid inhibited the growth of CCA in a dose-dependent manner. The IC<sub>50</sub> value of ascorbic acid on K100 at 24 h was 55± 9.4 mM. In addition, treatment with ascorbic acid resulted in reduction of glutathione and increased hydrogen peroxide contents in cells. Moreover, the disturbance of the mitochondrial membrane potential was detected in ascorbic acid treated cells in the dose-dependence manner. Finally, ratio of Bcl2/Bax was reduced in CCA treated with ascorbic acid. Taken together, our results showed that the mechanism of anti-proliferation effect of ascorbic acid in CCA may be attributable to modulate the expression of Bcl-2 and Bax proteins and dissipation of the mitochondrial electrochemical potential gradient which is known as an early event leading to apoptosis.

**Keywords:** *vitamin C, cholangiocarcinoma, apoptosis*

## Tehnike reduciranog navodnjavanja kod uzgoja cijepljene rajčice

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### Sažetak

Reducirano navodnjavanje pretpostavlja opskrbu biljaka vodom u količinama manjim od onih potrebnih za postizanje maksimalnih prinosa. Dvije tehnike reduciranog navodnjavanja su deficitarno navodnjavanje (DI) i izmjenično djelomično zasušivanje korijena (PRD). Cijepljenje na podloge koristan je alat za prevladavanje abiotskih stresova u plodovitom povrću. Cilj ovog rada bio je utvrditi utjecaj djelomičnog zasušivanja korijena i deficitarnog navodnjavanja na rast i prinos cijepljene rajčice. Rajčice sorte Attiya, cijepljene na vlastitom korijenu i uzgajane na 1 ili 2 izboja te cijepljene na dvije *Solanum* podloge Emperador i Maxifort i uzgajane na 2 grane, uzgajane su tlu u plasteniku s tri tipa navodnjavanja: DI, PRD i potpuno navodnjavanje (FI). Najveći broj listova po izboju i visinu izboja su imale biljke uzgojene na podlogama Emperador i Maxifort neovisno o tipu primijenjenog navodnjavanja. Kod sva 3 tipa navodnjavanja biljke uzgojene na podlogama imale su najveći prinos. Najveći prinos je zabilježen kod biljaka uzgojenih na podlozi Maxifort kod FIa, i to 5,78 kg po izboju to jest 11,56 kg po biljci. Najmanji prinos utvrđen je kod samocijepljenih biljaka s 2 izboja, 2,9 kg po grani ili 5,8 kg po biljci.. Najveći rani prinos zabilježen je kod sva 3 tretmana navodnjavanja kod samocijepljenih biljaka uzgajanih na 1 granu/izboj te je imao najveće vrijednosti kod PRD. Vrijednosti NPK hraniva u listu bile najviše kod sva 3 tipa navodnjavanja na *Solanum* podlogama.

**Ključne riječi:** *Solanum lycopersicum L., podloge, modificirani uzgoj, djelomično zasušivanje korijena, prinos*



## Effect of deficit irrigation on grafted tomato cultivation

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### Summary

Deficit and alternate partial root-zone drying (PRD) irrigation are the water-saving techniques, while grafting onto some rootstocks is a useful tool to overcome abiotic stresses in fruit vegetables. The aim of this study was to investigate the effect of deficit irrigation (DI) and partial root-zone drying on grafted tomato growth and yield parameters. The tomato plants (cv. Clarabella) self-grafted and grafted onto Emperor and Maxifort rootstocks were soil grown in greenhouse under three irrigation regimes, DI, PRD and full irrigation (FI). There were no differences in plant height between the treatments, while plants grafted on rootstocks had more leaves compared to self-grafted plants. On average in all three irrigation treatments plants on Emperor rootstock had highest yield (6,54 kg) and the least tomatoes were harvested on self-grafted plants (4,9 kg). More fruits were noted in grafted plants grown under DI and PRD. Highest early yield had plants grafted on Maxifort under DI, while in the same plants was lowest under PRD. Highest average fruit mass had plants on Emperor grown under PRD (317 g), while smallest fruits were measured in self-grafted plants under DI and FI (263 g). These results show the effectiveness of DI and PRD with respect to upgrading growth and yield of grafted tomato compared to full irrigation.

**Key words:** *Solanum lycopersicum L., water stress, rootstocks, partial-root drying, yield*

## Utjecaj lokacije, gnojidbe i biostimulatora na rast i razvoj autohtone baranjske začinske paprike

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### Sažetak

Najveće proizvodne površine začinske paprike u Hrvatskoj se nalaze u Baranji gdje se ostvaruju i najviši prinosi, ali se uglavnom uzgajaju hibridne sorte podrijetlom iz Mađarske. Međutim, u Baranji je pronađena autohtona začinska paprika za koju nisu poznati podaci o mogućim prinosima te optimalnoj tehnologiji proizvodnje. Prema tome, cilj ovog istraživanja je bio utvrditi optimalnu tehnologiju proizvodnje baranjske autohtone začinske paprike sorta Baranjka. Istraživanje je provedeno tijekom 2017. godine na tri različite lokacije u Baranji i to u Karancu, Lugu i Branjin Vrhu. Sjeme paprike Baranjka je posijano u polistirenske kontejnere napunjene sa Klassmann Potgrond H supstratom te smješteno u grijani plastenik. Nicanje je počelo 10 dana poslije sjetve, a sadnja je obavljena 52 dana nakon sjetve na tri spomenute lokacije. Pokus je postavljen po slučajnom blok rasporedu u 4 varijante gnojidbe, varijanta gnojidbe prema analizi tla bez prihrane kristalonima (GPA), primjena kristalona navodnjavanjem u punoj dozi (K100), primjena kristalona uz redukciju koncentracije od 30% uz dodatak biostimulatora (R30B) i primjena kristalona uz redukciju od 30% (R30). Kod varijante R30B uz prihranu kristalonima, dodani su biostimulatori Radifram, Probac i Benefit zasebno prema fenofazama rasta i razvoja paprike. Kristaloni su primijenjeni u koncentraciji od 0,21% ili 0,30%, a biostimulatori u koncentraciji od 0,25-0,30%. Biljke koje nisu tretirane (GPA), istovremeno su dobile adekvatnu količinu vode bez hraniva i/ili biostimulatora. Tijekom istraživanja su uzorkovani listovi iznad prvog grananja i plodovi po dozrijevanju te je zabilježena visina biljke tijekom pune cvatnje i zametanja plodova. Podatci su obrađeni analizom varijance koristeći Fisher LSD test u statističkom programu SAS 9.1. Statističkom analizom je utvrđeno da su lokacija i varijanta gnojidbe značajno utjecali na masu lista, dužinu i širinu lista, visinu biljke, broj plodova, masu ploda te ukupan prinos. Kod svih pokazatelja rasta i razvoja, varijanta R30B je dala značajno bolje rezultate. Također, svi mjereni parametri imali su značajno veću vrijednost na lokaciji Karanac u usporedbi sa svim ostalim lokacijama, osim u slučaju mase ploda koja je bila značajno veća na lokaciji Lug. Iz navedenog se može zaključiti da rast i razvoj začinske sorte Baranjka ovisi o modelu gnojidbe te lokaciji tj. opskrbljenosti tla s organskom tvari i hranivima budući da je tlo na lokaciji Karanac analizom okarakterizirano kao najbogatije tlo zalihamo hraniva i organske tvari.

**Ključne riječi:** začinska paprika, gnojidba, biostimulatori, rast i razvoj, prinosi

## **Influence of location, fertilization and biostimulants on growth and development of autochthonous baranyan spice pepper**

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### **Summary**

The biggest production sites of red spice pepper in Croatia are situated in Baranya where also highest yields are obtained, but most of the produced quantities are from growing the Hungarian hybrid cultivars. However, in Baranya was recently found autochthonous cultivar of red spice pepper for which optimal production technology nor expected yields are not known. Accordingly, the aim of this investigation was to determine the optimal production method, precisely optimal fertilizer and irrigation rates for baranyan autochthonous spice pepper called Baranjka. Investigation was carried out during 2017 on three different locations in Baranya as follows, Karanac, Lug and Branjin Vrh. Seeds of Baranjka were sown to polystyrene plug trays filled with Klassmann Potgrond H substrate and placed in heated greenhouse. Emerging started 10 days after sowing and planting was done 52 days after sowing on abovementioned locations. Experiment was set out as randomized block design in 4 different fertilization models as follows: fertilization according to recommendation based on soil analysis without application of kristalon fertilizers (GPA), with application of kristalon in full dose (K100), application of kristalon with reduced concentration for 30% with addition of biostimulants (R30B) and application of kristalon with reduced concentration for 30% (R30). Biostimulants, in variant R30B, Radifram, Probac and Benefit were applied to plants separately depending on plant growth stage in concentrations 0.25-0.30%. Kristalon fertilizers were applied by watering in concentration 0,21% or 0,30%. Untreated plants (GPA) were watered with the same amount of water during the treatments. For analysis of growth and development, leaves were sampled above the first branching and fruits at the time of ripeness. Also, plant height was recorded at the stage of flowering and fruit setting. Data were statistically analyzed by factorial ANOVA with Fisher's LSD test using SAS 9.1. Statistical analysis confirmed that location and fertilization model significantly influenced on leaves weight, length and width, plant height, fruit weight and number as well as on total yield. Significantly higher values of each investigated parameter were recorded in variant R30B. Also, Karanac showed to be the best location compared to other two, except for fruit fresh weight which was significantly higher at location Lug. It can be concluded that growth and development of red spice pepper Baranjka depends on fertilization model and location or soil agrochemical properties since it was determined that soil on location Karanac was the richest in organic matter content and nutrient supply.

**Key words:** *spice pepper, fertilization model, biostimulants, growth and development, yield*

## Samonikle mediteranske biljke kao tradicionalno povrće - tradicionalno znanje u općini Kršan (Istra, Hrvatska)

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### Sažetak

Istra je poznata kao agroturistička regija Hrvatske s brojnim obiteljskim gospodarstvima koja proizvode kvalitetnu domaću hranu. Istraživano područje općine Kršan nalazi se na istočnoj obali i proteže se u unutrašnjost koju odlikuje obilježje submediteranske klime. Zbog promjena načina života i nedovoljno podataka na ovom području, postoji opasnost od gubitka tradicionalnog znanja (TZ) o upotrebi samoniklih biljaka. Cilj ovog istraživanja bio je istražiti lokalno TZ i sadašnju uporabu samoniklih biljaka za hranu, narodnu medicinu te druge namjene, a ovdje se iznosi samo korištenje divljeg povrća. U ovom preliminarnom istraživanju, provedenom 2017. godine, dokumentirano je korištenje 36 samoniklog, nekultiviranog povrća iz 22 porodice, od kojih su najzastupljenije *Apiaceae* i *Amaryllidaceae*. Najčešće prikupljene vrste su: *Asparagus acutifolius*, *Cichorium intybus*, *Ruscus aculeatus*, *Tamus communis*, *Taraxacum officinale*, *Foeniculum vulgare*, *Crithmum maritimum*, *Urtica dioica*, *Sonchus asper*, *S. oleraceus*, *Diplotaxis tenuifolius*, *Chenopodium album*, *Geranium robertianum*, *Humulus lupulus*, *Plantago major* i *Silene latifolia*. Zanimljiva je upotreba mješavine "zeje" - 12 vrsta samoniklog povrća što se tradicionalno jede na Veliki petak. Zaključujemo da se samoniklo povrće danas konzumira u manjoj mjeri nego prije nekoliko desetljeća i da je potrebno ponovno uvođenje tradicionalnih etno-kulinarskih događaja i još veći razvoj agro-, eko- i gastro turizma kako bi se očuvalo TZ. Svi herbarski primjerci su dostupni u ZAGR virtualnom herbariju (<http://herbarium.agr.hr/>).

**Ključne riječi:** samoniklo mediteransko bilje, tradicionalno znanje, samoniklo povrće, tradicionalna hrana, Istra

## **Wild Mediterranean plants as vegetable food – traditional knowledge in Kršan municipality (Croatia)**

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### **Summary**

Istria is well-known as an agro-tourist region of Croatia with many family farms that produce good quality traditional homemade food. The researched area of Kršan municipality is located on the east coast and extends into the inland, in sub Mediterranean climate. Due to changes of lifestyle, and not sufficient documentation on the area, there is a threat of wild plants use traditional knowledge (TK) loss. The aim of study was to investigate the local TK and the present use of wild plants for food, medicinal plants and other uses. Here only the use of wild vegetables is presented. In this preliminary survey, conducted in 2017, the uses of 36 wild, non-cultivated vegetables from 22 families were documented. Most represented families are *Apiaceae* and *Amaryllidaceae*, and the most commonly collected species are: *Asparagus acutifolius*, *Cichorium intybus*, *Ruscus aculeatus*, *Tamus communis*, *Taraxacum officinale*, *Foeniculum vulgare*, *Crithmum maritimum*, *Urtica dioica*, *Sonchus asper*, *S. oleraceus*, *Diplotaxis tenuifolius*, *Chenopodium album*, *Geranium robertianum*, *Humulus lupulus*, *Plantago major*, and *Silene latifolia*. The use of "zeje" mixture, vegetable food traditionally eaten on a big Friday, is interesting. We conclude that wild vegetables are consumed nowadays to less extent than decades ago and the re-introduction of old tradition ethno-culinary events and even a greater development of agri-, eco- and gastro-tourism is needed to preserve TK. Herbarium specimens are available in ZAGR Virtual herbarium (<http://herbarium.agr.hr/>).

**Key words:** *Wild Mediterranean plants, traditional knowledge, wild vegetable, traditional food, Istria*

## The effect of indol-3-acetic acid on productive characteristics of bulbous corm flower species

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### Summary

In order to obtain the best quality of flowers, contemporary flower production is increasingly relying on the use of phytohormones and biostimulators. Thanks to the widespread application, in recent years, their use in production of bulbous corm flower species has been increasingly examined, especially phytohormones. The justification of the use of indole-3-acetic acid in the production of bulbous corm flower species is reflected in the possibility of improving productive characteristics. In this paper was examined the effect of the application of indole-3-acetic acid as a microbiological fertilizer - commercial name *Slavol* - on the productive characteristics of two species of the genus *Gladiolus sp.* and *Lilium sp.* During the research, the bulbs and corm was soaking in two different time intervals (1 h and 24 h) and in two different concentrations of *Slavol* (100 ml and 150 ml). The obtained results showed the positive effect of the application of indole-3-acetic acid on the examine productive characteristics: plant height, overhead mass, number of leaves, number of flower buds, length of the flower and weight of bulbs. Studies have also shown that for species of the genus *Lilium sp.*, a greater impact on productive characteristics has the concentration of indol-3-acetic acid in relation to the duration of treatment, while for species of the genus *Galdiolus sp.* a greater impact has shown the duration of the treatment.

**Key words:** *indol-3-acetic acid, bulbous corm flower, productive characteristics, lilium, gladiolus*



**Ratarstvo**

**05**

**Field Crop  
Production**





## Kako spriječiti propadanje proizvodnje krumpira u Hrvatskoj

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### Sažetak

Krumpir je bogat izvor energije, škroba, vitamina, minerala, organskih kiselina i od izuzetnog je značaja za prehranu stanovništva u Hrvatskoj i u svijetu. Proizvodnja krumpira treba biti jedan od prioriteta u proizvodnji svake države pa tako i Hrvatske, zbog tradicije u proizvodnji kao i mogućnosti za uzgoj kvalitetnog konzumnog i sjemenskog krumpira. Konzumni krumpir proizvodi se u Hrvatskoj na približno 7000 hektara (procjena Agencije za plaćanja u poljoprivredi, ribarstvu i ruralnom razvoju (APRRR) i autora). Većina proizvodnje se odvija na OPG-ima koja još uvijek imaju niz nedostataka: usitnjenost parcela, nedovoljna i neadekvatna primjena tehnologije (od sadnje, njege, navodnjavanja do vađenja) i nedovoljno kvalitetni uvjeti skladištenja. Sve to rezultira neujednačenim prosječnim prinosima koji dosta variraju po godinama i kreću se u prosjeku oko 25 tona/ha. To je znatno manja prosječna proizvodnja konzumnog krumpira od nekih zemalja također članica EU: Belgije, Francuske, Njemačke, Nizozemske i Velike Britanije koje ostvaruju prosječne prinose iznad 44 tona/ha. U Hrvatskoj proizvodnja sjemenskog krumpira iz godine u godinu pada u hektarima i tonama. Od 1985. do 1990. godine godišnja proizvodnja bila je na 500 ha čime je Hrvatska bila jedan od većih proizvođača u okruženju. Do 2010. godine proizvodnja se kretala blizu 200 ha, da bi u 2014. godini spala na 58 ha. U 2017. godini šest proizvođača posadilo je 33 ha sjemenskog krumpira što je najmanja sjemenska proizvodnja do sada. Prosječan prinos u sjemenskoj proizvodnji u Hrvatskoj kretao se od 18-20 t/ha, dok je prosječna proizvodnja u EU na približno 1,8 mil. hektara s prosječnim prinosom od 30 t/ha. Ulaskom Hrvatske u EU našim proizvođačima se još otežala situacija jer se moraju nositi s organiziranom proizvodnjom iz susjednih zemalja i zemalja EU. U izlaganju će se prikazati neke od smjernica za rješenje i opstanak domaće proizvodnje krumpira. Moramo iskoristiti komparativne prednosti kao što su dobri klimatski i pedološki uvjeti za proizvodnju, manje prisustvo bolesti i štetnika, a osobito odsustvo karantenskih bolesti koje su prisutne u nekim zemljama značajnim proizvođačima krumpira kao što su: Nizozemska, Belgija, Njemačka, Škotska i dr. Konkurentnost i održivost na tržištu EU može se održati samo povećanjem proizvodnih površina i prinosa krumpira.

***Ključne riječi:*** konzumni krumpir, sjemenski krumpir, proizvodnja, prinos

## How to prevent deterioration of potato production in Croatia

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### Summary

Potato is a rich source of energy, starch, vitamins, minerals, organic acids and is of great importance for the nutrition of the population in Croatia and in the world. The production of potatoes should be the priority in the production and nutrition of each country as well as Croatia, because of the tradition in the production as well as opportunities for growing high quality table and seed potatoes. Table potatoes are produced in the Republic of Croatia on approximately 7000 ha (estimation of Paying Agency for Agriculture, Fisheries and Rural Development (PAAFRD) and author). The largest proportion of production takes place on family farms (OPG) where there are still many issues to be solved: small parcels, insufficient and inadequate application of technology (from planting, care, irrigation to harvest) and insufficiently adequate storing conditions. As a result, there is an unbalanced annual yield over several years, which varies from year to year and amounts to 25 t/ha. This is significantly lower average production of table potatoes compared to countries which are also members of the EU: Belgium, France, Germany, the Netherlands, Great Britain with an average annual yield above 44 t/ha. The production of seed potatoes in Croatia has been falling year after year both in hectares and tonnes. From 1985 to 1990 annual production was 500 hectares, making Croatia one of the largest producers in the region. By 2010, production was near 200 hectares, and it fell to 58 hectares in 2014. In 2017 six producers planted 33 hectares of seed potatoes which is the smallest seed production so far with an average yield 18-20 t/ha while the average production in the EU is about 1.8 million ha with an average yield of 30 t/ha. The Republic of Croatia having joined the EU, the conditions for domestic producers worsened because they have to compete with the organized production from countries in the region and countries in the EU. The guidelines towards the solution and the survival of the domestic potato production will be presented. We must use our competitive advantages such as good climate and pedological conditions for the production, low soil contamination, less presence of disease and pests, especially the absence of quarantine diseases that are present in countries which are major potato producers such as Netherlands, Belgium, Germany, Scotland, etc. Competitiveness and sustainability on the EU market can be maintained only by increasing planted areas and the potato yield.

**Key words:** *table potatoes, seed potatoes, production, yield*

## Pšenica obogaćena selenom upotrebljena za proizvodnju kukuruznih snack proizvoda

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### Sažetak

Ekstrudirani snack proizvodi su jedni od najpopularnijih grickalica u svijetu. Uglavnom nisu obogaćene nutritivnim tvarima, ali mogli bi biti dobar izvor nutrijenata zbog svoje rasprostranjenosti. Sukladno tome, tema ovog rada je povećanje nutritivne vrijednosti kukuruznih ekstrudata s pšenicom obogaćenom selenom (Se). Se je važan za redukciju hidroksiperoksida, zbog glutathion peroksidaze (GPX) koja ovisi o Se te GPX katalizira redukciju hidroksiperoksida. Osim kao antioksidans, Se ima važnu ulogu u održavanju homeostaze hormona štitnjače, u reprodukciji, imunitetu, procesu starenja, zaštiti od trovanja teškim metalima. Manjak Se može biti povezan s mnogim bolestima, među kojima je i karcinom, zbog njegovih antimutagenih i antikancerogenih svojstava. Budući da je moguće i trovanje Se, preporučena dnevna doza unosa za odrasle osobe je 55 µg. Pšenica obogaćena Se samljevena je u brašno (PB) i brašno je dodano u kukuruznu krupicu u udjelima 10, 20, 30 i 40 % s. tv. Vlažnost zamjesa podešena je na 15 %. Pripremljeni uzorci ekstrudirani su u laboratorijskom jednopužnom ekstruderu, sa sapnicom promjera 4 mm, pužem konfiguracije 4:1, pri temperaturnim profilima: 140/170/170 °C; 150/180/180 °C i 160/190/190 °C. Dobiveni ekstrudati su sušeni na zraku i određena su im fizikalna svojstva. Dodatak PB povećao je ukupnu promjenu boje ( $\Delta E$ ) u promatranim ekstrudatima, dok povećanje temperature ekstrudera nije imalo značajan utjecaj na  $\Delta E$ . Dodatak PB i povećanje temperature, utjecali su na ekspanzijski omjer (EO) ekstrudata, ali ne i na nasipnu masu (BD). Najviše vrijednosti EO imali su ekstrudati s 10 i 20 % PB, ekstrudirani pri temperaturnom profilu 140/170/170 °C. Povećanje temperature i dodatak PB utjecalo je na smanjenje EO. Oba parametra su utjecala na lomljivost ekstrudata, ali nije se pokazao značajniji utjecaj na tvrdoću. Pšenica obogaćena selenom uspješno je primijenjena u proizvodnji ekstrudiranih snack proizvoda na bazi kukuruzne krupice. Budući je selen važan mineral za ljude, ovo bi mogao biti dobar primjer razvoja novih funkcionalnih proizvoda.

**Ključne riječi:** selen, kukuruzni snack proizvodi, pšenično brašno, obogaćivanje

## Wheat enriched by selenium incorporated in corn snack products

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### Summary

Extruded snack products are one of the most popular snacks consumed worldwide. Usually they are not fortified with nutrients, but they can be very good source of nutrients, because of their prevalence. Consequently, the objective of this research was to increase nutritional value of the extruded corn-based snacks with wheat enriched with selenium (Se). Se is important for reduction of hydroperoxide, because glutathione peroxidase (GPX) is dependent on Se, and GPX catalyzes reduction of hydroperoxide. Except as antioxidant, Se has important part in maintaining thyroid hormone homeostasis, has role in reproduction, immunity, aging process, protection against heavy metal poisoning. Lack of Se can be associated with various diseases, including cancer, due to its antimutagenic and anticancer properties. Since poisoning with Se is also possible, there are recommendations for daily intake which amount to about 55 µg for adults. Wheat enriched with Se was milled to flour and flour was added to corn grits in 10, 20, 30, 40% d. m., and mixture moisture was set to 15%. Prepared samples were extruded in laboratory single screw extruder with 4 mm round die, screw with compression ratio of 4:1, at temperature profiles: 140/170/170 °C; 150/180/180 °C and 160/190/190 °C. Obtained extrudates were air-dried and physical properties were determined. Addition of flour increased total color change ( $\Delta E$ ) in obtained extrudates, but increasing temperature of extruder did not have significant influence on  $\Delta E$ . Both flour addition and increasing temperature of extruder had influence on expansion ratio (ER), but not so much on bulk density (BD). The highest ER values had snacks with 10 and 20% added wheat flour, extruded at temperature profile 140/170/170 °C. Increasing temperatures of extruder and addition of flour decreased ER. Both parameters decreased fracturability of extrudates and did not show significant influence on hardness. Wheat enriched with selenium was successfully incorporated in extruded snack products based on corn grits. Since selenium is important mineral for humans, this can be a good example for development of new functional products.

**Key words:** *selenium, corn snacks, wheat flour, fortification*

## Management of *Helicoverpa armigera* on tobacco

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### Summary

*Helicoverpa armigera* represents a significant challenge to tobacco fields and it is producing high economic losses of tobacco seed each year. The aim of our investigations is lifecycle of the pest and its control in tobacco. Population dynamics of *H. armigera* shows that the species is present on tobacco throughout the vegetation. Larvae of different generations usually overlap. The maximum number of larvae in 2016 was recorded in 20 August. In 2017 the population is mostly numbered in 10 August and reached another high level of density on 9 September. In the middle of the plots the percentage of plants infested by larvae was 27.67 % in 2016 and 18.67 % in 2017. On the margin parts of the plots, the percentage of plants infested by larvae was 54.33 % in 2016 and 37.33 % in 2017. For management of this pest we tested different chemical products: Chlorpyrifos + Cypermethrin 1.5 L/ha; Metaflumizone 1 L/ha; Emamectin 2 kg/ha, Flubendiamide 25 g/100L, Indoxacarb 0.25 L/ha and Spinetoram 0.3 kg/ha. All insecticides have shown high efficacy in control of larvae, 85-100 % in treated plots and 80-97.5 % in laboratory. Insecticidal evening treatment should be performed after emergence of the caterpillars and before they enter into the seed capsules. The integration of various methods was found to be the best in reducing the damage, so more attention should be devoted to forecasting activities and use of traps. Chemical control is still the most reliable way of protecting tobacco from *H. armigera*.

**Key words:** *H. armigera*, dynamics, management, insecticides, tobacco

## **BC hibridi kukuruza u proizvodnim pokusima u 2017. godini**

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### **Sažetak**

Proizvodni pokusi BC hibrida kukuruza bili su postavljeni na velikom broju lokacija u RH. Svrha postavljanja pokusa je da se hibridi ispituju u različitim agroekološkim uvjetima. U 2017. godini obrađeno je 139 lokacija s 8 hibrida u prosjeku po svakoj lokaciji. Za vrijeme nicanja i ranog porasta kukuruza uvjeti su bili povoljni. Na nekim lokacijama je uslijed isušivanja tla i nedostatka oborina došlo do redukcije sklopova. Uslijed ranog nedostatka oborina i pojave visokih temperatura, kukuruz pod stresom dolazi do faze cvatnje. U cvatnji su klimatski uvjeti bili vrlo nepovoljni (visoke temperature, nedostatak oborina) na svim područjima uzgoja kukuruza, što je rezultiralo slabijom oplodnjom i slabijim nalijevanjem zrna. Tijekom kolovoza nastavlja se razdoblje visokih temperatura i nedostatka oborina, što je rezultiralo bržim i ranijim dozrijevanjem kukuruza te ranijim berbama i nižim urodima zrna. Obradjeni rezultati 23 Bc hibrida pokazuju prosječni urod od 9,2 t/ha i 18,1 % vode u zrnu pri berbi, uz ostvarenje sklopa na razini 63 000 biljaka/ha. Ranije grupe FAO 300 i 400 bolje su podnijele, odnosno izbjegle kritične trenutke u oplodnji i nalijevanju zrna, te ostvarile više urode u odnosu na kasnije grupe FAO 500 i 600. Sagledavajući ostvareni urod u ovakvim proizvodnim uvjetima novi BC hibridi FAO 300 i 400 pokazali su vidljivu prednost u odnosu na hibride kasnije vegetacije, te starije komercijalne hibride.

***Ključne riječi:*** proizvodni pokusi, kukuruz, hibridi, urod zrna

## BC maize hybrids in production trials in 2017

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### Summary

Trials with BC maize hybrids were conducted on a large number of locations in the entire Croatia. The purpose of the trials is to test the hybrids in different agroecological conditions. During 2017, trials on 139 locations were processed (8 hybrids on average). The conditions for early phases of growth and development were favourable. In some locations due to soil drainage and lack of rainfall, there was a reduction in stands. Due to the early lack of rainfall and high temperature occurrences, hybrids under stress come to the stage of flowering. During flowering, climatic conditions were very unfavourable (high temperatures, lack of rainfall) at all region of growing, which resulted poorer fertilization and poorer grain filling period. In August, the period of high temperature and lack of precipitation continues, resulting in faster and earlier maturing and harvests, as well as lower grain yield. Seed analyses results from 23 BC hybrids showed an average yield of 9.2 t/ha, with 18.1% grain moisture at harvest, and a plant density at the level of 63,000 plants/ha. Earlier groups of FAO 300 and 400 better tolerated critical moments in fertilization and grain filling, and achieved better yields than FAO 500 and 600. Considering the achieved yield, under such production conditions, the new BC hybrids FAO 300 and 400 showed a visible advantage over those later as well as over the older commercial hybrids.

**Key words:** *production trials, maize, hybrids, grain yield*



## **The fall armyworm (*Spodoptera frugiperda*) damage and management to Zimbabwe farmers: implications to food security**

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### **Summary**

Fall armyworm (*Spodoptera frugiperda*) is native to tropical and sub-tropical regions of the Americas. The pest was detected in Western and Central Africa in early 2016 and by the start of the summer season it had spread to southern Africa particularly Zimbabwe. It became necessary to determine fall armyworm damage to both rural and commercial farmers in northern Zimbabwe, gather and analyze farmer management methods and the implications of the fall armyworm to food security. The study survey was carried out through questionnaires and field tours from Mukumbura to Harare which covers two provinces and three farming factors namely: communal, resettled and commercial farmers. The results indicated that the pest had spread to all agro-ecological regions in the surveyed area. Small scale farmers had identified the problem but had simple means of managing the pest. Communal farmers who had mixed maize and sorghum reported that the pest preferred maize to sorghum. It was observed that the pest preferred yellow maize compared to white. Across all the farming sectors farmers had tried to use chemicals but they failed. The communal farmers reported more than 50 % loss of both maize and sorghum. There was a positive correlation between farming sector and the food security.

**Key words:** *fall armyworm, maize, communal, commercial farmers, food security*

## Investigations on the major production properties of some domestic and introduced oriental tobacco varieties

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### Summary

The three years of investigation (2010-2012) were carried out with four oriental tobacco of the types: Prilep P-23, Prilep P-79-94 (domestic varieties, created in Tobacco institute-Prilep), and Basma1 and Elenski 817 (introduced varieties created in Tobacco and tobacco products Institute- Plovdiv). The aim of this investigation is to study the effect of the different nitrogen rates on major production properties, as: dry tobacco yield per hectare, stalk height with inflorescence, number of leaf per stalk, the largest leaf length and width and average relative leaf surface. From the results, it can be noted that increase in yield correlates with the increase of nitrogen quantities. Fertilized varieties with the 30 kg N/ha had yield increase of 18.5 % and 22.1 % respectively, as opposed to the control. The highest yield is noted to the P-23 variety (3630 kg/ha), and the lowest to the Basma 1 variety (2125 kg/ha). The fertilization has a positive effect on the gross income, and there is a slight decrease in the average price. Also, positive effect is observed on other manufacturing properties as stalk height, leaf number per stalk, length/width of the largest leaf and average relative surface. Based on the obtain results it can be conclude that due to lower yield and gross income per ha, the introduced varieties Basma 1 and Elenski 817 are not perspective varieties for wider production in the investigation region.

**Key words:** *oriental tobacco, fertilization, varieties, yield, manufacturing properties*



**Ribarstvo,  
lovstvo i  
pčelarstvo**

**06**

**Fisheries,  
Game Management  
and Beekeeping**



## Utjecaj lokacije, iskustva, metode lova i vremenskih prilika na rezultate rekreacijskog ribolova

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### Sažetak

Cilj rada bio je utvrditi utjecaj lokacije, vremenskih prilika i metode ribolova, te iskustva ribiča na rezultate ulova. Analizirani su podaci o ulovu ribiča zadarskog ŠRD "Zubatac" za vrijeme natjecanja na zadarskom području 2016. godine, te pojedinačnog ulova ronioca s puškom. Izračunat je ulov po jedinici napora (CPUE) izražen kao ulov u gramima jednog ribiča na sat, te prosječna masa ulovljenih riba u gramima. Ukupno je ulovljeno 237 jedinki riba iz 19 vrsta, najviše iz porodica ljuskavki (Sparidae) i usnača (Labridae). Uspoređeni su ulovi udicom 20 mlađih juniora (do 12 godina) s obale (9. travnja), 30 starijih juniora (do 16 godina) i seniora s obale (16. travnja), 15 seniora iz čamca (7. svibnja), te jednog podvodnog ribolovca s puškom (24. travnja). Prema očekivanju najmanje prosječne primjerke (27,60 g) hvatali su mlađi juniori, znatno veće stariji juniori i seniori (50,69 g), još veće seniori iz čamca (67,05 g), dok su daleko najveći bili oni ronioca s puškom (107,27 g). Sličan slijed imaju i razlike u veličini CPUE – mlađi juniori (49,67 g ribič<sup>-1</sup> sat<sup>-1</sup>), seniori iz čamca (77,91 g ribič<sup>-1</sup> sat<sup>-1</sup>) i podvodni ribolovac (393,33 g ribič<sup>-1</sup> sat<sup>-1</sup>). No najmanji CPUE je zabilježen kod starijih juniora i seniora (33,58 g ribič<sup>-1</sup> sat<sup>-1</sup>), jer je taj dan puhalo snažno jugo koje je ometalo natjecanje. Rezultati potvrđuju da se više ribe i veći primjerci love dalje od obale, da ribolovac s puškom, koji vidi svoj plijen, ima najbolje rezultate, da iskustvo donosi znatnu prednost, no da nepovoljne vremenske prilike mogu poremetiti ovaj slijed.

**Ključne riječi:** ribiči, podvodna puška, natjecanje, CPUE, masa ribe

## The influence of location, experience, catching method and weather conditions on the results of recreational fishing

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### Summary

The aim of the paper was to determine the influence of the location, weather conditions, catching techniques and fishermen's experience on the catch results. The catching data obtained by angling by the members of Zadar Sport Club „Zubatac“ during their 2016 competition and by the speargun of one diver were analysed. The catch per unit effort (CPUE, as g per hour by one fisherman) and average fish weight (g) were counted. Altogether 237 fish specimens belonging to 19 species were caught, mostly from Sparidae and Labridae families. The catch by 20 younger juniors (up to 12 years) from the coast (April 9<sup>th</sup>), 30 older juniors (up to 16 years) and seniors from the coast (April 16<sup>th</sup>), 15 seniors from the boat (May 7<sup>th</sup>) and one diver with a speargun (April 24<sup>th</sup>) were compared. As expected, the smallest average specimens (27.60 g) were caught by younger juniors, significantly bigger (50.69 g) by older juniors and seniors, additionally bigger (67.05 g) by seniors from the boat and the biggest (107.27 g) by a diver with the speargun. The CPUE values went by similar order – younger juniors (49.67 g fisherman<sup>-1</sup> hour<sup>-1</sup>), seniors from the boat (77.91 g fisherman<sup>-1</sup> hour<sup>-1</sup>) and the diver (393.33 g fisherman<sup>-1</sup> hour<sup>-1</sup>). Due to the strong sirocco on the day, the smallest CPUE had the older juniors and seniors from the coast (33.58 g fisherman<sup>-1</sup> hour<sup>-1</sup>). The results confirmed that more and bigger specimens were caught out of the coast, that the diver who could see his prey had the best results, that the experience was advantageous. Nevertheless, weather conditions can disrupt this order.

**Key words:** *anglers, speargun, competition, CPUE, fish weight*

## Utjecaj klimatskih faktora na gospodarenje srnećom divljači u državnom otvorenom lovištu XVI/14 Trizlovi - Rastovo

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### Sažetak

Analizirana je struktura trofeja odstrijeljene srneće divljači u razdoblju od 5 godina (2011. do 2015.) u državnom otvorenom lovištu broj XVI/14 „Trizlovi - Rastovo“ koje se nalazi u jugoistočnom dijelu Vukovarsko-srijemske županije. Ukupna površina lovišta iznosi 3102 ha, dok lovno produktivna površina iznosi 1400 ha za srneću divljač. Prema podacima iz lovno gospodarske osnove orografske, hidrografske i klimatske prilike, te količina dostupne hrane i mir u staništu su povoljni za uzgoj srneće divljači (III bonitetni razred, 6 grla/100 ha LPP, a godišnji prirast iznosi 26 grla). Podaci u istraživanju prikupljeni su iz trofejnih listova srnjaka ocjenjenih u tom razdoblju. Ukupno je odstrijeljeno 125 grla, od toga 63 muška grla, a ocjenjeno je 28 trofeja srnjaka dok ostala odstrijeljena grla nisu imala elemente za ocjenu te nisu uvrštena u analizu. Od mjerljivih elemenata u izračun su uzeta kvantitativna obilježja, a to su prosječna masa i volumen trofeja, prosječna duljina grana i ukupan broj CIC točaka. Prosječna masa trofeja kretala se od 268 do 312 grama, prosječan volumen od 104,83 do 116,71 cm<sup>3</sup>, prosječna duljina grana rogova od 21,13 do 23,20 cm, dok je prosječna vrijednost trofeja iznosila od 80,56 do 88,29 CIC točaka. Trofejna vrijednost kretala se od minimalnih 71,3 do maksimalnih 110, 53 CIC točke, a pri tome su odstrjeljena 2 grla kapitalne vrijednosti u brončanoj medalji. Prosječna vrijednost svih mjerljivih elemenata kretala se uzlaznom putanjom četiri godine osim zadnje lovne 2014/2015. godine kada je značajno opalo brojno stanje divljači, narušena je spolna i dobna struktura te trofejna vrijednost divljači zbog pucanja nasipa na rijeci Savi i poplava u jednom dijelu lovišta. Poplava je značajno utjecala na brojno stanje divljači, rezultate gospodarenja i trofejnu vrijednost divljači.

**Ključne riječi:** srneća divljač, klimatske prilike, “Trizlovi – Rastovo”, trofej



## **Influence of climate factors on the management of roe deer game in the state open hunting ground XVI / 14 Trizlovi - Rastovo**

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### **Summary**

The trophy structure of the deceased roe deer game was analysed for the period of five years (2011-2015) in the state open hunting area number XVI / 14 "Trizlovi - Rastovo" located in the south-eastern part of Vukovar-Srijem County. The total area of the hunting ground is 3102 ha, while the hunting productive area is 1400 ha for roe deer. According to the data from the hunting management documents of the orographic, hydrographic and climate conditions, the quantity of available food and tranquillity in the habitat are favourable for the breeding of roe deer (III value class, 6 units/100 ha LPP, and the annual increase is 26 units). Research data was collected from trophy lists of deer evaluated in that period. In total, 125 units were killed, of which 63 was male. 28 of them were evaluated as a trophy while the others had no evaluation elements and were not included in the analysis. Quantitative features were taken from the measurable elements in the calculation, which are the average mass and volume of the trophies, the average length of the branch and the total number of CIC points. The average trophy weight ranged from 268 to 312 grams, an average volume of 104.83 to 116.71cm<sup>3</sup>, the average length of horns branches 21.13 to 23.20cm, while the average trophy value was 80.56 to 88, 29 CIC points. The trophy value ranged from a minimum of 71,3 to a maximum of 110, 53 CIC points. Accordingly, two roe deer caps of bronze medal were killed. The average value of all measurable elements was moving upward four years apart from the last hunting season 2014/2015. That year, due to the scorching of the dam on the Sava River and flooding in one part of the hunting ground, the great number of wild game dropped significantly, the sex and age structure were damaged as well as the trophy value of the game. Flood had a significant impact on the numerous wildlife status, management results and the trophy value of game.

**Key words:** *roe deer game, climate conditions, "Trizlovi – Rastovo", trophy*

## Dinamika rasta rogova kod europskog muflona u sjevernojadranskoj regiji

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### Sažetak

Na rast rogova divljih populacija goveda Bovidea mogu utjecati različiti čimbenici, a njihovom analizom se mogu dobiti važne informacije o životu jedinke i populacije. Koristeći 430 uzoraka trofeja europskih muflona (*Ovis aries musimon* Pall.) jedne populacije (Senj) u razdoblju od 25 godina (1988. - 2013.), ispitane su varijacije u veličini i godišnjem rastu rogova. Korišteni su različiti ekološki čimbenici, kao i podatci o odstreljenoj divljači, za procjenu utjecaja na rast roga. Visoka varijabilnost rasta roga u istim kalendarskim godinama, s istim klimatskim uvjetima, upućuje na problem odabira modela za opisivanje rasta roga i određivanju važnosti klimatskih faktora. Potrebno je nastaviti daljnja istraživanja o utjecaju klimatskih i okolišnih faktora, o utjecaju čovjeka i populacije, te istražiti njihove interakcije, da bi smanjili pogreške u selekciji i kvalitetnije gospodarili divljim populacijama. Rast i razvoj rogova može biti koristan indeks kvalitete staništa, te važan čimbenik razumijevanja fenotipske plastičnosti i evolucije.

**Ključne riječi:** rogovi, muflon, klimatski faktori, trofejni lov

## The dynamics of the horn growth in European mouflon of North Adriatic region

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### Summary

Horn growth of wild ungulates of *Bovidae*, can be influenced by various factors, and their analysis can provide important information on the life history of the individual and the population. Using 430 European mouflon (*Ovis aries musimon Pall.*) trophies of one population (Senj) during a period of 25 years (1988-2013), we explore a variation of horn size and annual horn growth. We used the range of ecological factors, as well as hunting record data to assess the influence on horn growth. The high variability of horn growth within the same calendar years, with the same climatic conditions, indicates the problem of selecting a model for describing the horn growth and defining the importance of climatic factors. Non-selective and excessive harvest may result falling in trophy size in the population and may disturb the density and age structure of the population. Horn growth and development can be a useful index of habitat quality, and an important factor in understanding phenotypic plasticity and evolution.

**Key words:** horns, mouflon, climate factors, trophy hunting

## Lovno gospodarenje u odabranim lovištima Splitsko-dalmatinske županije u razdoblju 2007. – 2017.

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### Sažetak

Splitsko-dalmatinska županija nalazi se u središnjem dijelu južne Hrvatske. Prema prirodno-geografskim obilježjima podijeljena je u tri cjeline: obalno područje, zaleđe i otoci. U Splitsko-dalmatinskoj županiji ustanovljena su 83 lovišta na ukupnoj površini od 449.490 ha. Lovno gospodarenje u 10-godišnjem razdoblju (2007.-2017.) analizirano je u odabrana 32 zajednička otvorena lovišta. Važnije vrste divljači su: svinja divlja, zec obični, fazan, jarebica kamenjarka-grivna, muflon i divokoza. Iz planskih dokumenata za svako lovište prikupljeni su i obrađeni podaci o vrstama divljači i njihovim matičnim fondovima, planiranom i ostvarenom odstrjelu, trofejnoj vrijednosti i drugim značajnim parametrima uzgoja i korištenja divljači. Gospodarenje matičnim fondovima i planirani odstrjel vrsta krupne, odnosno sitne divljači uglavnom su uspješno ostvarivani u analiziranom razdoblju. Negativni utjecaj predacije vuka na divokozu, muflona i divlju svinju postao je ozbiljni problem zbog štete koju nanosi u lovištima. Ukupno je ocijenjeno 179 trofeja divlje svinje, od kojih 71 ili 40% u kategoriji kapitalnih, a najvrjedniji je ocijenjen sa 136,00 CIC točaka. Kvalitetno lovno gospodarenje, uključujući i stalnu brigu o divljači i provođenje aktivnosti za poboljšanja kakvoće staništa, doprinosi stabilnosti matičnih fondova divljači i preduvjet je za postizanje visoke, kapitalne trofejne vrijednost divljači.

**Ključne riječi:** lovište, gospodarenje, divljač, trofej

## **Hunting management practice in the selected hunting grounds in Split – Dalmatia County in the period 2007 – 2017**

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### **Summary**

Split-Dalmatia County is located in the middle part of the southern Croatia. Based on the natural geographic features it is divided into three parts: the coastal area, the hinterland and the islands. In Split-Dalmatia County, 83 hunting grounds had been established at total surface of 449,490 ha. Hunting management practice during 10-year period (2007-2017) was analysed in 32 selected joint hunting grounds. The important game species are: wild boar, the European hare, pheasant, the rock partridge, the European mouflon and the chamois. From the planning documents for each hunting ground, following records were collected and analysed: game species and their domicile stocks, planned and achieved culling rate, trophy value and other important parameters of importance for game breeding and utilization. Management with domicile stocks and planned culling rate of big and small game animals was mostly satisfactory in the analysed period. Negative impact of wolf predation on the chamois, the European mouflon and wild boar become a serious problem due to damage caused by the burden of damage in the hunting grounds. Total of 179 trophies of wild boar were scored, 71 or 40% were in category of capital trophy, with the highest score of 136.00 CIC points. Quality hunting management, including permanent care fore game animals and implementing activities for improving the habitat quality, contributes to stability of domicile game stocks and makes a precondition for achieving the high, capital trophy values of game.

**Key words:** *hunting ground, management, game, trophy*

## Utjecaj godine uzgoja na morfološka svojstva reproduktivnih organa matica sive pčele (*Apis mellifera carnica*)

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### Sažetak

Dobro razvijeni reproduktivni organi matica pčela (*Apis mellifera* L.) u velikoj mjeri ovise o tehnici uzgoja, gdje se broj jajnih cjevčica ili promjer spermateke smanjuje s povećanjem starosti ličinke. Prema objavljenim podacima, broj jajnih cjevčica u jednom jajniku matice kreće se od 100 do 180, dok promjer spermateke iznosi u prosjeku 1,08 mm. Cilj ovog istraživanja bilo je utvrđivanje utjecaja godine uzgoja na morfološka svojstva reproduktivnih organa matica sive pčele (*Apis mellifera carnica*) uzgojenih kroz nacionalni uzgojni program. Matice sive pčele prikupljene su iz pčelinjaka registriranih uzgajivača tijekom lipnja 2015. i 2017. godine. Matice su prikupljane iz oplodnjaka nakon što je potvrđeno uspješno parenje. Matice uzgojene tijekom 2017. godine imale su značajno ( $p < 0,05$ ) veći prosječni broj (144,09) jajnih cjevčica u usporedbi s maticama uzgojenim tijekom 2015. godine (121,73). Međutim, prosječni promjer spermateke bio je značajno ( $p < 0,05$ ) veći u matica iz 2015. (1,12 mm) u usporedbi s maticama iz 2017. (1,08 mm). Rezultati ovog istraživanja ukazuju da godina uzgoja ima značajan, premda suprotan, utjecaj na broj jajnih cjevčica i na promjer spermateke, što ukazuje na potrebu daljnjih istraživanja.

**Ključne riječi:** *Apis mellifera carnica*, matice, morfologija reproduktivnih organa

## The effect of the breeding year on the morphological traits of the Carniolan honey bee queen (*Apis mellifera carnica*) reproductive organs

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### Summary

Well-developed reproductive organs of the honey bee queens (*Apis mellifera* L.) depend in large part on a technique of queen rearing where the ovariole number or spermatheca diameter decreases with increasing age of the grafted larva. According to published data, the number of ovarioles determined per ovary of honey bee queens varies in the range from 100 to 180; while spermatheca has an average diameter of 1.08 mm. The aim of this study was to investigate the effect of breeding year on physical traits of honeybee queen reproductive organs reared within Croatian breeding program. Carniolan honey bee (*Apis mellifera carnica*) queens were collected from registered breeding apiaries in Croatia during June 2015 and 2017 year. Queens were collected from mating nucs after confirmation of successful mating. Queens reared in 2017 had significantly ( $p < 0.05$ ) higher average number of ovariole (144.09) in comparison to queens reared during 2015 (121.73). However, the average diameter of spermatheca was significantly ( $p < 0.05$ ) higher in queens from 2015 (1.12 mm) in comparison to queens from 2017 (1.08 mm). Results of this study show that the year of rearing has a significant, but opposite effect on the number of ovarioles and spermatheca diameter, which indicates the need for further research.

**Key words:** *Apis mellifera carnica*, queens, reproductive organs morphology

## Trophy structure of common carp, pike, wels catfish and pike-perch in Drava – Danube fishing zone

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### Summary

The general heterogeneous angler population in Croatia is slowly dispersing in more homogeneous subgroups, specialized in certain fishing techniques or focused on fishing favorite fish species. These subgroups prefer specimen-sized fish rather than the catch of many smaller fish, peculiarly during catch-and-release fishing. The new desires of the anglers gradually influence the changes in the management of fishing waters, resulting in the preservation of bigger specimens of fish with trophy value. The purpose of this paper is to analyze the caught specimens of common carp (*Cyprinus carpio*), pike (*Esox lucius*), wels catfish (*Silurus glanis*) and pike-perch (*Sander lucioperca*) in fishing waters of Drava-Danube fishing zone in the period 2011-2017, and to evaluate the trophy structure of mentioned fish. The fish sampling was carried out using a combinations of fishing gear (commercial fishing nets, survey nets) and an electrofishing. Proportional Stock Density (PSD) is a measure of species size (trophy) structure. The metric is a ratio (expressed as percentage) between the number of quality-sized individuals or larger individuals and stock-sized individuals. During the monitoring period 1.044 specimens of common carp was caught, followed by 220 specimens of wels catfish, 142 specimens of pike and 118 specimens of pike-perch. Proportional stock density for common carp was 78%, meaning that 78% of caught specimens were above minimal size for stock length (20–26% of the world-record length). PSD values were 30% for pike, 36% for wels catfish and 69% for pike-perch. These results indicate a favorable fish trophy structure in fishing waters of the Drava-Danube fishing zone for specialized anglers, which is a result of good management of fishing waters, effort of warden service and the rise of awareness on fishing culture. Relative stock density (RSD) was also calculated for memorable (59-64% of and the world-record length) and trophy (74-80% the world-record length) category. RSD value for common carp was 4%, 6% for pike, 1% for wels catfish and unexpectedly high 18% for pike-perch. This was a preliminary research of trophy structure for the complete Drava-Danube fishing zone, so further research will be focused on individual fishing water in order to eliminate size difference between fishing waters.

**Key words:** *proportional stock density, length-frequency data, angling*



## Mogu li povoljni stanišni uvjeti i hibridizacija između podvrsta predstavljati važan čimbenik u razvoju rogova divokoze?

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### Sažetak

Dinarska regija je prirodno stanište Alpske (*Rupicapra rupicapra rupicapra*) i Balkanske (*Rupicapra rupicapra balcanica*) divokoze. Alpska divokoza obitava na sjevernim Dinaridima, dok su srednja i južna područja nastanjena Balkanskom divokozom. Danas je kontaktna zona, uz pojavu hibridizacije između ove dvije podvrste ustanovljena na Velebitu. Istraživana je varijacija godišnjeg prirasta i veličine rogova navedenih podvrsta, koristeći stečene trofeje pet populacija divokoza (Gorski Kotar, Sjeverni Velebit, Srednji Velebit, Biokovo, Prej) tokom 40 godina. Ekološki čimbenici i genetski podaci korišteni su pri procjeni utjecaja na rast rogova. Za analizu su uzimane duljine prva dva segmenta (L2) jer je rast rogova između prve i druge godine kod divokoze vrlo teško odrediti. Mjerene su ukupne dužine i opseg prvog vidljivog prstena lijevog i desnog roga na 214 uzorka (135 muških, 79 ženskih). Istaknuti treba da su L2 segmenti bili značajno duži i većeg opsega kod populacija Srednjeg i Sjevernog Velebita. Viša nadmorska visina i porast koeficijenta hibridizacije rezultirali su kraćim segmentima i manjim opsegom, dok je povećani udio otvorenih staništa, vapnenačkih podloga i južnih obronaka rezultirao duljim segmentima. Proporcija alela (q), zajedno s koeficijentom inbridinga, utjecala je na asimetriju rogova i opseg. Zanimljivo, u većini statističkih modela, prediktori su utjecali samo na rogove mužjaka. Ovim istraživanjem dokazali smo utjecaj ekoloških i genetskih čimbenika na rast rogova divokoze. Jedinствена situacija na sjevernim Dinaridima, pruža izuzetnu priliku za buduća istraživanja divokoza kako bi razjasnili ulogu unutarnjih i vanjskih čimbenika u razvoju sekundarnih seksualnih osobina i shvatili njihovu ulogu u razvoju jedinke.

**Ključne riječi:** *Rupicapra rupicapra*, stanišni uvjeti, rast rogova, Dinaridi, hibridizacija

## Could favourable habitat conditions and hybridization between subspecies represent an important factor in chamois horn development?

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### Summary

The Dinaric region is the natural habitat of Alpine (*Rupicapra rupicapra rupicapra*) and Balkan (*Rupicapra rupicapra balcanica*) chamois. The Alpine chamois inhabit the northern Dinaric mountains, whereas central and southern areas are used by Balkan chamois. Today, the contact zone between subspecies is established in the Velebit mountains, where hybridization between the two subspecies occurs. We explore a variation of horn size and annual horn growth of two subspecies using chamois trophies of five populations (Gorski Kotar, Northern Velebit, Central Velebit, Biokovo, Prenj) during a period of 40 years. We used the range of ecological factors, as well as genetic data to assess the influence on horn growth. We combined the length of first two segments (L2) because horn growth in the first and second year of life in chamois cannot be distinguished. We measured total horn length and circumference on the end of the first visible annuli ring on the left and the right horn of 214 samples (135 males, 79 females). We pointed out that L2 are significantly longer and larger in Northern and Central Velebit populations. Higher elevation and increasing in inbreeding coefficient resulted with shorter segments and smaller circumferences, while an increase in open habitat areas, limestone soil and aspect resulted with longer segments. The individual admixture proportion (q value) along with the inbreeding coefficient had affected horn asymmetry and the size of the circumferences. Interestingly, in most of the statistical models, predictors affected only the horns in males. We demonstrated that ecological and genetic factors affect chamois horn growth. This unique situation in the northern Dinaric mountains provides exceptional opportunity for further investigations of the chamois populations to disentail the role of intrinsic and extrinsic factors in the development of secondary sexual traits and to understand their role in individual life history.

**Key words:** *Rupicapra rupicapra*, habitat conditions, horn growth, Dinaric mountains, hybridization

## Obilježja dubokomorskog glavonošca *Ancistroteuthis lichtensteini* u Jadranskom moru

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### Sažetak

Dubokomorska vrsta *Ancistroteuthis lichtensteini* (Férussac, 1835) (*Onychoteuthidae*) je vrlo slabo istražena. Manjak informacija prvenstveno je povezan s činjenicom da obitava u dubljim područjima otvorenog mora, izvan kontinentalne podine, te je stoga slabije dostupna mada vrlo vjerojatno relativno brojna u dubokim dijelovima Jadrana, a time i potencijalno interesantna vrsta za dubokomorsko ribarstvo. Jedinke *A. lichtensteini* su ulovljene u Južnojadranskoj kotlini, najdubljem i najslabije istraženom dijelu Jadranskog mora, na dubinama između 690 i 1.200 m. Prilikom uzorkovanja u dubokom moru 2010. godine, korištena je pelagička i pridnena povlačna mreža pri čemu je prvi put u Jadranu ulovljen veći broj primjeraka ove vrste, ukupno 39 jedinki. Rezultati analize dužinsko-masenog odnosa ukazuju na negativni alometrijski rast dok je mjerenjem kljuna nađena pozitivna korelacija između povećanja dužine plašta i mase tijela. Analizom mikrostrukture statolita utvrđeno je da se starost pojedinih primjeraka u uzorku kretala od 72 do 178 dana. Analizirani uzorak se u cijelosti sastojao od spolno nezrelih jedinki širokog raspona dužina plašta i mase tijela. Prema rezultatima ovog istraživanja može se zaključiti da u vodenom stupcu Južnojadranske kotline obitavaju juvenilni primjerci vrste *A. lichtensteini*, dok zrele jedinke ili u potpunosti nestaju iz populacije nakon razmnožavanja ili naseljavaju neka druga područja, najvjerojatnije susjedne dijelove istočnog Mediterana.

**Ključne riječi:** *Ancistroteuthis lichtensteini*, starost, dužinsko-maseni odnos, morfometrija kljuna, Južnojadranska kotlina

## Characteristics of the deep-sea cephalopod *Ancistroteuthis lichtensteini* in the Adriatic Sea

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### Summary

The deep-sea *Ancistroteuthis lichtensteini* (Férussac, 1835) (*Onychoteuthidae*) is poorly investigated species. The lack of information is primarily related to the fact that it inhabits open-sea areas outside the continental shelf and is therefore less accessible for commonly used fishing tools although it is probably relatively abundant in depths of the South Adriatic and therefore potentially interesting for deep-sea fisheries. Specimens of *A. lichtensteini* were collected in the South Adriatic Pit, the deepest and also the least investigated area of the Adriatic Sea, at depths between 690 and 1200 m, using pelagic and bottom trawls, during a deep-sea research performed in 2010. It was the first time that a larger number of specimens of *A. lichtensteini* were caught and available for more detailed analysis, with a total of 39 individuals. The results of the length-weight analysis revealed a negative allometric growth of *A. lichtensteini*. Measurements of the upper and lower beak characters showed a positive correlation with increase of the mantle length and body weight. Statolith microstructure analysis showed that the individual age ranged between 72 and 178 days. The analyzed sample consisted exclusively of sexually immature individuals with a wide range of mantle lengths and body weights. Based on the results of the study it seems that only juvenile stages of the species appear in the water column of the South Adriatic Pit, while adult mature individuals either completely disappear from the population after spawning or they inhabit different areas and depths, most probably in the adjacent parts of the eastern Mediterranean Sea.

**Key words:** *Ancistroteuthis lichtensteini*, age, length-weight relationship, beak morphometry, South Adriatic Pit

## Population dynamic of Algerian Barbel *Luciobarbus callensis* (Valenciennes, 1842) (Cyprinidae) in El-Harrach river (North of Algeria)

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### Summary

The age and growth of Algerian barbel, *Luciobarbus callensis* (Valenciennes, 1842), in El-Harrach River (North of Algeria) were studied in samples taken from catches of local fishermen obtained between June 2013 and May 2014. The maximum length was 25.5 cm (TL - total length) in females and 23.5 cm in males. Among 1000 specimens representing 7 age classes (from 0+ to 6+), fishes of 2+ and 4+ was dominant (79.8 %). The population of *L. callensis* consists of 834 mature individuals (357 females and 477 males). The calculated overall sex ratio is 1:0.74 (Chi<sup>2</sup> X<sup>2</sup>= 58.59, P<0.01). The Von Bertalanffy equation for the theoretical growth in length was:  $L_t=26.249 [1-e^{-0.23(t-0.281)}]$  for males and  $L_t=23.158[1-e^{-0.31(t-0.213)}]$  for females.

**Key words:** barbel, age and growth, stream ecosystems, Von Bertalanffy model

## Procjena šteta od neprijatelja i štetnika riba u šaranskim ribnjacima

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### Sažetak

Velika koncentracija ribe u šaranskim ribnjacima, koja se dodatno hrani, uglavnom žitaricama, privlači brojne životinjske vrste (neprijatelje i štetnike riba), osobito ribojedne ptice, koje se tu hrane ribom i ribljom hranom, uzrokujući time određene materijalne štete proizvođačima ribe. Zbog nastalih šteta, proizvođači ostvaruju znatno niže prihode i manji profit. S druge strane, oni ulažu znatna sredstva za ljudske aktivnosti (plašenje, rastjerivanje i dr. nesmrtonosne metode zaštite), kako bi zaštitili ribu (proizvodnju) ali s tim narušavaju mir divljim životinjskim vrstama. Zbog zakonskih (državnih) mjera zaštite brojnih životinjskih vrsta na ribnjacima, proizvođači imaju sve više ograničenja u proizvodnji. Nastali sukobi između zaštite divljih životinja na ribnjacima (države) i ekonomskih interesa proizvođača ribe rješavaju se na sudovima. Dokazivanje visine financijskih gubitaka na pojedinom ribnjačarstvu u Republici Hrvatskoj i pravične nadoknade od strane države, putem suda, je vrlo složen, zahtjevan i dugotrajan postupak. Postoji određena sumnja od strane proizvođača ali i objektivni nedostaci u egzaktnoj (ornitološkoj) metodologiji dosadašnje procjene vrijednosti nastalih šteta od štetnika i neprijatelja riba, jer nedostaju recentni, znanstveno-stručni rezultati ove problematike (nedostatan monitoring životinjskih vrsta) na šaranskim ribnjacima. Provedenim istraživanjima kreiran je gospodarski model procjene šteta, izražen u kn/ha, koji se temelji na analizama egzaktnih podataka o proizvodnji ribe iz proizvodno-tehnološke dokumentacije u referentom razdoblju (3-6 godina) za jednogodišnju, dvogodišnju i trogodišnju proizvodnju ribe na šest velikih ribnjačarstava (ukupne površine 7.919 ha) u Republici Hrvatskoj. Gospodarski model procjene šteta definiraju: komadni gubici ribe (% i kom.), prosječna tjelesna masa izgubljene ribe tijekom uzgojne sezone (g/kom), ukupna ihtiomasa gubitaka (kg) i vrijednost šteta (kn). Indirektne štete izračunate su na temelju procijenjene godišnje količine pojedene riblje hrane (kg) od biljednih vrsta ptica i smanjenog prirasta riba zbog oduzimanja dodatne hrane ribama (kn/ha). Troškovi aktivnosti na zaštiti riba i održavanju infrastrukture od štetnika i neprijatelja riba izrađena je na temelju računovodstveno-financijske dokumentacije osam šaranskih ribnjačarstava RH. Sveukupne štete na šaranskim ribnjacima u od štetnika i neprijatelja riba, uključujući troškove dodatne riblje hrane i troškove aktivnosti u zaštiti riba i održavanju infrastrukture šaranskih ribnjaka u Republici Hrvatskoj, procjenjuje se na iznos od 7.472,15 kn/ha godišnje.

**Ključne riječi:** *šaranski ribnjaci, predatori, financijski gubitak, gospodarski model procjene*

## Assessment of damage done by fish predators at carp fish farms

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### Summary

A large concentration of fish in carp fish ponds, which is additionally fed, mainly by grains, attracts numerous animal species (fish predators), especially piscivorous birds, which feed on fish and fish food here, thereby causing material damage to fish producers. Due to the resulting damage, the producers have significantly lower yields and lower profit. On the other hand, they invest substantial resources in human activities (frightening, hazing, and other non-lethal methods) to protect the fish (production), but by doing so they disturb wild animal species. Due to legal (state) measures for the protection of numerous species at fish farms, producers are becoming increasingly limited in production. The resulting conflicts between the protection of wildlife at fish farms (the state) and fish producers' economic interests are solved in courts. Proving the extent of financial damage at a certain fish farm in the Republic of Croatia and its fair compensation by the state in court is a very complex, demanding and lengthy process. There is some suspicion on the producers' part but also some objective inadequacies in the exact (ornithological) methodology that had been used thus far to estimate the value of damage caused by fish predators since the recent scientific and professional data on this problem (insufficient monitoring of animal species) at carp fish farms is lacking. An economic model of damage assessment has been created through conducted research, expressed in kn/ha, based on analyses of exact data on fish production from production and technological documentation in the referent period (3-6 years) for one-, two- and three-year fish production on six large fish farms (total surface area of 7,919 ha) in the Republic of Croatia. The economic model of damage assessment is defined as: individual lost fish (% and number), the average body mass of the lost fish during the breeding season (g/number), the total loss of ichthyomass (kg) and the value of the damage (kn). Indirect damage was calculated on the basis of estimated annual quantity of eaten fish food (kg) by herbivorous bird species and reduced fish yield due to the lack of additional food for fish (kn/ha). The costs of activities to protect the fish and maintain the infrastructure to protect them from predators were calculated on the basis of accounting and financial documentation of eight carp fish farms in the Republic of Croatia. The total damage to carp fish farms done by fish predators, including the cost of additional fish food and the cost of activities in fish protection and maintenance of carp fish farms' infrastructure in the Republic of Croatia, is estimated at 7,472.15 kn/ha per year.

**Key words:** *carp fish farms, predators, financial loss, economic model of assessment*

## Utjecaj raznovrsnosti usjeva i gnojidbe na izbirljivost u prehrani jedinki jelena običnog (*Cervus elaphus* L.)

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### Sažetak

Prostorni i vremenski raspored te fenologija kultura može biti ključni faktor koji utječe na izbor staništa te prostornu i vremensku migraciju jelenskih jedinki u slobodnom uzgoju. Povezanost dostupnosti raznovrsnih kultura i gnojidbe fosforom i kalcijem s učestalosti pojave jelena običnog na miko i makro parcelicama i selektivnost konzumacije kultura istraživana je na poplavnom području nizinskih šuma posavine. Raznovrsnost hrane ostvarena je sjetvom ozimih usjeva zobi (*Avena sativa*), ljulja (*Lolium* sp.) i ječam golog zrna (*Hordeum* sp) u kombinaciji sa stočnim graškom za zrno (*Pisum sativum* ssp. *arvense*). Promjene u mineralnom sastavu i utjecaj na kvalitetu ostvaren je gnojidbom kultura fosforom i kalcijem te kontrolna varijanta bez gnojidbe. Promatranja su kronološki provedena tijekom perioda rujna 2016 – rujna 2017. U reproduktivnoj feno fazi, osmatranjem je zamijećena preferencija u konzumaciji slijedom: ječam>zob>ljulj>grašak. Ječam je imao signifikantno ( $p = 0,05$ ) viši udio sirovih proteina (SP), a niži udio vlaknine (KDV i NDV) u odnosu prema ljulju i zobi. Istovremeno su signifikantno više koncentracije N, Ca, Mg, Fe, Zn, i  $P_2O_5$  utvrđene u ječma. Promjena mineralnog sastava kultura varira sa gnojidbom, ali razlike između tretmana nisu statistički značajne. Prinosi svježe mase signifikantno variraju ovisno o gnojdbi i biljnoj vrsti te su u negativnoj relaciji s intenzitetom konzumacije. Prinosi ječma uz gnojidbu fosforom signifikantno su niži od prinosa zobi i ljulja, a gnojidba fosforom daje signifikantno niži prinos u odnosu prema tretmanu bez gnojidbe. Prostorna i vremenska variranja u dostupnosti te hranidbena vrijednost kultura i mineralni sastav značajno su utjecali na migraciju, selektivnost i učestalost konzumacije kultura.

**Ključne riječi:** jelen obični, dostupnost usjeva, kvaliteta hrane, mineralni sastav, ishrana



## Effect of crop diversity and fertilization on the selectivity in nutrition of red deer (*Cervus elaphus* L.)

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### Summary

Spatial and temporal distribution and culture phenology can be a key factor influencing the choice of habitats and the spatial and temporal migration of deer in free-breeding. The relationships between the availability of diverse cultures and fertilization with phosphorus and calcium from the incidence of disease on micro and macro plots and selectivity of crop consumption was investigated mainly in the area of lowlands of Posavina. Variety of food was achieved by sowing of winter crop oat (*Avena sativa*), ryegrass (*Lolium* sp.) and barley (*Hordeum* sp) in combination with livestock peas (*Pisum sativum* ssp. *arvense*). Changes in mineral composition and impact on quality were achieved by fertilization of phosphorus and calcium as well as control variants without fertilization. The observations were chronologically carried out during the period September 2016 to September 2017. In the reproductive plant phenology phases, the observation in consumption was as follows: barley > oats > ryegrass > peas. The barley had a significantly higher ( $p = 0.05$ ) proportion of raw protein (SP) and lower fiber content (KDV and NDV) compared to ryegrass and oats. At the same time, significant concentrations of N, Ca, Mg, Fe, Zn, and  $P_2O_5$  were found in barley. The change in the mineral composition of the culture varies with fertilization, but differences between treatments are not statistically significant. The fresh mass yields vary considerably depending on the fertilization and plant species and are in a negative relationship with the intensity of consumption. Barley yields with fertilizer phosphorus are significantly lower than oats and swings, and fertilization with phosphorus yields significantly lower fresh mass yields compared to non-fertilized treatment. Spatial and time variations in the availability and the nutritional value of cultures and mineral composition have a significant influence on the migration, selectivity and frequency of consumption of cultures.

**Key words:** *Cervus elaphus*, availability of crops, food quality, mineral composition, nutrition

## Quality parameters of Novigrad mussels for PDO application

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### Summary

Shellfish (including mussels) are considered as a healthy food and their nutritional value is based on a favorable comparison of proteins and fatty acids and the large amount of glycogen. Nevertheless, the chemical parameters could vary significantly and largely depends on living environment of mussels. To confirm that, we compared environment parameters (temperature, salinity and chlorophyll *a*) of two mussel's farms in Adriatic Sea: Novigrad sea and open sea near island Vrgada and as well production parameters of mussels (chemical composition, growth and condition index). After one year observations, the results showed high variation of sea temperature and salinity and higher content of chlorophyll *a* in the Novigrad Sea. Further, the Novigrad mussels expressed higher content of meat fats and more constant and higher condition index, although the docosahexaenoic acid (as one of omega-3 fatty acid group) was the most common fatty acid in both groups of mussels. Due to the unique environmental factors which cause high quality mussels, application for Protected Designation of Origin (PDO) was initiated and financed by the Croatian ministry of agriculture. For the PDO purposes more detailed natural/geographical conditions that are transmitted to mussels and particular quality characteristics of Novigrad mussels were stated and justified and will be presented as part of Product Specification in PDO application procedure.

**Key words:** *Mussel aquaculture, Novigrad sea, Protected Designation of Origin (PDO)*

## The Effects of the Policy Implemented in the Aquaculture Sector on the Economic Development in the Context of Sustainability in Turkey

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### Summary

The aquaculture sector is an important sector in regard to its economic contribution in meeting the needs of animal nutrition, employment, industry, domestic and foreign trade. As a matter of fact, aquaculture in Turkey is the fastest growing sector with 11% growth rate. Turkey, which ranks 22 in the aquaculture production in the world, is in the 2nd place among the countries of the European Union. While in the marine fishing 36th in the world, it is the 5th among the countries of the European Union. Turkey has about 26 million hectares of aquatic environment and 500 species have been identified in the sea of Turkey and 370 species in the inland waters. Of these, about 100 species were commercially caught in Turkey. As of 2016, 56.9% of the aquaculture production is 588.7 thousand tons from fisheries and 43.1% from the aquaculture. Within the scope of sustainability, although the aquaculture sector in Turkey is not at the sufficient level, it shows significant developments. However, sustainability in the aquaculture sector more depends on resource utilization and planning in fisheries management. However, in recent years, climate changes, increasing water pollution, adverse impacts from cross-border areas, overfishing and wrong methods and policies application have increased problems especially in the fishing. Fluctuations in the production of fisheries in the last decade are an indication of the situation. For this reason, in this study, the methods and policies applied for the mentioned problems in the aquaculture sector, which is of great importance for the Turkish economy, the positive and negative effects on the economic development of the sector have been discussed.

**Key words:** *fisheries, sustainability, economy, development, Turkey*

**Stočarstvo**

**07**

**Animal  
Husbandry**



## Kvaliteta rasplodnih jaja kokoši hrvaticice

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### Sažetak

Istraživanje kvalitete rasplodnih jaja kokoši hrvaticice provedeno je na ukupno 360 jaja grupiranih po sojevima (crveni i crni po 90, crno-zlatni 70 te jarebičasto-zlatni 110 jaja). Jaja su prikupljena iz registriranih matičnih jata kokoši hrvaticice te su izvaljena u inkubatoru. Cilj istraživanja bio je utvrditi valivost rasplodnih jaja, mase (g) rasplodnih jaja te mase (g) jednodnevnih pilića. Jaja su vagana prije stavljanja u inkubator, a pilići odmah po valenju. Za statističku obradu podataka korišten je programski paket SAS. Prosječna masa jaja bila je 46,65g, a kretala se od 36,10 do 56,80 g. Mase rasplodnih jaja nisu se statistički razlikovale ( $p>0,05$ ) između sojeva. Prosječna valivost iznosila je 68,89 %, a kretala se od 44,44 % kod crnog do 94,28 % kod crno-zlatnog soja. Najveće prosječne mase jednodnevnih pilića utvrđene su kod crnog soja (38,43 g) te su statistički značajno veće ( $p<0,05$ ) u usporedbi s prosječnim masama ostalih istraživanih sojeva. Usporedno su prikupljeni podaci o valivosti jaja crvenog i jarebičasto-zlatnog soja na obiteljskim poljoprivrednim gospodarstvima u Splitsko-dalmatinskoj županiji. U farmskim uvjetima prosječna valivost bila je 37,25 %, a kretala od 31,79 % kod crvenog do 50,75 % kod jarebičasto-zlatnog soja. Rezultati dobiveni istraživanjem u kontroliranim uvjetima upućuju na mogućnost poboljšanja valivosti promjenama u načinu uzgoja rasplodnih jata kokoši.

**Ključne riječi:** kokoš hrvatica, rasplodna jaja, valivost

## Quality of Hrvatica hen breeding eggs

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### Summary

Research on the quality of breeding eggs of Hrvatica hen was carried out on a total of 360 eggs grouped by strains (red and black 90 eggs each, golden-black 70 and partridge-golden 110 eggs). Eggs were collected from herd book flocks of Hrvatica hens and hatched in an incubator. The aim of the study was to determine the mass (g) and hatchability of breeding eggs, and mass (g) of day-old chickens. Eggs were weighted before incubation and chickens immediately after hatching. The SAS software package was used for statistical analyses. The average weight of eggs was 46.65 g and was in the range from 36.10 to 56.80 g. Average weights of breeding eggs were not statistically different ( $p>0.05$ ) among strains. The average hatchability was 68.89 %, ranging from 44.44 % in black to 94.28 % in black-golden strain. The highest average mass of one-day chickens was found in black strain (38.43 g) and was significantly higher ( $p<0.05$ ) compared to the average mass of other researched strains. At the same time data were collected on hatchability of red and partridge-golden strains on family farms in Split-Dalmatia County. In farm conditions, the average hatchability was 37.25 % and ranged from 31.79 % in red to 50.75 % in the partridge-golden strain. The results obtained by research in controlled conditions suggest the possibility of improving the hatchability by upgrading conditions on breeding farms.

**Key words:** *Hrvatica hen, breeding eggs, hatchability*

## Kakvoća trupova i mesa turopoljskih svinja iz uzgoja na otvorenom

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### Sažetak

Turopoljska svinja (TS) je autohtona hrvatska pasmina svinja masnog tipa nastala tijekom ranog srednjeg vijeka na području Turopolja u središnjoj Hrvatskoj. Zbog skromnih zahtjeva, otpornosti i prilagodbe tradicijskom uzgoju na otvorenom, stoljećima je osiguravala egzistenciju lokanog stanovništva. Međutim, tranzicijom iz ekstenzivnog u intenzivno svinjogojstvo sredinom 20. stoljeća uzgoj TS jenjava i pasmina gotovo izumire. Trenutno, unatoč državnoj potpori, populaciju TS čini samo 116 krmača i 14 nerasta, pa je za održiviji način očuvanja pasminu nužno bolje gospodarski iskoristiti i znanstveno istražiti. Cilj ovog rada bio je stoga utvrditi kakvoću trupova i mesa svinja TP iz otvorenog uzgoja. Korišteno je 20 tovljenika (nazimice i kastrati), žive mase  $94,8 \pm 11,55$  kg i dobi  $18,5 \pm 1,4$  mj. Utvrđena je masa toplog trupa  $75,2 \pm 10,6$  kg, uz randman  $79,1 \pm 2,3\%$ . Dužina trupa i polovice iznosila je  $71,9 \pm 2,6$  cm i  $86,0 \pm 3,0$  cm. Debljina slanine (iznad *m. gluteus medius*) bila je  $40,9 \pm 6,6$  mm, a mišića  $51,0 \pm 5,8$  mm, uz procijenjeni udio mišićnog tkiva od  $35,8 \pm 4,3\%$ . Udio (%) osnovnih dijelovi mesa I., II. i III. kategorije u trupu bio je redom  $41,2 \pm 1,5$ ,  $15,4 \pm 0,9$  i  $43,4 \pm 1,4$ . Glede kakvoće mesa (*m. longissimus dorsi*), utvrđen je pH<sub>1</sub>  $6,43 \pm 0,17$  i pH<sub>2</sub>  $5,97 \pm 0,22$ , parametri boje L\*, a\* i b\* redom  $44,55 \pm 1,66$ ,  $19,24 \pm 0,98$  i  $5,65 \pm 0,88$ , te 48<sup>h</sup> gubitak mesnog soka (EZ metoda)  $1,95 \pm 1,07\%$ . Rad je dio projekta TREASURE financiranog u okviru programa Europske unije za istraživanja i inovacije Obzor 2020, br. potpore 634476.

**Ključne riječi:** svinja, turopoljska pasmina, kakvoća trupova, kakvoća mesa, otvoreni uzgoj



## Carcass and meat quality of *Turopolje* pigs reared outdoors

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### Summary

Turopolje pig (TP) is an autochthonous Croatian fatty-type pig breed, created during the early middle-ages in Turopolje region in Central Croatia. Due to its modest demands, resilience and good adaptation to outdoor rearing, the TP has been an important food source for the local population for centuries. However, with the transition from extensive to intensive pig production in the middle of the 20<sup>th</sup> century, the TP breed almost disappeared. Currently, despite the state support, TP breed is still endangered, with a population of only 116 sows and 14 boars. Hence, to preserve TP in a more sustainable way, the breed needs to be more economically exploited and scientifically explored. This work aimed therefore to determine the carcass and meat quality of TP reared outdoors. The 20 TP (barrows and gilts) weighted  $94.8 \pm 11.55$  kg and aged  $18.5 \pm 1.4$  months, were used. The established hot carcass weight was  $75.2 \pm 10.6$  kg, with  $77.2 \pm 2.1\%$  of carcass yield. Carcass lengths were  $71.9 \pm 2.6$  cm (*os pubis*–first rib) and  $86.0 \pm 3.0$  cm (*os pubis*–atlas). The backfat and muscle thickness (above and below *m.gluteus medius*) were  $40.9 \pm 6.6$  mm and  $51.0 \pm 5.8$  mm, with  $35.8 \pm 4.3\%$  of estimated muscle tissue share. The share (%) of basic parts of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> category meat in carcass were  $41.2 \pm 1.5$ ,  $15.4 \pm 0.9$  and  $43.4 \pm 1.4$ , respectively. With regard to quality of meat (*m.longissimus dorsi*), the pH<sub>1</sub>  $6.43 \pm 0.17$  and pH<sub>2</sub>  $5.97 \pm 0.22$ , the color L\*  $44.55 \pm 1.66$ , a\*  $24 \pm 0.98$  and b\*  $5.65 \pm 0.88$ , and the EZ drip-loss  $1.95 \pm 1.07\%$ , were determined. Work is part of the TREASURE project funded under European Union's Horizon 2020 research and innovation programme, grant no. 634476.

**Key words:** pig, *Turopolje* pig breed, carcass quality, meat quality, outdoor rearing

## Utjecaj iskorjenjivanja artritisa encefalitisa koza na zdravlje stada i tehnologiju uzgoja

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### Sažetak

Artritis encefalitis koza (AEK) je virusna neizlječiva bolest koza koja se očituje paralizom ekstremiteta i uginućem jaradi, a kod odraslih koza artritismom, induracijom vimena, padom mliječnosti, upalom pluća i mršavljenjem. Istraživanje je provedeno na populaciji od 1142 mliječne koze u 12 stada u Međimurskoj županiji. Cilj istraživanja bio je utvrditi utjecaj iskorjenjivanja bolesti odvajanjem jaradi nakon poroda na zdravlje stada i tehnologiju uzgoja. Dijagnoza bolesti se temeljila, pored kliničkog pregleda, na serološkoj pretrazi krvi svih koza u laktaciji. Životinje pozitivne na AEK utvrđene su u svim stadima uključenim u istraživanje. Prevalencija na istraženoj populaciji iznosila je 63%, a kretala se u rasponu od 1 do 95%. Na četiri farme uzgajivači su počeli program iskorjenjivanja koji se temeljio na odvajanju jaradi od majki neposredno nakon poroda i hranidbi mlijekom zdravih koza ili mliječnom zamjenom. U tim stadima manje se javljao klinički mastitis. Jarad je držana u odvojenim odjeljcima grijanim infracrvenom lampom što im je osiguralo bolju opću otpornost i manje uginuća tijekom zimskih mjeseci. Hranidba jaradi bila je jeftinija zbog 50% niže cijene mliječne zamjene u odnosu na otkupnu cijenu mlijeka koza. Napajana su dvokratno putem kanti čime se kontrolirala količina posisane mliječne zamjene. Ovim načinom hranjenja spriječeno je prežderavanje, a samim time i rizik od enterotoksemije i kokcidioze. Na temelju istraživanja možemo zaključiti da iskorjenjivanje AEK ima višestruku korist za uzgajivače koza. Pored povećanja mliječnosti stada i ranije predaje mlijeka otkupljivaču, smanjen je rizik od pojave kliničkog mastitisa i drugih bolesti. Troškovi hranidbe jaradi značajno su smanjeni, kao i gubitci zbog bolesti i ugibanja.

**Ključne riječi:** koze, AEK, zdravlje stada, tehnologija

## **Influence of CAE eradication on herd health and breeding technology**

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### **Summary**

Caprine Arthritis Encephalitis (CAE) is a viral and incurable disease which presents itself in extremity paralysis and death of kids while in adults it causes arthritis, indurations of the udder, lower milk production, pneumonia and weight loss. The research was carried out on a population of 1142 goats in 12 herds in the Međimurje County. The goal of the research was to establish the influence of disease eradication on flock health and breeding technology by removing the kids from the does postpartum. The diagnosis was based on serological blood tests from goats in lactation, along with clinical examinations. Animals positive for CAE were found in every tested herd included in the research. The prevalence in the researched population was 63% and ranged from 1 to 95%. On four farms the breeders started an eradication programme based on removing the kids from their does immediately after birth and feeding them milk from healthy goats or a milk replacer. Clinical mastitis occurred less in those herds. The kids were kept in separate compartments heated by infrared lamps which ensured a higher overall resilience and fewer deaths during the winter period. Kid nutrition was less expensive due to the milk supplement being cheaper by 50% than the goat milk redemption price. They were fed twice a day from buckets thus controlling the amount of suckled milk replacer. This way of feeding prevented over eating and the risk of enterotoxaemia and coccidiosis. Based on the research we can conclude that the eradication of CAE has multiple benefits for goat breeders. Along with increasing milk production and earlier delivering of milk to the integrator, it lowers the risk of clinical mastitis and other disease. The nutrition costs are considerably lower, as are losses due to disease and death.

**Key words:** *goats, CAE, herd health, technology*

## Primjena inovativne i brze metode protočne citometrije za određivanje psihrotrofnih bakterija u sirovom mlijeku

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### Sažetak

Hlađenje i vremenski duža pohrana sirovog mlijeka na niskim temperaturama pogoduje rastu psihrotrofnih bakterija koje predstavljaju ozbiljan problem za mljekarsku industriju jer utječu na pojavu kvarenja, vrijeme održivosti i randman mlijeka tijekom prerade. Stoga je broj tih bakterija u ohlađenom sirovom mlijeku u odnosu na broj mezofilnih aerobnih bakterija značajno viši od njihovog idealnog omjera od 10%. Prema tome, za industriju je od presudne važnosti brzo određivanje broja psihrotrofnih bakterija u sirovom mlijeku. Metoda protočne citometrije se u odnosu na dugotrajnu referentnu metodu utvrđivanja ukupnog broja psihrotrofnih bakterija razlikuje u iskazivanju rezultata. Protočnom citometrijom određuje se individualni broj bakterija (IBC) koji predstavlja ukupan broj živih i neživih bakterija te ga je potrebno preračunati u ukupan broj živih psihrotrofnih bakterija (CFU). Cilj ovoga rada bio je utvrditi jednadžbu regresijskog pravca za psihrotrofne bakterije pomoću koje se IBC preračunava u CFU. U 287 uzoraka sirovog mlijeka utvrđen je IBC metodom protočne citometrije i CFU referentnom metodom (ISO 6730). Iz rezultata izračunat je konverzijski pravac pomoću linearne regresije (ISO 21187) koji iznosi  $y=1,0594x-0,7874$ , gdje  $y$  predstavlja logaritamsku vrijednost CFU, a  $x$  logaritamsku vrijednost IBC. Utvrđena jednadžba pravca omogućit će mljekarskoj industriji brzo i pouzdano određivanje ukupnog broja psihrotrofnih bakterija u sirovom mlijeku.

**Ključne riječi:** *psihrotrofne bakterije, protočna citometrija, IBC, CFU, konverzijski pravac*

## **Application of innovative and rapid flow cytometry method for determination of psychrotrophic bacteria in raw milk**

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### **Summary**

Cooling and longer storage of raw milk at low temperatures favors the growth of psychrotrophic bacteria which pose a serious problem for the dairy industry, as they affect the deterioration, sustainability and milk yield during processing. Therefore, the number of these bacteria in cooled milk compared to the number of mesophilic aerobic bacteria is significantly higher than their ideal ratio of 10%. For the industry it is of crucial importance to rapidly determine the number of psychrotrophic bacteria in raw milk. Flow cytometry method compared to the time consuming reference method is significantly different in the expression of the results. Flow cytometry method determines the total individual bacterial count (IBC) that represents the total number of living and non-living bacteria and needs to be converted to the total number of living psychrotrophic bacteria (CFU). The aim of this study was to establish the regression equation for psychrotrophic bacteria by which the IBC is converted into CFU. In 287 raw milk samples the IBC was determined by flow cytometry method and the CFU by reference method (ISO 6730). The conversion line  $y = 1,0594x - 0,7874$  was calculated by using linear regression (ISO 21187) where  $y$  represents the logarithmic value of CFU and  $x$  the logarithmic value of the IBC. The established conversion line will enable the dairy industry to quickly and reliably determine the total number of psychrotrophic bacteria in raw milk.

**Key words:** *psychrotrophic bacteria, flow cytometry, IBC, CFU, conversion line*

## Tovna svojstva banijske šare svinje

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### Sažetak

Cilj rada je bio utvrditi toвна svojstva banijske šare svinje i usporediti ih sa dosadašnjim istraživanjima provedenim na našim ostalim autohtonim pasminama svinja. Banijska šara svinja je pasmina za koju se donedavno smatralo da je iščezla sa ovih prostora. Upornim radom stručnjaka sa Agronomskog i Veterinarskog fakulteta Sveučilišta u Zagrebu te djelatnika Odjela za svinjogojstvo Hrvatske poljoprivredne agencije na području Banovine otkriveni su vjerojatno zadnji primjerci ove pasmine. Nakon osnivanja Udruge uzgajivača banijske šare svinje i upisa prvih životinja u matičnu populaciju pokrenuta su dva projekta sufinancirana od Ministarstva poljoprivrede i lokalne uprave koji su imali za cilj očuvanje banijske šare svinje, njenu revitalizaciju i proizvodnju svinja za preradu u specifične mesne proizvode ovog kraja. U okviru projekta "Održiva proizvodnja svinja na otvorenom na području Banovine" postavljen je pokus za praćenje tovnih svojstava pasmine banijska šara gdje je proveden tov svinja do većih završnih masa. Prvi rezultati istraživanja pokazuju veliki potencijal rasta ove pasmine koja bi trebala biti jedan od temelja proizvodnje svinja za preradu u tradicionalne mesne proizvode na obiteljskim gospodarstvima na području Banovine.

**Ključne riječi:** svinje, banijska šara, autohtone pasmine, toвна svojstva

## Fattening traits of Banija spotted pig

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### Summary

The aim of the study was to determine the fattening traits of Banija spotted pigs and compare them to the previous studies carried out on our other autochthonous pig breeds. The Banija spotted pig breed had long considered as disappeared from Banovina region. The hard work of experts from the Faculty of Agriculture and Veterinary Medicine of the University of Zagreb and the employees of the Department for Pig Development of the Croatian Agricultural Agency in Banovina region resulted in discover of probably the last specimens of this breed. Following the establishment of the Association of Banija spotted pig breeders, two national projects were funded by the Ministry of Agriculture and local government, which aimed to preserve the Banija spotted pigs, its revitalization and production of pigs for processing into specific meat products of this region. As part of the project "Sustainable outdoor pig production in Banovina region", an experiment was carried out to determine the fattening capacities of the Banija spotted pigs, where the fattening of pigs was carried out to larger final body weights. The first research results show great potential for growth of this breed, which should be one of the basis of pig production for processing into traditional meat products on family farms in the Banovina region.

**Key words:** pigs, Banija spotted pig, autochthonous breeds, fattening traits

## Zaštita mesa crne slavonske svinje - fajferice oznakom izvornosti

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### Sažetak

Crna slavonska svinja - fajferica najbrojnija je autohtona pasmina svinja u Republici Hrvatskoj. Odlikuje se dobrom otpornošću na specifične uvjete držanja i bolesti te izuzetnom kakvoćom mišićnog i masnog tkiva. Najbolje proizvodne rezultate postiže u ekstenzivnim ili poluintenzivnim sustavima držanja. Upravo su navedene prednosti bile temelj za pokretanje postupka zaštite naziva proizvoda „*Meso crne slavonske svinje*“ oznakom izvornosti na nacionalnoj razini. Cilj ovog rada bio je prikazati postupak zaštite proizvoda te sastavne dijelove Specifikacije zaštićenog proizvoda „*Meso crne slavonske svinje*“ u kojima su opisane osnovne značajke proizvoda i njegove posebnosti, zemljopisno područje u kojemu se proizvodi zaštićeni proizvod, dokazi o podrijetlu, opisi metoda dobivanja proizvoda, dokazi o uspostavljanju poveznice između kakvoće proizvoda i zemljopisnog okruženja, sustav sljedivosti i kontrole proizvoda te načini označavanja i pakiranja proizvoda. Sustav proizvodnje zaštićenog proizvoda „*Mesa crne slavonske svinje*“ i oznaka izvornosti osiguravaju krajnjem potrošaču navedenog proizvoda jamstvo da je to proizvod visoke kakvoće, proizveden u kontroliranim uvjetima koji su bili u skladu s kriterijima dobrobiti i zdravlja životinja, očuvanja okoliša te u duhu dobre stočarske prakse.

**Ključne riječi:** *crna slavonska svinja, meso, oznaka izvornosti, zaštita*



## **Crna Slavonska pig - fajferica meat protection with designation of origin**

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### **Summary**

Crna Slavonska pig - fajferica is the most numerous indigenous pig breed in the Republic of Croatia. It is characterized by good resistance to specific conditions of keeping and disease and the exceptional quality of muscle and fat tissue. The best productive results are achieved in extensive or semi-intensive keeping systems. The aforementioned advantages were the basis for initiating the procedure for the protection of the name of the product "*Meat of Black Slavonian pig*" with the designation of origin on the national level. The aim of this paper was to present the process of product protection and components of the Specification of the protected product "*Meat of Black Slavonian pig*", which describes the basic features of the product and its particularity, the geographical area in which the product is produced, the origin evidence, the description of the methods of obtaining the product, evidence of establishing a link between product quality and geographic environment, traceability and product control, and the way of labeling and packaging products. The production system of the protected product "*Meat of Black Slavonian pig*" and the designation of origin guarantee the ultimate consumer of the said product guarantee that it is a high quality product, manufactured under controlled conditions that is in accordance with animal welfare and animal welfare criteria, environmental conservation and the spirit of good livestock practices.

**Key words:** *Crna Slavonska pig, meat, designation of origin, protection*

## Utjecaj gustoće naseljenosti na pojavu kontaktnog dermatitisa na nogama pilića u tovu

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### Sažetak

Cilj rada bio je istražiti utječe li gustoća naseljenosti na pojavu kontaktnog dermatitisa na jastučićima nogu i tarzalnim zglobovima pilića u tovu. Istraživanje je provedeno u komercijalnim uvjetima proizvodnje, u nastambi za tov pilića na obiteljskoj farmi, tijekom šestotjednog razdoblja tova. Pilići su bili podijeljeni u tri jednake skupine (n=50), od kojih je svaka držana na sjeckanoj slami, pri različitim gustoćama naseljenosti (12, 16 i 20 jedinki/m<sup>2</sup>). Jednom tjedno, počevši od drugog tjedna, mjerena je vlaga stelje i procjenjivana pojavnost kontaktnog dermatitisa na nogama pilića i to na 10 nasumično odabranih pilića iz svake skupine, prema Uputi Uprave za veterinarstvo i sigurnost hrane Republike Hrvatske za obavljanje i procjenu rezultata *post mortem* pregleda u svrhu utvrđivanja mogućih znakova loših uvjeta držanja na farmi s obzirom na dobrobit pilića koji se uzgajaju za proizvodnju mesa. Prema rezultatima istraživanja, skupine se nisu značajno razlikovale u prosječnoj pojavnosti promjena na nogama. Vlaga stelje tijekom trajanja tova bila je veća pri većoj gustoći naseljenosti pilića, ali između vlage u stelji i pojavnosti kontaktnog dermatitisa nije utvrđena značajna povezanost. Može se zaključiti da gustoća naseljenosti i vlaga stelje nisu imale utjecaj na pojavu kontaktnog dermatitisa na jastučićima nogu i tarzalnim zglobovima pilića u tovu, te da se njegova pojava može kontrolirati odgovarajućom tehnologijom proizvodnje, neovisno o gustoći naseljenosti peradi.

**Ključne riječi:** pilići u tovu, kontaktni dermatitis, stelja, gustoća naseljenosti

## Effect of stocking density on the occurrence of contact dermatitis on broiler legs

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### Summary

The aim of the study was to assess the possible effect of stocking density on the occurrence of footpad dermatitis and hock burns in broilers. The study was conducted in the conditions of commercial production in broiler housing at a family farm during 6-week fattening period. Broilers were divided into three groups of 50 animals each, all three groups raised on chopped straw but with different stocking density (12, 16 and 20 animals/m<sup>2</sup>). Litter moisture was measured and the occurrence of contact dermatitis on broiler legs assessed weekly, starting from week 2, in 10 broilers randomly selected from each group, according to the Croatian Veterinary and Food Safety Directorate instructions on *post mortem* inspection and result evaluation to identify the possible signs of poor housing conditions at a farm considering welfare of broilers raised for meat production. Study results showed that there was no significant difference among the three groups of animals according to the mean rate of leg lesions. Litter moisture during fattening period was higher with greater stocking density but there was no significant correlation between litter moisture and contact dermatitis occurrence. In conclusion, stocking density and litter moisture had no effect on the occurrence of footpad dermatitis and hock burns in broilers; accordingly, the occurrence of these lesions could be controlled by appropriate production technology irrespective of stocking density.

**Key words:** broilers, contact dermatitis, litter, stocking density

## Mogućnosti proizvodnje govedeg mesa i mlijeka u Republici Hrvatskoj sustavima ispaše na travnatim površinama

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### Sažetak

Mliječni sektor u EU suočava se s mnogim izazovima kao posljedica političkih, gospodarskih i društvenih zbivanja i promjena. Mnoge zemlje pokušavaju reagirati na ove promjene. To čine tako što istražuju nove mogućnosti za opstanak postojeće proizvodnje pa čak i njezino povećanje. Vidljiv je porast ulaznih troškovi kako u primarnoj, tako isto i u prerađivačkoj proizvodnji. Neke zemlje (poput Nizozemske) uvidjele su veliki potencijal u pašnjacima, odnosno travnatim površinama. Dobar primjer je Nizozemska gdje je 2013. godine bilo oko 923.000 ha gospodarsko iskorištenih travnatih površina, što predstavlja 50,4% ukupnih poljoprivrednih površina ove zemlje. Ovdje se radi o vrlo kvalitetnim pašnjacima na čijoj se kvaliteti tla i botaničkom sastavu stalno i oprezno pristupa. Kako bi ove travnate površine stvarno i bile u funkciji proizvodnje, poduzeto je niz agrotehničkih mjera (drenaža, gnojidba, kalcifikacija tla i sl.) kojima se poboljšala kvaliteta i trajna održivost tla. Nakon tog uslijedio je odabir najboljih botaničkih vrsta biljaka. Ovakav način djelovanja može, i treba, biti dobar primjer i poljoprivrednim proizvođačima u Republici Hrvatskoj. Statistički podaci govore kako RH raspolaže s približno 3 milijuna ha poljoprivrednih površina. Od toga, oko 33% površina (1,08 milijuna ha) je pogodno ili umjereno pogodno za obradu i poljoprivrednu proizvodnju. U 2013. godini oko 350.000 ha statistički je vođeno kao trajni travnjaci. Međutim, u ARKOD sustavu za 2014. godinu bilo je upisano samo 130.000 ha livada i pašnjaka, što predstavlja samo 37% površina trajnih travnjaka. Iako bi ove površine prividno bile i dostatne za trenutni broj krava u proizvodnji mlijeka (oko 170.000 krava), moramo imati na umu da je naša trenutna dostatnost u proizvodnji mlijeka samo 50%. Jednu od ključnih mjera agrarne politike za stabilnost govedarske proizvodnje koju bi preporučili u smislu povećanja proizvodnje mlijeka u RH, svakako je značajnije uključivanje travnatih površina. To podrazumjeva i niz agrotehničkih mjera i zahvata na istima, s ciljem podizanja kvalitete i plodnosti tla. Ovisno o utvrđenoj i dostignutoj kvaliteti tla, daljni pravac bi trebao biti odgovarajući odabir botaničkih vrsta biljaka koje bi se zasijavale na ovim površinama. Ako se uzme u obzir da se ulazni troškovi proizvodnje govedeg mesa i mlijeka na gospodarstvima koja koriste travnjačke površine mogu umanjiti i za 50%, smatramo kako imamo veliki neiskorišteni potencijal za unapređenje govedarske proizvodnje u Republici Hrvatskoj.

**Ključne riječi:** govede meso i mlijeko, Hrvatska, travnate površine

## Possibilities of production of beef and milk in Croatia in grazing systems on grasslands

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### Summary

Dairy sector in the EU is faced with many challenges that are result of political, economic and social developments and changes. Many member states are trying to respond to these changes. These countries explore new possibilities for keeping the existing production and also for increase of it. In the last few years there is a noticeable increase in input costs both in primary production and in dairy industry. Some countries (like the Netherlands) have found great potential in pastures that is grassland. A good example is the Netherlands where, in year 2013, were approximately 923,000 ha of economically utilized grasslands, representing 50.4% of total agricultural area of the state. This is a very high quality grasslands whose soil and botanical composition are constantly and cautiously maintained. In order to make these grasslands really in function of production, a number of agro-technical measures (drainage, fertilization, soil calcification etc.) have been undertaken to improve the quality and durability of the soil. After that, best plant species was selected. This kind of action can, and should, be a good example and agricultural producers in the Republic of Croatia. Statistics show that the Republic of Croatia has about 3 million ha of agricultural land. About 33% of this area (1.08 million ha) is suitable or moderately suitable for cultivation and agricultural production. In year 2013, about 350,000 ha were statistically classified as permanent grasslands. However, in the ARKOD system for year 2014 only 130,000 ha of meadows and pastures have been entered, which represents only 37% of permanent grassland areas. Although these areas apparently were and are sufficient for the current number of cows in milk production (about 170,000 cows), we must keep in mind that our current sufficiency in milk production is only 50%. One of the crucial agricultural policy measures for the stability of cattle production that could be recommended aiming increase of milk production in the Republic of Croatia is the inclusion of grasslands. This also implies a number of agro technical measures and interventions in the same, with the aim of raising the quality and fertility of the soil. Depending on the determined and the achieved quality of the soil, further direction should be the appropriate choice of the plant species that would be sown on these lands. Considering that the input costs of beef and milk production on farms that use grasslands can be reduced by 50%, we think that we have a huge unused potential for the improvement of cattle production in the Republic of Croatia.

**Key words:** *beef and cattle milk, Croatia, grasslands*

## Sezonske varijacije proizvodnje i kakvoće kozjeg mlijeka tijekom godina s ekstremno toplim vremenskim prilikama

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### Sažetak

Iako intenzivni sustavi proizvodnje podrazumijevaju kontrolirane uvjete držanja i hranidbe životinja, utjecaj okolišnih (klimatskih) čimbenika nije zanemariv. Stoga je cilj rada bio utvrditi sezonske varijacije proizvodnje i kakvoće mlijeka alpina koza držanih u intenzivnom sustavu uzgoja tijekom četiri uzastopne godine (od 2012. do 2015.), koje su, prema podacima Državnog hidrometeorološkog zavoda, bile ekstremno tople. Između godina utvrđene su značajne ( $P < 0,01$ ) razlike u prosječnoj dnevnoj proizvodnji mlijeka (2,12 kg 2012., 2,20 kg 2013., 2,30 kg 2014. i 2,47 kg 2015.). Utvrđen je i značajan ( $P < 0,001$ ) utjecaj godine na sadržaj mliječne masti, laktoze i suhe tvari u mlijeku, s najvišim prosječnim sadržajem suhe tvari u godini s najmanjom prosječnom proizvodnjom mlijeka. Ovisno o godini, geometrijska srednja vrijednost broja somatskih stanica (BSS) varirala je od  $467 \times 10^3/\text{mL}$  do  $615 \times 10^3/\text{mL}$ . Utvrđene su značajne ( $P < 0,001$ ) sezonske varijacije dnevne proizvodnje i kemijskog sastava mlijeka te BSS. Vrhunac dnevne proizvodnje mlijeka koze su ostvarile u ožujku (početak razdoblja mužnje). Odmicanjem laktacije prosječna dnevna proizvodnja mlijeka progresivno je opadala iz mjeseca u mjesec ( $P < 0,001$ ), dok je najniži sadržaj mliječne masti, bjelančevina i suhe tvari utvrđen tijekom lipnja i srpnja. Radi sezonalnosti proizvodnje mlijeka uvjetovane sezonskom poliestričnošću koza, utjecaj sezone na promjene u proizvodnji i kakvoći mlijeka nije jasno razlučiv od stadija laktacije.

**Ključne riječi:** kozje mlijeko, francuska alpina, kemijski sastav, broj somatskih stanica, godina

## Seasonal variations of production and quality of goat's milk in extremely warm calendar years

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### Summary

Although intensive livestock production systems generally imply controlled conditions of animal keeping and feeding, the effect of environmental (climatic) factors is not negligible. Therefore, the aim of the work was to determine the seasonal variations of daily milk yield and the quality of alpine goats' milk from intensive production system during four consecutive years (from 2012 to 2015), which, according to the official data of Meteorological and hydrological institute of Croatia, were extremely warm. Significant ( $P < 0.01$ ) differences in average daily milk yield between studied years (2.12 kg, 2.20 kg, 2.30 kg, and 2.47 kg in 2012, 2013, 2014, and 2015, respectively) were determined. Also, the year significantly affected the content of milk fat ( $P < 0.01$ ), lactose ( $P < 0.001$ ) and dry matter in milk ( $P < 0.001$ ), with the highest average dry matter content in the year with the lowest average daily milk yield. Depending on the year, the geometric mean value of somatic cell count (SCC) varied from  $467 \times 10^3/\text{mL}$  to  $615 \times 10^3/\text{mL}$ . Significant ( $P < 0.001$ ) seasonal variations of daily milk yield, milk chemical composition and SCC were determined. The peak of daily milk yield was determined in March (beginning of the milking period). By delaying lactation, average daily milk yield progressively decreased from month to month ( $P < 0.001$ ) while the lowest content of milk fat, protein and dry matter was determined during June and July. Because of the seasonality of goat milk production induced by goats' seasonal polyestrous activity, it is not easy to distinguish the impact of season from the impact of stage of lactation on milk yield and quality.

**Key words:** *goat milk, French Alpine, chemical composition, somatic cell count, year*

## Preliminarno istraživanje genetske raznolikosti populacije banijske šare svinje mikrosatelitskim biljezima

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### Sažetak

Smatra se da je banijska šara svinja nastala križanjem krmača domaće bijele svinje s klopavim ušima (landras) i/ili turopoljske svinje i nerastova crnog berkšira. Cilj ovog rada bio je pokazati genetsku raznolikost današnje populacije banijske šare, utvrditi sličnosti s bliskim populacijama svinja, te utvrditi razinu diferencijacije unutar populacije banijske šare. Temeljem genotipova dobivenih za 24 ISAG-FAO preporučena mikrosatelitna markera za svinje proučeni su osnovni pokazatelji genetske raznolikosti populacije banijske šare (n=30) u usporedbi s turopoljskom (n=20), crnom slavonskom (n=20) svinjom i landras pasminom svinja (n=17). Opažena heterozigotnost proučavanih populacija bila je u rasponu 0.36 - 0.60, pri čemu je ona kod banijske šare iznosila 0.58. Prosječno alelna bogatstvo (raspon 2.9 - 5.2) bilo je najviše u populaciji banijske šare, kao i broj privatnih alela uz rarefakciju (raspon 9 - 27). Modelno klasteriranje uz potvrđeni model za k=5 razlučuje banijsku šaru od ostalih analiziranih populacija, te pokazuje evidentnu genetsku substrukтуру unutar populacije. Zaključujemo da populacija banijske šare pokazuje veliku genetsku raznolikost, te se razlikuje od geografski bliskih populacija.

**Ključne riječi:** banijska šara, autohtone pasmine svinja, genetska raznolikost, mikrosatelitski markeri



## **Preliminary study on genetic diversity of the Banija spotted pig breed using microsatellite markers**

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### **Summary**

It is believed that Banija spotted pig breed (BS) was created by crossing domestic white sows with drooping ears and/or Turopolje pig sows with black Berkshire. The aim of this study was to assess genetic diversity of Banija spotted pig, to compare this population with geographically close populations and to assess the differentiation level of Banija spotted pig. Based on genotypes obtained for 24 ISAG-FAO recommended pig microsatellite markers, basic genetic diversity indicators were determined for 30 samples of Banija spotted pig, 20 samples of Turopolje and Crna Slavenska pig each, and 17 samples of Landrace population. Observed heterozygosity ranged from 0.36 - 0.60 reaching 0.58 in Banija spotted pig population. Average allelic richness ranged from 2.0 - 5.2 and was the highest in Banija spotted pig population. Rarefaction number of private alleles (range 9 - 27) was also the highest in this population. Structure analysis showed that there are five clusters in four analyzed populations, where Banija spotted pigs are clearly distinguished from other populations and substructured. We conclude that the population of Banija spotted pig shows great genetic diversity and is genetically different from neighboring (geographically close) pig populations.

**Key words:** *Banija spotted pig; indigenous pig breeds; genetic diversity; microsatellites*

## Primjena huminske kiseline kao dodatka hrani u proizvodnji prasadi

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### Sažetak

Huminske tvari su heterogena smjesa biološko-kemijsko-geoloških proizvoda raspada organske mase koji sadrži huminsku kiselinu i brojne minerale. Nova su istraživanja utjecaja huminskih tvari na rast i zdravlje životinja. Pokus je proveden na 12 gravidnih krmača i 144 njihove prasadi. Krmače su hranjene smjesom za gravidne krmače uz dodatak 1% pripravka Vitapol® u prahu (Alpha-vet, Mađarska) 30 dana prije prasnjenja. Prasad pokusne skupine dobivala je prvih sedam dana života otopinu pripravka Vitapol® u količini od 100 ml po leglu dnevno per os. Sedam dana prije odbića prasad je dobila 1% suhog pripravka umiješanog u starter za prasad. Praćena je porodna masa prasadi i masa na odbiću. Krv za hematološke i biokemijske pretrage uzeta je 7. i 30. dana života prasadi, a određeni su metaboliti, koncentracija željeza, bakra, cinka, selena. Pažnja je posvećena utvrđivanju moguće interakcije huminske kiseline sa željezom pa su određeni transportni protein za željezo transferrin, feritin, enzim ceruloplazmin, imunoglobulini G i M, protein akutne faze haptoglobin i C3 komponenta komplementa. Pokusne krmače imale su 5,7% više živorođene prasadi. Porodna masa prasadi pokusne skupine krmača bila je 14,43% veća od mase prasadi kontrolnih krmača. Pokusna prasad na odbiću imala je 14,8% veću tjelesnu masu od kontrolne prasadi. Nije utvrđena razlika u koncentracijama glukoze, proteina, globulina. Utvrđene su statistički značajne razlike u sisajućem razdoblju u pokusne prasadi za sljedeće pokazatelje: veća koncentracija albumina, HDL i LDL kolesterola, nezasićenog i ukupnog kapaciteta vezanja željeza, C3 komponente komplementa, bakra i cinka u plazmi i u punoj krvi, a snižene vrijednosti imunoglobulina M klase, željeza u plazmi i proteina koji transportiraju željezo, dok koncentracija željeza u punoj krvi, broj eritrocita i vrijednost hemoglobina nisu bile značajno različite. U odbite prasadi nisu utvrđene statistički značajne razlike u promatranim pokazateljima. Za zaključiti je da dodatak huminske kiseline u gravidnih krmača i sisajuće prasadi poboljšava rast. Huminska kiselina interferira s metabolizmom željeza u plazmi, ali ne pogoršava fiziološku anemiju u sisajuće prasadi. Postoje naznake boljeg funkcioniranja nespecifičnog imunog sustava.

**Ključne riječi:** huminska kiselina, prasad, željezo, biokemijski pokazatelji

## Humic acid as a feed additive in piglets production

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### Summary

Humic compounds are heterogenic mixture of biological-chemical-geological products of organic degradations and are composed of humic acid and a number of minerals. Research in the area of humic compounds on growth and health of animals is new. The experiment was conducted on 12 gestation sows and 144 of their piglets. Control group sows were fed with feed mixture for gestation sows, experimental group of animals received 1% addition of Vitapol® powder (Alfavet, Hungary) in their feed mixture during the last 30 days of gestation. During the first seven days of lactation experimental group of piglets received 100mL of Vitapol® solution *per os* per litter. Before weaning piglets of experimental group received starter mixture with 1% of Vitapol® powder during a seven-day period. Birth weight and weaning weight of piglets were measured. On 7<sup>th</sup> and 30<sup>th</sup> day of piglets' life hematological and biochemical parameters in blood were determined. Since interaction of humic acid and iron was a focus of research, concentration of iron, transport proteins for Fe, transferrin and ferritin, ceruloplasmin, IgG, IgM, acute phase protein haptoglobine and C3 complement component were determined. Experimental group of sows had 5.7% more live born piglets. Average weight of piglets born live from the experimental group of sows was 14.43% higher compared to the piglets from the control group. Experimental group of piglets at weaning had 14.8% higher body weight compared to the control group. There were no significant ( $P>0.05$ ) differences in glucose, total protein and albumin concentrations between groups on 7<sup>th</sup> day of lactation. On the same day significantly ( $P<0.05$ ) higher concentration of albumin, HDL, LDL, TIBC, UIBC, C3 complement component and Cu and Zn (both in plasma and full blood) and significantly ( $P<0.05$ ) lower concentration of IgM, iron in plasma and iron transporting proteins. Concentration of iron in full blood, erythrocyte number and hemoglobin concentration did not significantly ( $P>0.05$ ) differ between groups. After weaning there were no significant ( $P>0.05$ ) differences in determined blood parameters between groups. It can be concluded that addition of humic acid to the diet of sows and piglets improves piglet's growth. Humic acid interferes with iron metabolism but does not deteriorate physiological anemia of suckling piglets. Improvement in native immune system response might be evident.

**Key words:** *humic acid, piglets, iron, biochemical parameters*

## Recovery of milk fat to Škripavac cheese produced from standardised milk

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### Summary

Milk fat is an important component in the forming of the cheese curd. It influences the firmness of the curd, as well as flavour of cheese and cheese yield. Therefore, in industrial cheesemaking standardisation of milk by adjusting the content of protein and milk fat to the optimal ratio of 0.9 : 1 is regularly carried. On contrary, it is not carried out in small scale dairy plant, which could result with reduced recovery of milk fat to cheese and due to that lesser financial profit. The aim of this study was to determine the effect of the milk standardisation on the recovery of milk fat to Škripavac cheese. In the small scale dairy plant, 10 batches of Škripavac cheese were produced. The milk of each batch was divided into three categories: milk for cheese production without standardisation (1); milk for cheese production with standardised ratio protein : fat = 0.9 : 1 by the addition of skimmed milk powder – SMP (2), and by skimming the part of milk fat (3). Standardisation of milk by the addition of SMP significantly increased the content of total solids, lactose ( $P < 0.0001$ ) and proteins ( $P < 0.05$ ) in whey. Addition of the SMP resulted in a significantly ( $P < 0.05$ ) higher recovery of milk fat to Škripavac cheese (76.88 %) compared to the treatment of skimming the part of the cream (71.52 %). Addition of SMP can provide the economic benefits in the production of traditional cheeses due to the better recovery of milk fat to cheese.

**Key words:** *milk standardisation, milk powder, skimming, recovery, Škripavac cheese*

## **Edukativni centar s tradicijskim pasminama domaćih životinja u park šumi Marjan, Split - realnost ili ne?**

Nediljko Ževrnja

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### **Sažetak**

Park šuma Marjan predstavlja jedinstvenu zelenu površinu nadomak centru grada Splita, izuzetne prirodne i kulturne vrijednosti. Marjan je 1964. godine zaštićen u skladu sa Zakonom o zaštiti prirode u kategoriji park šume, a zbog svog značaja i vrijednih povijesnih građevina trajno je zaštićen i kao kulturno dobro 2014. godine. Osnivanje Edukativnog centra s tradicijskim pasminama domaćih životinja planirano je revitalizacijom i prenamjenom prostora ZOO vrta i sklopa zgrada Prirodoslovnog muzeja na prvom vrhu Marjana. Glavni ciljevi Centra bili bi držanje matičnih stada različitih pasmina s ciljem njihove daljnje selekcije i reprodukcije radi očuvanja genetskog fonda, suradnja s bankom gena domaćih životinja Republike Hrvatske radi pohrane genetskog materijala izvornih pasmina, zaštita i promocija izvornih i tradicijskih pasmina te podizanje svijesti javnosti o potrebi i važnosti njihovog očuvanja. Životinje koje su planirane za smještaj u Edukativnom centru na Marjanu odgovaraju klimatsko-geološkim obilježjima prostora. Radilo bi se isključivo o životinjama karakterističnim za primorsko područje, mirne naravi, prihvatljivim za druženje s djecom svih uzrasta kao što su ovce, koze, kokoši, purani, goveda, magarci i konji. Planirano je ukupno 9 vrsta s maksimalno 16 pasmina, među kojima su i one koje nisu uvrštene na Popis izvornih i zaštićenih pasmina i sojeva domaćih životinja, zbog čega je potrebno provesti njihovu inventarizaciju te ih uključiti u sustav poticaja.

***Ključne riječi:*** Edukativni centar, tradicijske pasmine domaćih životinja, park šuma Marjan

## **Educational Centre with traditional breeds of domestic animals in the Park Forest Marjan, Split - reality or not?**

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### **Summary**

The Park Forest Marjan represents a unique green area near Split, of exceptional natural and cultural value. Marjan was protected in 1964 in accordance with the Law on Nature Protection in the Park Forest category, and because of its historical value, it is also permanently protected as a cultural asset in 2014. Establishment of the Educational Centre with traditional breeds of domestic animals is planned through revitalization and use change of the ZOO garden area and buildings of the Natural History Museum at Marjan. The main goals of the Centre would be keeping of different breeds of parent flocks for their further selection and reproduction with the purpose of preserving the genetic fund, cooperation with the gene bank of Croatian animals for storing the genetic material of original breeds, protection and promotion of original and traditional breeds, and raising public awareness of the need and importance of their preservation. The animals planned for accommodation at the Marjan Educational Centre correspond to climatic-geological features of the area. Animals would be characteristic for the coastal area, of peaceful nature, and acceptable for socializing with children of all ages, e.g. sheep, goats, chickens, turkeys, cattle, donkeys and horses. A total of 9 species with a maximum of 16 breeds are planned, some of which are not yet included in the list of native and protected breeds and strains of domestic animals, which is why they have to be catalogued and included in the incentive system.

**Key words:** *Educational Centre, traditional breeds of domestic animals, Park Forest Marjan*



**Voćarstvo,  
Vinogradarstvo  
i vinarstvo**

**08**

**Viticulture,  
Enology and  
Pomology**





## Netipična aroma dozrijevanja (UTA) u hrvatskim vinima; senzorna analiza i sadržaj 2-aminoacetofenona (2-APP)

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### Sažetak

Netipična/atipična aroma dozrijevanja (UTA) relativno je novi problem u bijelim vinima *Vitis vinifera* i, bez sumnje, veliki znanstveni izazov. UTA je posljedica velikog broja različitih čimbenika fiziološkog stresa u proizvodnji grožđa i veliki broj različitih deskriptora poznat je u senzornom opisivanju ovakvih vina. Najčešći deskriptori za UTA su miris po mokroj vuni, naftalenu, pasti za poliranje namještaja, pasti za cipele, prljavoj krpi za pranje posuđa, starom vosku, cvatu bagrema, s gubitkom vinske i sorte prepoznatljivosti. Intenzitet većine mirisa raste s povećanim sadržajem slobodnog sumpornog dioksida. Utvrđeno je da je 2-aminoacetofenon (2-APP) glavni spoj prepoznatljivosti UTA-e iako putevi njegove sinteze i pojava netipične arome još nisu razjašnjeni. Jako aromatična, kompleksna vina mogu maskirati i veće koncentracije od 1,5 µg/L AAP, dok se u laganim, nježnim, jednostavnim vinima mana očituje i ako je sadržaj AAP manji od 0,5 µg/L. Analiza 2-aminoacetofenona provedena je u uzorcima vina koja su odbačena s napomenom UTA, na službenom organoleptičnom ocjenjivanju, prije stavljanja u promet. Senzorna analiza vina provedena je metodom 100 bodova (brojčana metoda) i metodom Da/ne (deskriptivna metoda). Analiza 2-APP provedena je tehnikom plinke kromatografije „GC-MS“ uz pripremu uzorka tehnikom „SPME“. U analiziranim uzorcima sadržaj 2-APP bio je između 0,33 µg/L i 4,41 µg/L. U kontrolnom uzorku koji nije imao napomenu UTA, koncentracija 2-APP bila je 0,11 µg/L. Većina uzoraka s UTA-om proizvedena je u najhladnijem i najvlažnijem području, vinogradarskoj zoni B i može se povezati s ekstremnim klimatskim uvjetima tijekom 2011., 2012. i 2014. godine.

**Ključne riječi:** Netipična aroma dozrijevanja, senzorno ocjenjivanje, 2-aminoacetofenon, vino

## Untypical aging off flavour (UTA) in Croatian wines; sensory detection and content of 2-aminoacetophenone (2-AAP)

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### Summary

"Untypical / Atypical aging off - flavour" (UTA, ATA) is a relatively new problem in *Vitis vinifera* white wines and, no doubt, a big scientific challenge. Many viticultural physiological stress factors can cause the UTA and plenty of different attributes can be used in sensory descriptive analyse. The most common aroma descriptors for UTA are wet wool, naphtalene, furniture and shoes polish, old wax, dirty dishtowel, or acacia blossom combined with a loss of the typical aroma of the grape variety. This odor pattern is reinforced by high concentrations of free sulfur dioxide. 2-Aminoacetophenone (AAP) is found to be main marker responsible for UTA, however synthesis pathways of AAP and the correlated appearance of UTA in wine has not been clarified yet. Very aromatic, complex wines can mask concentrations of AAP higher than 1.5 µg / L, while in light, simple vines, UTA can be recognised if the AAP content is less than 0.5 µg / L. Wines described as off-flavour wines with UTA in official sensory evaluation before market were analysed to determine the concentrations of 2-aminoacetophenone. Sensory analysis of samples were done by "100 positive points" method and descriptive method "Yes/No". A direct immersion (DI) solid phase microextraction (SPME) coupled with gas chromatography (GC) and mass spectrometry (MS) was used to quantify 2-AAP. Concentrations of 2-AAP in samples ranged from 0.33 µg/L to 4.41 µg/L. In control wine, where no sensory UTA was detected, concentration of 2-AAP was 0.11 µg/L. The samples with UTA originated mostly from viticulture zone B, the coldest and most humid area, and can be correlated with extreme climatic conditions during 2011., 2012. and 2014.

**Key words:** *untypical aging off flavour, sensory analyses, 2-aminoacetophenone, wine*

## Apple fruit diameter and daily fruit growth rate at three crop loads

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### Summary

Fruit thinning is indispensable practice in production of large sized and good quality apple fruits. Often problems are light and late thinning. Intensity and late thinning were evaluated in trail settled near Zadar, Croatia, on apple cv. 'Cripps Pink' grafted on M9 rootstock and cultivated at spindle-type system. Fruits were hand thinned on July 31<sup>st</sup> 2017 to standard (S), high (H) and very high (VH) crop load (levels of 6, 8 and 10 fruits per trunk cross-section area, TCSA, respectively). Fruit diameter was measurement on 1 to 3 fruits on each of four branches per tree with four trees per treatment (total of 90 fruits) using fruit sizing loop. Fruits were measured at 10 days intervals till December 30<sup>th</sup>. Fruit diameter and daily fruit growth rate (FGR) were compared at three crop loads and time of measurement. TCSA were  $13.7 \pm 0.681 \text{ cm}^2$ . Fruit diameter at VH was lower (67.9 mm) than at S and H (70.8 and 69.6 mm, respectively) which were not significantly different. Fruit diameter of 59.22 mm at 97<sup>th</sup> day of the year (D97) increased on D105, D125, D136, and D167, then fruit diameter remained similar until D188, being 77.1 mm. FGR was affected only by time. FGR was highest at D105 (0.388 mm/day), gradually decreased to D146, and from D157 to D188 was similar (0.092 mm/day). Interactions of crop load and time were not significant. Fruits were hand thinned at 75% of final fruit size. VH negatively affected fruit diameter, hence VH could be thinned to H. Thinning H to S was not justified.

**Key words:** *Cripps Pink, fruit size, TCSA, thinning, time*

## Utjecaj podloge na sadržaj i sastav organskih kiselina u moštu cv. Graševina (*Vitis vinifera* L.)

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### Sažetak

Graševina je najvažnija sorta vinove loze u Hrvatskoj sa udjelom od 23% u ukupnim površinama pod vinogradima, u proizvodnim nasadima je najčešće cijepljena na dvije podloge Kober 5BB i SO4. Cilj ovog rada bio je utvrditi postojanje razlika u sadržaju organskih kiselina uvjetovanih utjecajem lozne podloge. Organske kiseline direktno utječu na fizikalnu, biokemijsku i mikrobiološku stabilnost vina, kao i na senzorna svojstva vina. Istraživanje je provedeno u pokusnom nasadu klonskih kandidata cv. Graševina izdvojenih u kutjevačkom vinogorju u postupku individualne klonske selekcije cijepljenih na dvije podloge Kober 5BB i SO4 kroz dvije godine berbe 2015. i 2016. Analiziran je sadržaj tri najvažnije organske kiseline u grožđu: vinske, jabučne i limunske spektrofotometrijskim metodama. U 2015. godini koja je bila izuzetno sušna nisu utvrđene signifikantne razlike između sadržaja organskih kiselina na dvije promatrane podloge. U 2016. godini sa prosječnim vremenskim uvjetima utvrđen je signifikantno viši sadržaj jabučne kiseline na podlozi Kober 5BB.

**Ključne riječi:** grožđe, klonska selekcija, organske kiseline

## **Influence of the rootstock on the content and composition of organic acids in must of Graševina cv. (*Vitis vinifera* L.)**

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### **Summary**

Graševina is the most important grape variety in Croatia, with the 23% of the total area under vineyards. In the vineyards it is most often planted on two rootstock Kober 5BB and SO4. The aim of this work was to determine diversity in the content of organic acids with the emphasis on the influence of rootstock. The research was conducted in the experimental vineyard on clonal candidates cv. Graševina selected in the Kutjevo vineyard region in the process of individual clonal selection planted on two rootstock Kober 5BB and SO4 during two harvest years 2015 and 2016. Organic acids directly affect the physical, biochemical and microbiological stability of wine, as well as its sensory properties. Accumulation of tartaric, malic and citric acids in grapes was analysed using spectrophotometric methods. In year 2015, which was exceptionally dry, no significant difference was found between the organic acid content on the two observed rootstock. In year 2016, with average weather conditions, a significantly higher content of malic acid was found on the Kober 5BB rootstock.

**Key words:** *grape, clonal selection, organic acids*

## Fauna pipa (Insecta: Curculionidae) u maslinicima na području Zadarske županije

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### Sažetak

Maslinu napada nekoliko vrsta pipa. Posebno velika oštećenja pipe mogu izazvati u mladim nasadima koji su podignuti na iskrčenim terenima. Ovi kukci se najčešće pojavljuju na kamenitim i neobrađenim površinama. Najznačajnija i najštetnija među njima je Maslinin svrdlaš *Rhynchites cribripennis* (Desbrochers, 1868.). Glavni cilj ovog rada bio je istražiti faunu pipa u maslinicima u odnosu na tehnologiju uzgoja i načinima gospodarenja tlom (zatravljena površina, kultivirano tlo, maslinik u kršu). Ovo istraživanje je provedeno tijekom 2016. godine u 14 maslinika (4 ekološka, 3 ekstenzivna, 4 integrirana i 3 konvencionalna). Uzorkovanje je obavljeno metodom otresanja grana (entomološka mreža), korištenjem sintetičkih traka (rincotrap) i pomoću lovnih posuda (pitfall traps). Ulovljeno je sveukupno 25 jedinki iz porodice Cucurliionidae koje pripadaju unutar 4 vrste. Pronađeno je 19 primjeraka vrste *Otiorhynchus cardiniger* (Host, 1789.), 3 primjerka vrste *R. cribripennis*, 1 primjerak vrste *Otiorhynchus cribricolis* (Gyllenhal, 1834.), te 2 primjerka roda *Cucurlio* spp. Najveća populacija ovih kukaca je uočena u maslinicima na kršu (56%), zatim na zatravljenim površinama (28%), a najmanja u obrađenim maslinicima (7%). Rezultati su pokazali kako je veći broj jedinki bio prisutan u zapuštenim nego u njegovanim maslinicima. S obzirom na tehnologiju uzgoja, najmanji broj pipa (2) je pronađen u konvencionalnim nasadima.

**Ključne riječi:** maslina, pipe, maslinin svrdlaš, krš

## Weevils fauna (Insecta: *Curculionidae*) in olive orchards of Zadar County

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### Summary

Olive trees are attacked by several species of weevils. Special damages weevils can cause in young olive orchards which have been built on a reclaimed terrain. Curculionidae occur most on rocky and uncultivated areas. Among them, the most important and most harmful species is Olive Fruit Curculio (*Rhynchites cribripennis* Desbrochers 1868). The main aim of this research was to explore the weevil fauna in correlation with soil management (area covered with weeds, cultivated land, olive grove in karst) and olive cultivation technology. Sampling was done by the mechanical knock down (entomological net), using synthetic tapes (rincotrap) and pitfall traps. This research was conducted during 2016 in 14 olive orchards (organic 4, extensive 3, integrated 4 and conventional 3). In total 25 beetles from the Curculionidae family, belonging to 4 species were found. There were 19 individuals of *Otiorhynchus cardiniger* (Host, 1789.), 3 individuals of *Rhynchites cribripennis*, 1 specimen of *Otiorhynchus cribricollis* (Gyllenhal, 1834.) and 2 individuals of *Cucurlio* spp. The highest population of this insects was noticed in the olive orchard on karst (56%), followed by groves covered with weeds (28%), until the lowest population was found in cultivated ones (16%). Results showed a higher number of individuals in extensive, unlike well-maintained orchards. According to cultivation technology, the lowest number (2) was found in conventional orchards.

**Key words:** olive tree, weevils, olive fruit curculio, karst



## Istraživanje pojave sušenja masline u Istri

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### Sažetak

U okviru ovog rada, istraživala se pojava djelomičnog ili potpunog sušenja stabala masline u Istri u 2016. i 2017. godini. Na terenu su provedeni vizualni pregledi i sakupljeni uzroci biljnog materijala radi utvrđivanja uzroka i uzročnika bolesti. Pregledi i sakupljanje uzoraka obuhvatili su 23 lokacije unutar četiri maslinogorja (bujsko-umaško, porečko-vrsarsko, rovinjsko i vodnjansko-pulsko). Lokaliteti su se razlikovali mikroklimatski, agrotehnički, te prema sortimentu i starosti stabala. Ukupno je sakupljeno 78 izolata fitopatogenih gljiva. Za identifikaciju vrsta korištene su klasične metode (uzgoj na hranjivim podlogama, analiza morfologije izolata) i molekularne metode dijagnostike (PCR i sekvenciranje). Prema rezultatima pregleda i analizi sakupljenih uzoraka utvrđeno je nekoliko vrsta, rodova i porodica fitopatogenih gljiva. Najčešća izolirana vrsta koja se dovela u vezu sa simptomima djelomičnog ili potpunog sušenja, slabijeg rasta i vigora stabala masline bila je vrsta *Verticillium dahliae* Kleb. Osim ove vrste, utvrđene su i gljive iz porodice Botryosphaeriaceae, vrsta *Armillaria mellea* (uzročnik bijele truleži korijena) i još nekoliko drugih vrsta. Prema geografskoj raširenosti utvrđenih patogena, vrste *V. dahliae* i *A. mellea* utvrđene su u svim maslinogorjima na istarskom poluotoku obuhvaćenih ovim radom. Prisutnost i raširenost ovih fitopatogenih gljiva može predstavljati ozbiljan problem u uzgoju masline u Istri.

**Ključne riječi:** *Armillaria mellea*, *Botryosphaeriaceae*, istarski poluotok, *Olea europaea*, *Verticillium dahliae*

## A survey on olive decline in Croatian Istria

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### Summary

The phenomenon of partial or total decline of olive trees in Istria in 2016 and 2017 was investigated within this research. In the field, visual examinations and collection of samples of plant material were carried out to determine the cause and causal agents of olive trees decline. Survey and collection of samples included 23 locations within four olive growing hills (areas of Buje-Umag, Poreč-Vrsar, Rovinj and Vodnjan-Pula). The locations differed microclimatic, agrotechnically, according to olive varieties and different trees' ages. A total of 78 isolates of phytopathogenic fungi were collected. Identification of species was performed by conventional methods (cultivation, analysis of isolate morphology), and by molecular diagnostic methods (PCR and sequencing). According to the results of the examination and analysis of collected samples several species, genera and families of phytopathogenic fungi were identified. The most commonly isolated species associated with symptoms of partial or total decline, weaker growth and vigor of olive trees was the species *Verticillium dahliae* Kleb. In addition to this species, fungi from the family Botryosphaeriaceae, the species *Armillaria mellea* (a causative agent of white root rot) and several other fungal species were also found. According to the geographical distribution of the pathogens, *V. dahliae* and *A. mellea* species were found in all olive growing hills on the Istrian peninsula covered by this work. The presence and distribution of these phytopathogenic fungi can represent a serious problem in olive growing in Istria.

**Key words:** *Armillaria mellea*, *Botryosphaeriaceae*, *Istrian peninsula*, *Olea europaea*, *Verticillium dahliae*

## Istraživanje brojnosti cikade *Scaphoideus titanus* Ball i zlatne žutice vinove loze u Koprivničko – križevačkoj županiji

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### Sažetak

Američki je cvrčak najznačajniji vektor zlatne žutice vinove loze u svim vinogradarskim područjima Europe. Cilj ovog istraživanja bio je utvrditi utjecaj tipa uzgoja na brojnost jedinki američkog cvrčka, te postoji li izravna povezanost brojnosti jedinki američkog cvrčka ulovljenog na žute ploče i pojave simptoma zaraze u vinogradima u Koprivničko – križevačkoj županiji. Istraživanje je provedeno 2016. i 2017. godine u pet vinograda različitog načina uzgoja (konvencionalni, integrirani, ekstenzivni). U vinogradu s ekstenzivnim načinom uzgoja međuredni prostor se obrađuje ručno, jedan je vinograd zatravljen i redovno se kosi, dok je u ostalim vinogradima prisutna spontana flora koja se 2-3 puta godišnje kultivira ili tretira herbicidima. Uzorkovanje je obavljeno u periodu od lipnja do rujna, a za ulov insekata korištene su žute ljepljive ploče. Brojanje je vršeno svakih 2-3 tjedna. Na svim je lokacijama utvrđena prisutnost cvrčka, a primjećene su velike razlike u brojnosti. Ulov jedinki cvrčka kretao se od 12 u Lukovcu na 12 ha vinograda u kojem je izbrojeno 20 simptomatskih biljaka 2017. godine, do 1215 jedinki u Virju, na 2 ha vinograda u kojem je izbrojeno 30 simptomatskih trsova 2017. godine. U vinogradu s najmanjim ulovom međrudeni prostor u vinogradu je zatravljen i redovno se kosi, dok je u vinogradu s najvećim ulovom jedinki prisutna spontana flora. Broj simptomatskih biljaka je neznatno veći u odnosu na broj ulovljenih jedinki.

**Ključne riječi:** Američki cvrčak, *Scaphoideus titanus*, vinova loza, zlatna žutica, žute ploče

## The research of the number of leafhopper *Scaphoideus titanus* Ball and Flavescence doree symptoms in Koprivnica – Križevci County

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### Summary

*Scaphoideus titanus* Ball is the most significant vector of Grapevine Flavescence doree in European vineyards. The main aim of this research was to determine if there is a connection between the type of growing and the number of insects and between the number of insects and the number of symptomatic plants in Koprivnica – Križevci County. The survey was conducted from June to September 2016. and 2017. in five different vineyards (conventional, integrated, extensive). The cover cropping system varies from manual tillage, grass cover regularly mowed to spontaneous flora cultivated or treated with herbicides two to three times a year. Samples were carried out every 2-3 weeks using yellow sticky traps. The presence of the vector is confirmed on all locations. The differences in number of individuals on yellow sticky traps were high. The number of individuals was between 12 in Lukovec on 12 ha of vineyard where there were 20 symptomatic plants in year 2017 and 1215 individuals in Virje, on 2 ha of vineyard, with 30 symptomatic plants in the same year. The vineyard with the smallest numbers of individuals is regularly mowed, while the vineyard with the highest number of individuals has spontaneous flora treated with herbicides. The number of symptomatic plants is only slightly higher in relation to the number of individuals on yellow sticky traps.

**Key words:** *Nearctic leafhopper, Scaphoideus titanus, grapevine, golden flavescence doree, yellow sticky traps*

## Kvaliteta ploda i kemijske karakteristike sorti jabuka uzgojenih u sustavu održive voćarske proizvodnje

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### Sažetak

Tradicionalne, otporne i komercijalne sorte jabuka se u pokusnom voćnjaku Zavoda za voćarstvo, Hrvatski centar za poljoprivredu, hranu i selo u Donjoj Zelini, uzgajaju u intenzivnom sustavu proizvodnje. Cilj istraživanja bio je odrediti svojstva kvalitete i kemijska svojstva ploda. Analizirane su sorte jabuke: tradicionalne (Ovčji nos, Mašanka, Zlatna zimsko parmenka); otporne (Topaz®, Pinova®, Querina-Florina) i komercijalne (Gala Schnitzer Schniga®, Golden Delicious, Idared). Prikazani su rezultati istraživanja za 2017. godinu. Mjerena su svojstva: čvrstoća ploda, topljiva suha tvar refraktometrijski, ukupne kiseline i pH vrijednost, sadržaj vitamina C, ukupni antocijani, boja ploda. Boja ploda je izmjerena spektrofotometrom i izražena prema CIE  $L^*a^*b^*$  sustavu. Rezultati su statistički obrađeni analizom varijance i LSD testom. Tradicionalne sorte su bile najčvršće ( $8,36 \text{ kg/cm}^2$ ), imale su najviše topljive suhe tvari ( $16,04 \text{ °Brix}$ ), najviše ukupnih kiselina ( $20,81 \text{ g/l}$ ) i najveću  $b^*$  vrijednost ( $30,98$ ), a najmanje ukupnih antocijana ( $0,73 \text{ mg/100 g}$  svježeg ploda) i najmanju vrijednost za  $a^*$  ( $11,58$ ). Komercijalne sorte su imale najviše ukupnih antocijana ( $8,19 \text{ mg/100 g}$  svježeg ploda) i vitamina C ( $3,04 \text{ mg/l}$ ), a najmanju čvrstoću ( $6,16 \text{ kg/cm}^2$ ), količinu topljive suhe tvari ( $13,35 \text{ °Brix}$ ) i ukupnih kiselina ( $16,01 \text{ g/l}$ ). Otporne sorte imale su najvišu vrijednost  $a^*$  ( $31,22$ ), a najmanje vitamina C ( $1,42 \text{ mg/l}$ ),  $L^*$  ( $45,09$ ) i  $b^*$  vrijednost ( $25,81$ ). Komercijalne, otporne i tradicionalne sorte uzgajane u intenzivnom sustavu proizvodnje su prema ispitivanim svojstvima postigle zadovoljavajuću kvalitetu ploda.

***Ključne riječi:*** jabuka, sorta, intenzivan sustav proizvodnje, kvaliteta ploda

## Fruit quality and chemical traits of apple varieties grown in sustainable production system

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### Summary

Traditional, resistant and commercial apple varieties are grown in experimental orchard of the Institute of Pomology, Croatian Centre for Agriculture, Food and Rural Affairs in Donja Zelina, in a sustainable production system. The aim of this study was to estimate chemical and quality parameters of fruit. Traditional (Ovčji nos, Mašanka, Zlatna zimsko parmenka), resistant (Topaz®, Pinova®, Querina-Florina) and commercial (Gala Schnitzer Schniga®, Golden Delicious, Idared) apple varieties were analysed. In the paper are presented research results for year 2017. Following characteristics were measured: fruit firmness, soluble solids content, total acidity, pH, vitamin C, total anthocyanins content and fruit colour. Fruit colour was measured with spectrophotometer by using CIE L\*a\*b\* system. Data were statistically analysed by variance analysis and LSD test. Traditional varieties were the most firm (8.36 kg/cm<sup>2</sup>), with highest amount of soluble solids (16.04 °Brix), total acidity (20.81 g/l) and b\* value (30.98), with the lowest total anthocyanin content (0.73 mg/100g FW) and a\* value (11.58). Commercial varieties had highest total anthocyanins (8.19 mg/100g FW) and vitamin C content (3.04 mg/l), with the lowest firmness (6.16 kg/cm<sup>2</sup>), soluble solids (13.35 °Brix), total acidity (16.01 g/l) amount. Resistant varieties had highest a\* value (31.22), and lowest vitamin C content (1.42 mg/l), L\* (45.09) and b\* value (25.81). Commercial, resistant and traditional varieties cultivated with an intensive production system, according to the analyzed traits, achieved satisfactory quality of fruit.

**Key words:** *apple, variety, intensive production system, fruit quality*

## Effect of tannin addition on the efficacy of bentonite fining and the quality of Malvazija istarska (*Vitis vinifera* L.) wine

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### Summary

In order to investigate the effect of the addition of tannins to Malvazija istarska (*Vitis vinifera* L.) must during fermentation on the protein stability and selected aspects of wine quality, several vinification treatments were performed: addition of tannins during fermentation (TA), addition of bentonite at the end of fermentation (BE), combination of the addition of tannins and bentonite (TA+BE), and a control treatment (CO) without tannin and bentonite added during fermentation. Protein stability of wines was evaluated, additional doses required were determined and applied. Volatile aroma compounds were extracted from wine samples by SPE for the measurements by GC-MS. Hydroxycinnamoyltartaric acids and the corresponding free derivatives were determined by HPLC-DAD. Wines were evaluated by 100-point OIV method and quantitative descriptive sensory analysis. The most effective treatment in terms of achieving total protein stability was TA. The reduction of the total bentonite dose required in relation to CO was 19%. Treatment TA resulted in higher concentrations of the majority of important acetate and ethyl esters. Concentration of most acids detected were higher in wines obtained without tannin addition. TA+BE treatment preserved the highest concentration of hydroxycinnamoyltartaric acids, followed by BE, TA, and CO. Free hydroxycinnamic acid concentrations responded diametrically opposite. Significant differences in the intensity of wine sensory attributes were mainly detected among wines that were not stabilized after fermentation. Wines fermented with tannin addition gained higher scores, but the additional bentonite fining step after fermentation mostly decreased their sensory quality.

This work has been supported in part by Croatian Science Foundation under the project UIP-2014-09-1194.

**Key words:** *tannin, bentonite, wine stability, aroma, phenols*

## Senzorska procjena sušenih plodova sorti šljive podvrgnutih kemijskim i mehaničkim predtretmanima

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### Sažetak

Plodovi sorti šljive Bistrica, Topend plus i President podvrgnuti su različitim tretmanima prije procesa sušenja kako bi se uklonila voštana prevlaka te time potaknula dehidracija i ubrzalo vrijeme sušenja. Plodovi sorti šljiva tretirani su slijedećim pred tretmanima: mehanički abrazijom na 5, 10 i 15 min; potapanjem u vodu na temperaturama 22 °C i 60 °C te kemijskim potapanjem u otopinu KOH s tri razrjeđenja (0,5 %, 1,0 % i 1,5 %) na dvije temperature (22 °C i 60 °C), svi u trajanju od 90 sekundi, uz kontrolni uzorak. Plodovi su sušeni do 35% sadržaja vlage u M. Buchner AG Typ 16B sušari kapaciteta do 30 kg. Cilj istraživanja bio je utvrditi intenzitet pojedinog senzorskog svojstva sušenih plodova šljive uzrokovanih primjenom različitih predtretmana. U ocjenjivanju je korištena kvantitativno deskriptivna analiza na skali intenziteta od 1 do 7. Ocjenjivani su parametri: intenzitet boje (smeđe/crno, tamno plavo/crno i sivo), miris (miris na šljivu, karamelu i na strani miris), okus (okus na šljivu, kiseli okus i sočnost) i aroma. Kod intenziteta svojstva boje tamno plavo/crno većina predtretmana imala je prosječnu vrijednost od 4,7, dok je značajno manji intenzitet svojstva izražen kod predtretmana koji su tretirani sa KOH 60 °C svih koncentracija. Karakterističan miris na šljivu bio je najizraženiji kod kontrolnog uzorka (4,39) a slijede uzorci predtretmana abrazijom, dok je najniži intenzitet ovog svojstva zabilježen kod predtretmana 60 °C KOH 1,5%. Najveći intenzitet svojstva okusa na šljivu utvrđen je kod kontrolnog uzorka (4,58), zatim slijede uzorci predtretmana abrazijom (4,24 – 4,12), dok je najmanji zabilježen kod predtretmana 22 °C KOH 1,5% (3,33).

***Ključne riječi:*** šljiva, sušenje, predtretmani, senzorna procjena



## Sensory evaluation of dried plum fruits treated with chemical and mechanical pre-treatments

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### Summary

Plum fruits of cultivars Bistrica, Topend plus and President were treated with different pre-treatments prior to drying in order to remove waxy layer and to foster dehydration and to expedite drying time. Plum fruits were treated with following pre-treatments: abrasive mechanical in 5, 10 and 15 min; water submersion on temperatures of 22 °C and 60 °C and chemical by submerging samples in KOH solution diluted to 0.5%, 1.0% and 1.5% at two temperatures (22 °C and 60 °C), all in duration of 90 sec, with control sample. Fruits were dried to 35% moisture content in M. Buchner AG Typ 16B dryer of 30 kg capacity. The aim of this research was to determine the intensity of individual sensory characteristic of dried plum fruits as influenced by different pre-treatments. Quantitative descriptive analysis on a scale of 1 to 7 was used. Following parameters were assessed: colour intensity (brown/black, dark blue/black and grey), flavour (plum flavour, caramel and foreign flavour), taste (plum taste, sour taste and juiciness) and aroma. Dark blue/black colour intensity most of pre-treatments scored average value of 4.7, while significantly lower colour intensity was pronounced on 60 °C KOH pre-treatments KOH of all concentrations. Characteristic plum like flavour was mostly pronounced at control sample (4.39), followed by abrasia pre-treatment, while 60 °C KOH 1.5% had the lowest intensity. Control sample had the highest plum like taste intensity (4.58), followed by samples with abrasia pre-treatments (4.24 – 4.12). The lowest intensity was recorded at 22 °C KOH 1.5% pre-treatment (3.33).

**Key words:** plum, drying, pre-treatments, sensory evaluation

## Aromatski profil vina različitih crnih sorata (*V. vinifera* L.) dozrijevanih u hrastovim bačvama

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### Sažetak

Aromatski profil crnih vina dozrijevanih u srednje i jako paljenim hrvatskim hrastovim bačvama definiran je pomoću GC-MS instrumentalne metode. Cilj istraživanja bio je utvrditi razlike u kemijskom sastavu i senzornim svojstvima vina 'Cabernet Sauvignon', 'Merlot' i 'Petit Verdot' tijekom 9 mjeseci dozrijevanja. Utvrđen je različiti intenzitet ekstrakcije, ovisno o jačini paljenja drva koji je najviše utjecao na koncentracije eugenola, gvaiakola, vanilina te *cis* i *trans* hrastovog laktona. Na oslobađanje ostalih analiziranih laktona ( $\gamma$ -heksalakton,  $\gamma$ -nonalakton,  $\gamma$ -dekalakton) izraženiji utjecaj je imala sorta u odnosu na jačinu paljena te vrijeme dozrijevanja. Ekstrakcija hlapivih spojeva iz drveta bila je različita među ispitivanim vinima, a najveća kod vina 'Cabernet sauvignon'. Različitost je utvrđena i u koncentracijama hlapivih fenola. Tako su vina 'Petit verdot' imala najnižu koncentraciju etil fenola i etil guaiakola dok je najveća koncentracija zabilježena u vinima 'Cabernet sauvignon' neovisno o jačini paljenja. Rezultati senzornog ocjenjivanja izdvojili su vina dozrijevana u srednje paljenim bačvama boljima u odnosu na ona iz jako paljenih, pri čemu je ukupno najbolje ocijenjeno vino dobiveno od sorte Merlot.

**Ključne riječi:** hrastove bačve, jačina paljenja, laktoni, dozrijevanje, hlapivi fenoli

## Volatile profile of red wines from different grape varieties (*V. vinifera* L.) aged in oak barrels

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### Summary

The wood-related volatile profile of red wines aged in medium and hard toasted Croatian oak wood barrels was studied by GC–MS. The objective of this study was to describe the differences in chemical composition and sensory properties of the 'Cabernet Sauvignon,' 'Merlot' and 'Petit Verdot' wines during the nine months aging period. Different rates of extraction have been observed depending on the toasting method used. The toasting level influenced more considerably eugenol, guaiacol, vanillin and *cis* and *trans* oak lactone concentrations. Among other lactones analysed ( $\gamma$ -hexalactone,  $\gamma$ -nonalactone,  $\gamma$ -decalactone) grape variety had more pronounced influence than toasting level and aging period. The accumulation of oak compounds was different depending on the wine aged in the barrels with the extraction rate being more favored in the 'Cabernet Sauvignon' wines. Marked difference was noted in the ethyl phenol concentrations between tested wines. 'Petit Verdot' contained the lowest levels of both phenols (ethyl phenol and guaiacol) while the highest concentrations were noted in 'Cabernet Sauvignon' wines regardless the toasting level. Sensory evaluation pointed out better overall quality of wines aged in medium toasted barrels, while between varieties the best results were achieved in Merlot wines.

**Key words:** *oak barrels, toasting level, aging, lactones, volatile phenols*

## Promjene u sastavu i sadržaju antocijana tijekom faze dozrijevanja grožđa

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### Sažetak

Tijekom rasta i razvoja bobica grožđa prolazi različite faze razvoja koje se na BBCH-skali označavaju brojevima od 71 do 89. Dolazi do velikih promjena u kemijskom sastavu, a jedan od važnih biokemijskih procesa koji se događaju tijekom faza dozrijevanja je biosinteza antocijana. Na trajanje pojedine faze značajno utječu genotip i okolišni uvjeti. U ovome radu istraživanje je provedeno na 10 autohtonih crnih sorata vinove loze te na 'Merlotu'. Uzorci grožđa na kojima je provedena analiza antocijana prikupljeni su u različitim fazama počevši od šare (81) pa do tehnološke zrelosti (89). U uzorcima prikupljenim u šari utvrđen je najmanji sadržaj svih analiziranih spojeva što ukazuje da u tom trenutku dolazi do početka biosinteze ovih spojeva. U kasnijim rokovima dolazi do značajnog povećanja svih pojedinačnih spojeva, ali dinamika njihovog povećanja značajno ovisi o samom spoju, fazi razvoja te u genotipu. Tijekom svih promatranih faza, neovisno o sorti najbrže se povećavao sadržaj malvidin-3-*O*-glukozida, a najsporije cijanidin-3-*O*-glukozida. Ovakvo opažanje može se pripisati samom biosintetskom putu u kojemu je cijanidin-3-*O*-glukozida ishodni spoj za sintezu drugih antocijana. Najveći utvrđeni sadržaj pojedinih antocijana značajno ovisi o fazi, ali i o genotipu. Tako su kod nekih sorata najveće vrijednosti utvrđene u vrijeme tehnološke zrelosti (89), a kod drugih 2 tjedna ranije.

**Ključne riječi:** fenofaze, sadržaj antocijana, autohtone sorte vinove loze

## Changes in composition and content of anthocyanin during the ripening phase of grapes

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### Summary

During the development and growth, grape berry undergoes through different phases, which can be categorized according to the BBCH scale with codes from 71 to 89. During the ripening chemical changes are significant among them anthocyanin biosynthesis is quite important. The period of a particular phase is significantly affected by genotype and environmental conditions. This study was conducted on 10 autochthonous red grape varieties and on 'Merlot'. Grape samples were collected at distinct stages starting from veraison (81) up to technological maturity (89). In the collected samples composition and content of anthocyanins were determined. The lowest content of all the analyzed compounds was determined in samples collected in the veraison, indicating that at this point the biosynthesis of these compounds is occurred. In later periods, significant increases of all individual compounds were observed. The dynamics of anthocyanins content increase significantly depends upon the compound, the developmental stage and the genotype. The highest increase of content was observed in the case of malvidin-3-*O*-glucoside while the lowest was for cyanidine-3-*O*-glucoside. These trends were not related to variety. This observation can be attributed to the biosynthetic pathway in which cyanidin-3-*O*-glucoside is the precursor for the synthesis of other anthocyanins. The highest determined content of individual anthocyanins was significantly dependent on the stage and the genotype, as well. Thus, in some varieties the highest value was determined at the time of technological maturity (89) and in the other 2 weeks earlier.

**Key words:** *phenophase, anthocyanins content, autochthonous red grape varieties*

## Utjecaj duljine trajanja maceracije na kemijski sastav i kakvoću vina sorte 'Plavac mali' (*V. vinifera* L.)

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### Sažetak

Plavac mali najvažnija je autohtona crna sorta Hrvatske. Problematika iznimno visokog sadržaja polifenolnih spojeva u grožđu odavna je predmet različitih istraživanja sa svrhom iznalaženja optimalnih tehnoloških postupaka uz koje bi se to bogatstvo iskoristilo u pravcu postizanja najbolje moguće kakvoće vina. Poznato je da uz brojne čimbenike na sadržaj ukupnih polifenola u vinu Plavca malog izravno i najznačajnije utječe duljina trajanja maceracije masulja. U ovom istraživanju primjenjena su tri različita vremenska intervala trajanja maceracije uz događanje alkoholnog vrenja. Prvi je uobičajeni, standardni interval u trajanju od osam dana, drugi u trajanju od tri tjedna, a treći interval u trajanju od sedam tjedana. Rezultati fizikalno kemijske analize pokusnih vina pokazali su pravilnost povećanja sadržaja ukupnih polifenola u vinu produljenjem trajanja maceracije, kao i sadržaja ukupnih antocijana, dok se u pogledu sadržaja pojedinačnih antocijana u vinu, pravilnost relativno zadržava kod petunidina (Pt-3-gl) i malvidina (Mv-3-gl). Senzorička evaluacija pokusnih vina metodom rangiranja, pokazala je da su vina iz najduljeg intervala maceracije svaki put (100%), ocjenjena kao najlošija, dok su, izraženo u postocima, vina najkraćeg trajanja maceracije ocjenjena kao najbolja u 75%, a vina srednje dugog intervala maceracije u 25% slučajeva.

**Ključne riječi:** *Plavac mali, maceracija, polifenoli, antocijani, kakvoća vina*

## **Influence of the maceration time length on the chemical composition and wine quality of 'Plavac mali' variety (*V. vinifera* L.)**

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### **Summary**

Plavac mali is the most important indigenous red variety in Croatia. The issue of the very high content of polyphenol compounds in grape has long been a subject of various researches with the purpose of finding the optimal technological procedures with which that richness would be used to achieve the best possible wine quality. It is known that, with many other factors, the most direct and most significant influence on the content of polyphenol compounds in the wine Plavac mali depends on the length of the maceration of marc. In this research, three different time intervals of the duration of the maceration with the events of alcoholic fermentation were used. The first is the usual, standard interval of eight days, the second of three weeks and the third interval of seven weeks. The results of the physical and chemical analysis of test wines showed a pattern of increase in the content of polyphenols in wine the longer the maceration process went on, as well as the increase in the overall content of anthocyanins, while with regard to the content of individual anthocyanins in wine, the pattern is relatively kept with petunidin and malvidin. The sensory evaluation of test wines using the method of ranking, showed that the wines from the longest period of maceration were each time (100%) rated as the worst, wines from the medium period of maceration were ranked the best in 25% of the cases and the wines from the shortest period of maceration were rated the best in 75% of the cases.

**Key words:** *Plavac mali, maceration, polyphenols, anthocyanins, wine quality*

## Energetska vrijednost i godišnji prirast drvene mase nekih kultivara vinove loze (*Vitis vinifera* L.) na različitim podlogama

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### Sažetak

Istraživanje energetske vrijednosti i godišnjeg prirasta drvene mase nekih kultivara vinove loze na različitim podlogama provedeno je tijekom 2015. godine na području vinogradarske regije Istočna kontinentalna Hrvatska, podregija Slavonija, vinogorje Đakovo, položaj Mandićevac. Cilj istraživanja bio je utvrditi utjecaj podloge na energetska vrijednost i godišnji prirast drvene mase različitih kultivara vinove loze. Pri izvođenju pokusa korišteno je pet vinskih sorata (Rajnski rizling, Graševina, Sauvignon bijeli, Traminac i Chardonnay), koje su cijepljene na dvije različite podloge. Reprezentativni uzorci drvene mase su uzeti slučajnim odabirom. Osušeni uzorci su izvagani, te im je izmjerena energetska vrijednost. Najmanja masa orezanog drva izmjerena je kod sorte Traminac na klonu SI 8 i podlozi SO4, a iznosila je 0,04 kg. Najveća masa orezanog drva izmjerena je kod Sauvignona bijelog i iznosi 0,44 kg. Najmanja energetska vrijednost utvrđena je kod sorte Rajnski rizling na klonu SI24 i podlozi SO4, a iznosila je 17219 J/g. Najveća energetska vrijednost utvrđena je kod sorte Graševina klon SI 11, podloga Kober 5BB te iznosi 18005 J/g. Nisu utvrđene statistički značajne razlike utjecaja podloge na energetska vrijednost i godišnji prirast drvene mase. Dobiveni rezultati se odnose na jednogodišnje istraživanje, za kvalitetniju procjenu utjecaja podloge na istraživane pokazatelje, trebalo bi istraživanje nastaviti na više godina i lokacija.

**Ključne riječi:** energetska vrijednost, drvena masa, podloga, klon



## **Energy value and annual increment of some varieties of grapevine (*Vitis vinifera* L.) on different rootstocks**

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### **Summary**

The investigation of energy value and annual increment of the wood mass of some grapevine cultivars on different rootstocks was carried out in 2015. in the wine region of Eastern continental Croatia, subregion Slavonia, Đakovo vineyards, position Mandićevac. The aim of the research was to determine the influence of the rootstocks on the energy value and the annual increment of the wood mass of different grapevine cultivars. During the experiment five grape varieties (Rhine riesling, Welsh riesling, Sauvignon blanc, Traminer and Chardonnay) grafted on two different rootstock, were used. Representative samples of wood mass were taken by random selection. Energy value and weight was measured on dried samples. The lowest energy value was found in the Rhine riesling variety on the SI-24 clone (SO4 rootstock), 17219 J/g. The highest energy value was measured in the Welsh riesling clone SI-11 (Kober 5BB rootstock), 18005 J/g. The lowest wood mass was measured in the Traminer variety on the SI-8 clone (SO4 rootstock), 0.04 kg. The largest mass of wood was measured on Sauvignon blanc, 0.44 kg. This experiment did not establish significant impact of rootstocks on the mass of pruned wood or on their energy value.

**Key words:** *energy value, wood mass, rootstock, clones*

## Utjecaj kalcija na fizikalno-kemijska svojstva plodova trešnje 'Regina' i 'Sweetheart'

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### Sažetak

Folijarno tretiranje kalcijem smanjuje pucanja plodova i utječe na fizikalno kemijska svojstva plodova. Cilj istraživanja bio je utvrditi fizikalno-kemijska svojstva plodova trešnje kultivara 'Regina' i 'Sweetheart' nakon različitih tretmana (tretman 1 - jedno folijarno tretiranje 2%-tnom otopinom kalcija, tretman 2 - dva folijarna tretiranja 2%-tnom otopinom kalcija, kontrola – bez tretiranja kalcijem). Utvrđene su statistički značajne razlike u djelovanju kalcija na istraživana svojstva ovisno o kultivaru. Najveća masa i širina utvrđena je kod plodova kontrole kultivara 'Sweetheart', a značajno najmanja masa, širina i visina plodova kod plodova u tretmanu 1 kultivara 'Sweetheart'. Duljina peteljke je bila značajno veća u plodovima tretmana i kontrole kultivara 'Regina', dok je debljina peteljke bila značajno veća u svim tretmanima i kontroli kultivara 'Sweetheart'. Tretmani kalcijem su pozitivno utjecali na tvrdoću plodova kultivara 'Regina' koje je bila veća u odnosu na plodove kontrole, dok su kod kultivara 'Sweetheart' plodovi kontrole imali najveću tvrdoću u odnosu na druge tretmane i kultivar 'Regina'. Značajno veći udio topljive suhe tvari i ukupnih kiselina utvrđen je kod plodova kultivara 'Sweetheart', a plodovi kontrole i jednog i drugog kultivara su imali veći udio topljive suhe tvari u odnosu na tretmane. Tretmani kalcijem su utjecali na smanjenje mase i dimenzije plodova, kao i na udio topljive suhe tvari u plodovima.

**Ključne riječi:** trešnja, 'Regina', 'Sweetheart', fizikalno-kemijska svojstva, kalcij

## Effect of calcium on physicochemical characteristics of sweet cherry fruit 'Regina' and 'Sweetheart'

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### Summary

Calcium spraying reduces fruit cracking and effects on physicochemical fruit characteristics. Aim of the research was to determine physicochemical characteristics of sweet cherry fruit cultivars 'Regina' and 'Sweetheart' after different treatments (treatment 1 – one 2%-calcium solution spraying, treatment 2 – two 2%-calcium solution sprayings, control – without calcium treatment). Fruit mass and size was higher in control, while significantly smaller fruit mass and size was in treatment 1 of cultivar 'Sweetheart'. Peduncle length was significantly longer in control and both treatments of cultivar 'Regina', while peduncle thickness was larger in control and treatments of cultivar 'Sweetheart'. Calcium treatments had higher fruit firmness than control of cultivar 'Regina', while fruit in control of cultivar 'Sweetheart' had highest firmness compared to calcium treatments and to cultivar 'Regina'. Significantly higher proportion of soluble solids and total acids was determined at fruit of cultivar 'Sweetheart'. Control of both cultivars had higher proportion of soluble solids compared to calcium treatments. Calcium treatments had effects on fruit mass and size decreasing, as well on proportion of soluble solids.

**Key words:** *sweet cherry, 'Regina', 'Sweetheart', physicochemical characteristics, calcium*

## Comparison of Istrian and Dalmatian virgin olive oils based on aroma and phenol profiles

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### Summary

With the aim to compare monovarietal virgin olive oils (VOO) produced from native varieties in two main Croatian olive growing areas, Istria (IS) and Dalmatia (DA), samples from harvest 2015 were collected from producers, and subjected to HS-SPME-GC/MS analysis of volatile aromas, and HPLC-DAD analysis of phenols. Hydrocarbon concentrations were generally significantly higher in IS. Terpenes, such as  $\gamma$ -terpinene, ocimenes, linalool, and  $\gamma$ -elemene, were more abundant in DA, while (+)-cycloisoterpene and  $\alpha$ -farnesene in IS. IS contained higher amounts of *green* aldehydes and ketones, such as important lipoxygenase products (*E*)-2-pentenal, (*E*)-3-hexenal, (*E*)-2-hexenal, and 1-penten-3-one, while DA were richer in hexanal. Among alcohols, IS were distinguished mostly by 1-penten-3-ol and (*Z*)-2-penten-1-ol, and DA by 3-methyl-1-butanol, 1-pentanol, and (*Z*)-3-hexen-1-ol. Short-chain acids were significantly higher in DA, and medium-chain acids in IS. (*Z*)-3- and (*Z*)-2-hexen-1-yl acetate characterised IS VOO. Benzenoid *p*-cymenene, acetophenone, and 4-ethylbenzaldehyde levels were higher in IS, while methyl benzoate, methyl salicylate, and benzyl alcohol in DA. Among phenols, IS had significantly higher concentrations of vanillin, apigenin, and pinoresinol, while hydroxytyrosol, its acetate, coumaric acid, luteolin, secologanoside, and an elenolic acid glucoside were more abundant in DA.

This work has been supported in part by Croatian Science Foundation under the project UIP-2014-09-1194.

**Key words:** virgin olive oil, Istria, Dalmatia, aromas, phenols

## A retrotransposon-inserted *VvmybA1a* allele analysis of Armenian and Croatian grapevines

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### Summary

Retrotransposons are retrovirus-related mobile elements having the potential to replicate via RNA intermediates and to increase the genome size by insertion into new sites. *Gret1* retrotransposon, has been identified as key factor in fruit colour variation in cultivated grape (*Vitis vinifera* L.) and produced *VvMybA1* gene silencing due to insertion into the promoter region. The aim of the presented research was determination of the presence and distribution of the *VvmybA1a* allele in the Armenian and Croatian grapevine cultivars, which would provide new information on the genomic relationships among these species and on the evolutionary differentiation of the genus *Vitis*. Thirty six Armenian and thirty six Croatian indigenous grape varieties and hybrids with different skin colours were analyzed. Genomic DNA was extracted using Qiagen DNA Plant Mini Kit (Qiagen, Hilden, Germany) and used as a template for PCR. As expected, for all analyzed white cultivars originated from Armenia and Croatia, we detected the presence of the null *VvMybA1a* allele. The expression of *VvMybA1* gene is blocked in the accessions holding the *VvMybA1a* allele, containing a retrotransposon, upstream of the *VvMybA1*-coding sequences. According to the obtained results all colored grapevines from Croatia, except 'Gegic' indigenous wine variety, were heterozygous for the non-functional allele. These data confirmed that the trait coloured berries is dominant. Among the colored grapevines from Armenia, only varieties carried out non-functional *VvMybA1a* allele, were 'Karmir Qishmish' and 'Vardaguyn Yerevani' table grapes with red-rose colored berries. The other coloured Armenian varieties supposed to be homozygous for the functional alleles. We analysed only the *VvmybA1a* allele and only in a limited number of varieties or cultivars. Further analyses using the other *VvmybA1* alleles and a wide range of species and accessions in the genus *Vitis*, and especially in *V. sylvestris*, will be necessary to clarify the genomic relationships and evolutionary differentiation of *Vitis* species.

**Key words:** grapevine, *Gret1* retrotransposon, *VvmybA1a* allele, non-functional allele

## ***In vitro* propagation of *Vitis vinifera* L. variety ‘Yereskheni’**

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### **Summary**

Grapevine is one of the most important fruit crops in Armenia. The objective of this study was to optimize a protocol for *in vitro* propagation of indigenous rare table and wine grapevine variety 'Yeraskheni'. Nodal segments were used as explants. Various sterilization agents are used to decontaminate the tissues. Solid Murashige and Skoog medium (MS) supplemented with various concentrations and combinations of 6-Benzylaminopurine (BAP), Kinetin and Gibberellic acid (GA<sub>3</sub>) was used for regeneration. For *in vitro* rooting, individual shoots were excised from the proliferated shoots cultures and implanted onto half strength MS with different concentrations and combinations of auxins (NAA, IBA and IAA). Sterilization of explants using 1.0% of Calcium hypochlorite for 10 min duration was optimum. In this case 65.0% sterile explants were received. No shoot regeneration was observed in the absence of plant growth regulators. The highest shoot regeneration frequency (69.2 %) with highest number of shoots(5.2) per explant was observed on medium containing 0.5 mg/L BAP+ 0.3 mg/L Kin + 1.0 mg·L<sup>-1</sup> GA<sub>3</sub>. The presence of GA<sub>3</sub> in the medium had a positive effect on the shoot length. The root induction was observed for all the treatments used, but good roots were found on MS medium supplemented with 0.8 mg/L of IBA. The plantlets were acclimatized in the glasshouse and survival percentage was 87.0%. Thus, the achievements of this study will play a great role in the grapevine culture program and for the conservation of germplasm.

**Key words:** *in vitro*, explants, grapevine, micropropagation, regeneration

## Preliminarni rezultati o utjecaju mehaničkog prorjeđivanja cvjetova na urod i kvalitetu ploda šljive

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### Sažetak

U proizvodnji voća prorjeđivanje je vrlo važno kako bi se postigla proizvodnja sa optimalnim brojem plodova po stablu visoke kvalitete. Ukoliko prorjeđivanje izostane plodovi su manjeg kalibra i lošije kvalitete. Prorjeđivanje plodova šljive uglavnom se obavlja ručno što je skupo i ekonomski neisplativo, stoga su smanjenje rada i troškova u voćnjaku jedan od prioriteta komercijalnih uzgajivača šljiva. U ovom istraživanju, mehanički stroj za prorjeđivanje, Darwin, korišten je za prorjeđivanje šljive. Mehaničko prorjeđivanje sa Darwinom novi je način prorjeđivanja u proizvodnji šljiva. Uređaj je korišten za prorjeđivanje šljive u vrijeme pune cvatnje kako bi se smanjio broj cvjetova prije formiranja plodova. Cilj istraživanja bio je ispitati utjecaj mehaničkog prorjeđivanja cvjetova na urod i kvalitetu ploda šljive. Istraživanje je provedeno na Poljoprivrednom institutu Osijek, pokusnom nasadu Tovljač, tijekom sezone 2017. godine na kultivarima Stanley i Čačanska ljepotica. Oba kultivara su cijepljena na podlogu Prunus myrobalana, posađena su 2000. godine na razmak 4x1,5 metara. Uzgojni oblik bio je vretenasti grm. U pokusu je kontrola sa ručnim prorjeđivanjem korištena za usporedbu sa mehaničkim prorjeđivanjem pomoću Darwina, sa brojem okretaja od 320 i 340 r.p.m. i brzini kretanja traktora 8 km/h. Ovo istraživanje je provedeno u sklopu VIP projekta „Suvremene tehnologije uzgoja šljive“ (2016.-2018.). Rezultati istraživanja pokazuju da je mehaničko prorjeđivanje sa Darwinom smanjilo urod po stablu kod oba kultivara u odnosu na kontrolu. Prosječna masa ploda oba kultivara se povećala povećanjem brzine rotora. Vrijednosti tvrdoće ploda i TST (topive suhe tvari) su također veće u tretmanima sa mehaničkim prorjeđivanjem u odnosu na kontrolu. Budući da projekt traje dvije vegetacijske sezone ovo istraživanje nam daje preliminarne podatke o mehaničkom prorjeđivanju cvjetova šljive i pokazalo je da mehaničko prorjeđivanje cvjetova ima potencijala u proizvodnji šljive kao alternativa ručnom prorjeđivanju.

**Ključne riječi:** šljiva, mehaničko prorjeđivanje, Darwin, Čačanska ljepotica, Stanley

## Preliminary results on the effect of mechanical bloom thinning on yield and fruit quality in plum fruits

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### Summary

In fruit production thinning is very important to achieved production with optimal fruit number per tree of high quality. In the absence of thinning, the fruits are smaller caliber and of lower quality. Thinning of plum fruit is mostly still done by hand which is costly and not an economically viable, therefore reducing labour and costs in the orchards is one of priorities for commercial plum growers. In this experiment, the mechanical string thinner, Darwin, was used for thinning of plum trees. Mechanical blossom thinning with Darwin is a new thinning option for plum production. This machine was used to thin plum trees during full bloom, to reduce the number of flowers before fruit set. The objective of this study was to evaluate the influence of mechanical thinning at bloom on plum yield and fruit quality. The trial was performed at the Agricultural institute Osijek, on experimental orchard Tovljač during the 2017 season, on the cultivars Stanley and Čačanska ljepotica. Both cultivars were grafted to *Prunus myrobalana* rootstock and planted in 2000 at a spacing of 4 x 1.5 m. Training system was spindle bush. In trail hand-thinned control was used for compared to mechanical thinning performed with the Darwin, at rotor speeds of 320 and 340 r.p.m. and 8 km/h vehicle speed. This research was done as part of the VIP project „Modern technologies of growing plums“(2016-2018). Results showed that mechanical thinning with Darwin decreased the total yield per tree in both cultivars compared to the control. Average fruit weight increased with increasing in rotor speed. Fruit firmness and TST (total soluble solids) in treatment with mechanical thinning also increased in both cultivars compared to control. This study provides preliminary data about mechanical blossom thinning of plum and it demonstrated that mechanical blossom thinning have potential in plum production as alternative to hand thinning.

**Key words:** plum, mechanical thinning, Darwin, Čačanska ljepotica, Stanley



## Sastav fenola u svježem plodu, sušenom plodu i soku tradicionalnih i otpornih sorti jabuka uzgojenih u intenzivnom sustavu proizvodnje

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### Sažetak

U istraživanju su uspoređene tradicionalne (Ovčji nos, Mašanka i Zlatna zimska parmenka) s otpornim (Topaz®, Pinova® i Querina-Florina) i komercijalnim sortama (Gala, Golden Delicious, Idared) u sustavu intenzivne proizvodnje s ciljem bolje procjene potencijala i pogodnosti plodova sorti za daljnju preradu te za implementaciju ekološki prihvatljivije proizvodnje pojedinih sorti jabuka u intenzivnom sustavu uzgoja. Pokus je proveden u pokusnom voćnjaku Zavoda za voćarstvo, Hrvatskog centra za poljoprivredu, hranu i selo. U vrijeme optimalnog roka berbe za svaku sortu zasebno, dio plodova sorti jabuka u istraživanju je posušen u sušari M.Bucher AG Typ 20, a dio je iskorišten za dobivanje soka u sklopu tvrtke LuPo-Voćni sokovi d.o.o. Na svježim i sušenim plodovima kao i u soku jabuka zasebno je određivan sadržaj ukupnih fenola (UF) i ukupnih hidroksicimetnih kiselina (UHK). Sadržaj UF bio je u prosjeku niži u soku, a slijede svježi te sušeni plod (96,60; 130,23; 470,49 mg/100gFW). Sorte su se razlikovale s obzirom na sadržaj UF pri čemu je kod komercijalnih utvrđen u prosjeku manji sadržaj UF, a slijede otporne te tradicionalne sorte, osim Mašanke koja je imala niži sadržaj UF od ostalih tradicionalnih i Topaza kod kojeg je utvrđen veći sadržaj od ostalih otpornih sorti. Sadržaj UHK također je bio najmanji u soku, a slijedi svježi te sušeni plod (22,39; 31,51; 101,76 mg/100gFW). Komercijalne i otporne sorte su u prosjeku imale niži, dok su sve tradicionalne imale značajno veći sadržaj UHK.

***Ključne riječi:*** jabuka, tradicionalne sorte, otporne sorte, ukupni fenoli

## Phenol content in fresh and dried fruit and juice of traditional and resistant apple varieties grown in intensive production system

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### Summary

Comparison of traditional apple cultivars (Ovčji nos - Schafnase, Mašanka - Marschankker and Zlatna zimna parmenka - Goldparmäne) with resistant (Topaz®, Pinova® and Querina-Florina) and commercial cultivars (Gala, Golden Delicious, Idared) in the integrated production system was performed in this research. Main goal was to better evaluate potential and suitability of fruits for further processing and implementation of ecologically applicable production of particular apple cultivars in intensive production system. Trial was implemented in the experimental orchard of the Institute of Pomology of the Croatian Centre for Agriculture, Food and Rural Affairs. At optimal harvest window for each cultivar, one part of fruit samples were dried in M.Bucher AG Typ 20 dryer and other portion was used for juice extraction at premises of LuPo-Voćni sokovi d.o.o. In fresh fruits, dried apple slices and in apple juice, content of total phenols (TP) and total hydroxycinnamic acids (THA) was identified. Content of TP was in average lower in juice extracts, followed by fresh fruits and dried apple slices (96.60; 130.23; 470.49 mg/100gFW). Cultivars differed in TP content whereas commercial cultivar had in average lower TP content, followed by resistant and traditional cultivars, except cv Mašanka - Marschankker which had lower TP in comparison to other traditional cultivars and cv Topaz which had higher TP content than other resistant cultivars. THA content was also the lowest in apple juice, followed by fresh fruits and dried apple slices (22.39; 31.51; 101.76 mg/100gFW). Commercial and resistant cultivars in average had lower, whereas traditional had significantly higher THA content.

**Key words:** *apple, traditional varieties, intensive cultivation, total phenols*

## Razvoj octenih muha (Diptera, Drosophilidae) u plodovima različitih sorata jagode

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### Sažetak

Octene muhe nisu se smatrale poljoprivrednim štetnicima jer se razvijaju u prezrelim i fermentiranim plodovima. S dolaskom invazivne vrste *Drosophila suzukii* (Matsamura, 1931.) u Europu, status octenih muha se promijenio jer se vrsta može razvijati u zdravim, neoštećenim plodovima u zriobi te uzrokovati ekonomske štete u proizvodnji voća mekanog eksokarpa tj. kožice ploda. Prve ekonomske štete od vrste *D. suzukii* u Hrvatskoj zabilježene su 2016. godine u proizvodnji jagode. Cilj ovog istraživanja bio je odrediti vrste octenih muha koje se razvijaju u plodovima jagode. Uzorci plodova tri sorte jagoda ('Albion', 'Portola' i 'San Andreas') prikupljeni su u blizini Zagreba u plasteniku (N 45° 41' 24", E 16° 24' 0") tijekom sezone berbe u 2016. godini. Slučajnim odabirom prikupljeno je 50 uzoraka potpuno zrelih plodova svake sorte, koji su smješteni u komoru za razvoj kukaca na određeni režim temperature i vlage. Nakon razvoja, identificirane su tri vrste octenih muha: *Drosophila immigrans* Sturtevant, 1921; *Drosophila simulans* Sturtevant, 1919 i *D. suzukii*. Analizom varijance utvrđeno je statistički više octenih muha u plodovima sorte 'Albion' u odnosu na ostale dvije sorte. Rezultati istraživanja pokazali su da se vrste *D. immigrans* i *D. simulans* također mogu razvijati u jagodama i oštetiti plodove ako su plodovi primarno oštećeni od vrste *D. suzukii* kao i da octene muhe za razvoj preferiraju sortu 'Albion'.

**Ključne riječi:** octene muhe, *Fragaria* × *ananassa* Duchesne, proizvodnja, štete

## The development of Drosophilid species (Diptera, Drosophilidae) in different strawberry cultivars

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### Summary

Drosophilids were not considered to be agricultural pests as they develop in overripe and fermented fruits. With the arrival of invasive species of *Drosophila suzukii* (Matsamura, 1931) in Europe the status of drosophilids was changed as the species is able to develop in healthy, unwounded and ripening fruits causing economic losses in production of soft-skinned fruits. The first economic damages from *D. suzukii* in Croatia were observed in production of fresh market strawberry. The aim of this study was to determine which species of drosophilids can develop in strawberry fruits. The samples of fruits of three strawberry cultivars ('Albion', 'Portola' and 'San Andreas') were collected during the harvest season of 2016 at greenhouse cultivation farm near Zagreb (N 45° 41' 24", E 16° 24' 0"). From each cultivar 50 samples of fully ripened fruit were randomly selected and placed into the chamber for insect development to a specific temperature and humidity regime. After development of flies, three drosophilid species: *Drosophila immigrans* Sturtevant, 1921; *Drosophila simulans* Sturtevant, 1919 and *D. suzukii* were identified. An analysis of variance showed statistically more drosophilids in cultivar 'Albion' compared to the other two cultivars. It was concluded that species *D. immigrans* and *D. simulans* can also develop in strawberries and damage the fruits if the fruit is primarily damaged by *D. suzukii* and also that drosophilids prefer the cultivar 'Albion' for development.

**Key words:** drosophilid flies, *Fragaria × ananassa* Duchesne, production, damages

## Prisutnost okratoksigenih gljivica u vinogradima Sjeverne i Srednje Dalmacije

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### Sažetak

Količina okratoksina A (OTA), sekundarnog metabolita nekih vrsta gljivica rodova *Aspergillus* i *Penicilium*, ograničena je u zemljama EU u hrani, krmivima i vinu Uredbom EC 1881/2006 zbog toksičnosti za ljude i životinje. OTA je čest kontaminant sjemenki žitarica, suhomesnatih proizvoda te vina i piva. Najvažnijim uzročnicima kontaminacije vina smatraju se *A. carbonarius* i *A. niger*. U proizvodnji vina OTA može predstavljati ozbiljan problem za komercijalnu vrijednost vina, a kontaminaciji su izložena crna vina južnog dijela Europe. Dalmacija se prema kartama rizika kontaminacije vina nalazi na granici između zona umjerenog i visokog rizika. S toga je provedeno istraživanje prisutnosti okratoksigenih gljivica u vinogradima Sjeverne i Srednje Dalmacije u proljeće i ljeto 2016. i 2017. godine. Uzorkovani su listovi, bobice i tlo na 5 lokacija i izolirana je mikoflora. Kulture morfološki identificirane kao potencijalni proizvođači OTA testirane su na proizvodnju toksina. Proizvođači OTA bili su prisutni u svim vinogradima, no njihova pojavnost je bila vrlo niska, a količine OTA u moštu i vinima proizvedenim tih godina bile su, u svim uzorcima, ispod limita osjetljivosti metode (10 ng/l). Rezultati ovog istraživanja ukazuju da je rizik kontaminacije vina u Sjevernoj i Srednjoj Dalmaciji nizak, no prisutnost okratoksigenih gljivica ukazuje da je potrebno podizati svijest o ovom problemu kod vinara i vinogradara.

**Ključne riječi:** okratoksin A, Sjeverna i Srednja Dalmacija, crno vino

## The presence of ochratoxigenic fungi in vineyards of North and Central Dalmatia

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### Summary

Presence of ochratoxin A (OTA), secondary metabolite of some fungi of the genus *Aspergillus* and *Penicillium* in feed, food and wine, is limited in EU countries by EC regulation 1881/2006 due to its toxic effects for humans and animals. OTA is reported as contaminant of various commodities including wine. The most important species causing contamination of wine contaminants are *A. carbonarius* and *A. niger*. In wine production OTA could present a serious problem due to sanitary and economic devaluation of the product, and the contamination is major issue in southern part of Europe. According to the OTA risk in grapes maps, northern and central Dalmatia are on the border between the medium and the high risk zone. To evaluate the risk of OTA contamination in wine, during the spring and summer of 2016 and 2017 the samples of leaves, grains and soil were taken in 5 different vineyards and mycoflora was isolated and determined. Potentially ochratoxigenic fungi were tested for OTA production. OTA producers were isolated in all vineyards, but their occurrence was low, and analysis of OTA presence in must and wine showed the quantities under the sensibility of the method (10 ng/l). Results of this study indicate that the risk of contamination of black wines in North and Central Dalmatia is low, but the presence of ochratoxigenic fungi suggests that it is necessary to raise awareness of this problem with winemakers.

**Key words:** *Ochratoxin A, North and Central Dalmatia, red wine*

## Razvoj sintetskih kimera vinove loze

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### Sažetak

Kimere su biljke kod kojih su prisutna tkiva najmanje dviju različitih genotipova u različitim slojevima meristema, a time i u organima koji se iz njih razvijaju. Mnoge sorte i klonovi vinove loze koje su danas značajne u proizvodnji su periklinalne kimere koje su nastale spontano zbog mutacija u jednom od slojeva apikalnog meristema (Pinot crni, sivi i meunier, neki klonovi sorte Chardonnay, Plavac mali sivi i sl.). Za razliku od kimera koje su nastale mutacijama postoje i tzv. međuvrsne ili međusortne kimere koje su sastavljene od dvaju različitih genotipova koji pripadaju različitim vrstama tj. sortama. Sintetske kimere imaju veliki potencijal u oplemenjivanju kod vinove loze, ali i u istraživanjima vezanim uz autonomne i neautonomne stanične procese kao i praćenje kretanja molekularnih informacija kod neautonomnih staničnih procesa. Provedeno je istraživanje o mogućnosti dobivanja i detekcije sintetskih kimera različitih sorata vinove loze: Cabernet sauvignon (CS), Chardonnay (C) i Babić (B) korištenjem kulture tkiva. U početnoj fazi istraživanja utvrđeni su uvjeti za uspješnu organogenezu pojedinačnih sorata. Nakon toga organogeneza je inducirana iz tkiva nakon kontaktno uzgajanih parova genotipova (CSxC i CSxB) pri čemu je dobiveno (aklimatizirano) ukupno 260 biljaka. Sve su biljke analizirane korištenjem mikrosatelitskih (SSR) markera pri čemu rezultati kod 8 biljaka sugeriraju kako se unutar njih nalaze dva genotipa, tj. kimerizam. Istraživanje je nastavljeno kako bi se utvrdilo status kimeralnih biljaka, tj. vrsta kimerizma, korištenjem kombinacije fenotipskih opažanja i genetičkih analiza.

**Ključne riječi:** *vinova loza, sintetske kimere, oplemenjivanje, kultura tkiva, mikrosatelitski markeri*

## Development of Grapevine Synthetic Chimeras

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### Summary

Chimeras are plants which contain tissues of at least two genotypes in different cell layers, as well as in organs which are developed from them. Many grapevine cultivars and clones important for viticulture production today are periclinal chimeras which have evolved spontaneously because of the mutations in one layer of apical meristem (Pinot noir, grey and meunier, some clones of cultivar Chardonnay, Plavac mali grey etc.). In comparison with chimeras that have evolved from mutations, there are also so-called intra- and interspecific chimeras, which are consisted from two different genotypes originated from different cultivars or species. Grapevine synthetic chimeras have huge potential for breeding, but also for investigation of cell autonomous vs non-cell autonomous developmental programs and track the movement of non-cell autonomous molecular information. Research on possibility of synthetic chimeras development and detection was conducted using three different grapevine cultivars: Cabernet sauvignon (CS), Chardonnay (C) i Babić (B) using tissue culture. In the first stage of the research, conditions for successful organogenesis were determined for individual cultivars. After this organogenesis was induced from tissue after contact growth of two pairs of genotypes (CSxC i CSxB), and this way 260 plants were developed (acclimatized). All of the plants were analysed using microsatellite (SSR) markers for grapevine and results for eight plants suggesting that they are composed of two different genotypes, ie. chimeras. Research on type of chimerism using combination of phenotyping and genotyping is in progress.

**Key words:** grapevine, synthetic chimeras, breeding, tissue culture, microsatellite markers



## Klimatski uvjeti Primorske Hrvatske i njihov utjecaj na sortu Plavac mali

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### Sažetak

Klimatski uvjeti predstavljaju jedan od najvažnijih čimbenika koji utječu na vinovu lozu te određuju je li neko područje prikladno za uzgoj vinove loze, odnosno u kojoj mjeri će neka sorta na određenom području iskazati svoj potencijal. Vinogradarska područja Hrvatske, prema prirodnim uvjetima za uzgoj vinove loze, dijele se na regije Istočna kontinentalna Hrvatska, Zapadna kontinentalna Hrvatska i Primorska Hrvatska. Prema sumi efektivnih temperatura u vegetacijskom razdoblju, regija Primorska Hrvatska smještena je u klimatsku zonu CII (1941-2220 °C). Prema podacima Agencije za plaćanja u poljoprivredi ribarstvu i ruralnom razvoju, najzastupljenija i najznačajnija crna sorta Hrvatske je Plavac mali, izvorna hrvatska sorta s izuzetnim kvalitativnim potencijalom. U ovome radu biti će prikazani podaci s meteoroloških postaja Državnog hidrometeorološkog zavoda (1961.-2017. g.), trendovi za 30-godišnja razdoblja (1961.-1990., 1988.-2017.) te Winklerov (GDD ili WI) i Huglinov (HI) agroklimatski indeksi. Tijekom berbi 2016. i 2017., u odabranim referentnim vinogradima unutar regije ubrani su uzorci tehnološki zrelog grožđa. Grozdovi i bobice izmjereni su i vagani, a analizom mošta dobivene su vrijednosti koncentracije šećera, ukupne kiselosti te vrijednosti pH. Rezultati istraživanja koristit će se za procjenu prikladnosti potencijalnih područja za uzgoj sorte Plavac mali, te će biti uspoređeni s trenutnom rasprostranjenosti sorte unutar regije Primorska Hrvatska.

**Ključne riječi:** klima, agroklimatski indeksi, vinova loza, Plavac mali

## Climate conditions in Coastal Croatia and their influence on grapevine variety Plavac mali

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### Summary

Climate conditions are one of the most important factors affecting wine, determining whether an area is suitable for planting of a vineyard, and how will express its quality potential. Based on natural conditions, Croatia is divided into viticulture regions: Eastern Continental Croatia, Western Continental Croatia and Coastal Croatia. According to the sum of effective temperatures in the vegetative period, region Coastal Croatia is located in climatic zone CII (1941 to 2220 °C). According to the official data of Payment Agency for Agriculture, Fisheries and Rural Development, the most important red wine variety in Croatia is Plavac mali, indigenous variety of Croatia with extraordinary quality potential. In this paper, data from the meteorological stations of the Meteorological and Hydrological Service of Agriculture (periods from 1961 to 2014), trends over 30 year periods (1961-1990, 1988-2017) and agroclimatic indices: Growing degree-days (GDD or WI) and Heliothermal index (HI) will be presented. During the harvest in 2016 and 2017, we collected samples of grapes in chosen vineyards throughout the region. Clusters and grape berries were measured and weighed, and by analyzing the must we obtained values of sugar concentration, acidity and pH. The results of this study will be used to evaluate the suitability of potential wine growing areas for cultivation of variety Plavac mali, and to compare it with its current distribution in the region of Coastal Croatia.

**Key words:** climate, agroclimatic indices, grapevine, Plavac mali

## Antioksidativni odgovor na NaOCl i pH u presadnicama malina iz TIB sustava

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### Sažetak

U standardnoj tehnologiji proizvodnje sadnog materijala *in vitro* kao i uporabom novih poboljšanih TIB sustava vrlo često dolazi do oksidativnog stresa i oštećenja staničnih struktura biljnog tkiva. Termalna destrukcija visoko koncentriranih otopina šećera u postupku autoklaviranja pod visokim pritiskom dovodi do ubrzane degradacije šećera (saharoze) hidrolizom pri čemu nastaje toksičan HMF (5-hydroxymethylfurfural). Također dolazi do ireverzibilnog snižavanja pH uslijed sinteze organskih kiselina (mravlja, mliječna i levulinska) koji imaju vrlo izražen inhibitorni efekt na rast biljaka. Cilj istraživanja bio je utvrditi antioksidativni odgovor analizom tkiva malina pri čemu razina lipidne peroksidaze predstavlja jedan je od najčešće prihvaćenih biomarkera oksidacijskog stresa. Tijekom 2017. godine na Poljoprivrednom fakultetu Osijek provedeno je ispitivanje mogućnosti stabilizacije tekućeg hranjivog medija bez autoklaviranja kod multiplikacije malina u sustavu submerznih bioreaktora (TIB). Modifikacija DKW tekućeg medija izvršena podešavanjem razine pH (6,2 i 7,2) uz dodavanje 0,03% NaOCl. Kao kontrola analizirane su biljke malina multiplicirane standardnim postupkom u staklenim teglama na polučvrstom mediju (DKW, pH 6,2). Na kontrolnom tretmanu utvrđena razina lipidne peroksidaze je značajno viša u odnosu na tretmane iz TIB sustava. Međutim, nema značajne razlike u ukupnom sadržaju fenola i ukupnoj antioksidativnoj aktivnosti između kontrole i oba tretmana iz TIB sustava. Daljnja istraživanja potrebno je usmjeriti na uspostavljanje boljeg antioksidativnog statusa tretiranih biljaka i različitih antioksidacijskih parametara. Ovo istraživanje je provedeno u sklopu VIP projekta „Suvremene tehnologije proizvodnje voćnih sadnica“ (broj 2016-14-55).

**Ključne riječi:** Antioksidativni odgovor, maline, TIB sustav

## Antioxidant response to NaOCl and pH in raspberries transplants from TIB System

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### Summary

The standard technology of in vitro planting material production and also the use of new improved TIB systems often results in oxidative stress and damage to cellular structure of plant tissue. Thermal destruction of highly concentrated sugar solutions under high pressure autoclaving processes leads to accelerated degradation of sugar (sucrose) by hydrolysis, resulting in formation of toxic HMF (5-hydroxymethylfurfural). There is also an irreversible decrease in pH due to synthesis of organic acids (formic, lactic and levulinic) which have a very pronounced inhibitory effect on plant growth. The aim of the study would be to determine the antioxidant response by analyzing raspberry tissue, whereby the level of lipid peroxidase is one of the most widely accepted biomarkers of oxidative stress. In 2017, the Faculty of Agriculture Osijek conducted a study of the possibility of stabilizing the liquid nutrient media without autoclaving in the multiplication of raspberries in the Temporary Immersion Bioreactor system. Modification of the DKW liquid medium was effected by adjusting the pH level (6.2 and 7.2) with 0.03% NaOCl added. As control, the raspberry plants were multiplied by standard procedure in glass jars on semi-solid medium (DKW, pH 6.2). The level of lipid peroxidase found in control treatment is significantly higher in relation to treatments from the TIB system. However, there is no significant difference in the total phenol content and overall antioxidant activity between the controls and both treatments from the TIB system. Further research needs to be focused on establishing better antioxidant status of treated plants and different antioxidant parameters.

This work has been supported in part by VIP project „Contemporary technology in the production of fruit seedlings“ (number 2016-14-55).

**Key words:** Antioxidant response, raspberries, TIB System

## **Potencijal rasta, rodnosti i kvalitete grožđa cv. 'Plavac mali' (*Vitis vinifera* L.) u uvjetima melioriranog krša**

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### **Sažetak**

U posljednjem desetljeću najzastupljenija autohtona sorta jadranskog priobalja 'Plavac mali' sadi se na nove položaje i u supstrat koji se razlikuje od tradicionalnih vinograda. U cilju istraživanja utjecaja specifičnosti supstrata melioriranog krša na vegetativni potencijal trsa kao i na kvantitativne i kvalitativne komponente grožđa provedeno je istraživanje u vinogradima 'Plavca malog' na položaju „Dingač“ i „Rota“. Prosječni prinos grožđa bio je veći u vinogradima na melioriranom kršu. Utvrđeno je da je vegetativni potencijal trsa ujednačen. Rezultati za prosječnu masu grozda pokazali su veliku varijabilnost gdje su zabilježene niske vrijednosti ovog parametra u vinogradu na melioriranom kršu. Dobile su prosječno veće vrijednosti šećera u grožđu iz tradicionalnih vinograda u odnosu na sadržaj u grožđu s melioriranog krša. Prosječna razina sadržaja ukupnih kiselina bila je značajno niža u grožđu s tradicionalnih vinograda dok je pH vrijednost značajno veća u odnosu na grožđe s melioriranog krša. Dobiveni rezultati pokazali su da nema statistički značajnih razlika u pokazateljima potencijala rodosti i mehaničkom sastavu grozda kao ni u sadržaju šećera. Međutim sadržaj ukupnih kiselina značajno je veći u moštu iz vinograda s melioriranog krša u odnosu na sadržaj iz tradicionalnih vinograda što ima veliki značaj kod njege i čuvanja vrhunskih vina proizvedenih od sorte 'Plavac mali'.

***Ključne riječi:*** prinos, sadržaj šećera, ukupne kiseline, pH

## **The potential growth, yield and grape quality cv. ‘Plavac mali’ (*Vitis vinifera* L.) under conditions of meliorated karst**

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### **Summary**

In the last decade, the most common autochthonous species of the Adriatic coast ‘Plavac mali’ is planted in new locations and in substrates that differ from traditional vineyards. In order to investigate the specificity of the substrate of meliorated karst on the vegetative potential as well the quantitative and qualitative components of the grape a study was carried out in the vineyards on the meliorated karst at the position "Dingač" and "Rota". The average yield was higher in vineyards on meliorated karst. It has been found the vegetative growth potential is balanced. The results for the average mass of the cluster show an exceptionally high variability where recorded unusually low values of this parameter on the meliorated karst. The average sugar contents are higher in grapes from traditional vineyards compared to grape on meliorated karst. The average level of total acid content was significantly lower in grapes from traditional vineyards while the pH value is significantly higher in comparison with grapes on meliorated karst. The results obtained have shown that there are no significant differences in the indicators of yield and mechanical composition of cluster as well as differences in the content of sugar. Meanwhile the total acid content is significantly higher in vineyards from meliorated karst compared to the content of traditional vineyards which has a great importance in the care and preservation of top quality wines produced from the ‘Plavac mali’ variety.

**Key words:** *yield, sugar content, total acids, pH value*

## ***In vitro* razmnožavanje i krioprezervacija virusima zaraženih genotipova vinove loze**

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### **Sažetak**

Vinova loza jedna je od poljoprivrednih kultura na kojoj je utvrđena zaraza velikim brojem virusa. Da bi se pristupilo biotehnološkim postupcima ozdravljanja od virusa (kultura meristema, termoterapija, krioterapija), potrebno je materijal uvesti u kulturu *in vitro*, a zatim ga multiplicirati kako bi se dobila dovoljna količina na kojoj bi se provelo ozdravljanje. Poznato je da sorte vinove loze različito reagiraju na sastav hranjive podloge i da virusna zaraza uvelike utječe na preživljavanje i regeneraciju u *in vitro* uvjetima, te na daljnje manipulacije istima. Cilj ovog rada je utvrditi razlike među sortama korištenim u istraživanju (Cabernet franc, Cabernet sauvignon, Grenache, Merlot, Babić) zaraženih različitim virusima u *in vitro* kulturi, te usporediti preživljavanje i regeneraciju sa kontrolnom sortom Portan, nakon provedenog potencijalnog postupka ozdravljanja smrzavanjem krioprezervacije. Pojedine sorte nisu preživjele niti u *in vitro* kulturi, a samo na jednoj sorti je provedena krioprezervacija. Postotak preživljavanja je bio podjednak kod nesmrzavanih eksplantata, dok su smrznuti eksplantati dali znatno lošije rezultate. Smrznuti eksplantati su jako loše regenerirali, što upućuje na potrebu za daljnim definiranjem protokola *in vitro* kulture i krioprezervacije za takav tip zaraženog materijala.

***Ključne riječi:*** *vinova loza, zaraza virusima, in vitro kultura, metode ozdravljanja, krioprezervacija*

## ***In vitro* propagation and cryopreservation of virus infected grapevine cultivars**

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### **Summary**

The grapevine is one of the horticultural crops on which we can find a large number of viruses. To conduct any biotechnological method (meristem culture, thermotherapy, cryotherapy) it is necessary to establish *in vitro* culture and use multiplication to gain enough plant material. It is known that grapevine cultivars react differently to medium composition but also viruses influence the survival rates and *in vitro* regeneration thus affecting the further manipulation. The aim of this study was to determine differences between cultivars used in experiment (Cabernet Franc, Cabernet Sauvignon, Grenache, Merlot, Babić) infected with different viruses in *in vitro* culture and then choose cultivar with best results to carry out the cryopreservation protocol and be compared to cv. Portan. Some of the cultivars did not manage to establish *in vitro* culture and cryopreservation was carried out only on one cultivar. The survival percentage of explants that were not exposed to low temperatures was similar, while explants exposed to low temperatures gave bad results thus showing the need for further research and defining the cryopreservation protocols.

**Key words:** *grapevine, virus infection, in vitro culture, elimination methods, cryopreservation*



## Digitalni pristup kvantitativnim analizama lista voćnih vrsta

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### Sažetak

U dosadašnjim analizama lista do kvalitativnih podataka se dolazilo ručnim mjerenjem morfoloških parametara što je zahtijevalo veliku preciznost i strpljenje osobe koje obavlja taj rad. Digitalnim pristupom osim brže i preciznije analize, moguće je analizirati veći broj parametara koji su korištenjem klasičnog pristupa ovisili o objektivnosti istraživača. Ciljevi rada su utvrditi postoje li statistički značajne razlike u kvantitativnim analizama lista korištenjem sustava WinFOLIA Pro u odnosu na klasičan način pomičnim mjerilom i sustava LI-COR. Drugi cilj je usporedba vremenskog razdoblja potrebnog za mjerenja svih parametara te mogućnost korištenja programa u obradi i analizi parametara koji su bili pod utjecaj subjektivne procjene istraživača. Analizirani su morfološki parametri 3 uzorka po 30 listova masline; prosječna i pojedinačna visina i širina lista; ukupna, prosječna i pojedinačna površina lista i indeks lista. Dobiveni rezultati morfoloških mjerenja analizirani su analizom varijance, pokazali su sukladno hipotezi, da nema statistički značajnih razlika u bilo kojem od morfološkom parametru te daljnja obrada podataka nije bila potrebna. Uspoređujući faktor vremena WinFOLIA Pro se pokazala kao kvalitetniji i brži pristup analizi kvantitativnih podataka. Korištenjem sustava WinFOLIA Pro dobiveni rezultati ne ovise o subjektivnom mjerenju koje je podložno statističkoj grešci uzrokovanoj dugotrajnim radom u odnosu na korištenje klasičnih metoda. Sustav WinFOLIA Pro omogućava korisniku obavljanje mjerenja u znatno kraćem vremenskom roku i mjerenje parametara koji su klasičnim načinom teško mjerljivi.

**Ključne riječi:** WinFOLIA Pro, analiza lista

## Digital approach to quantitative fruit leaf analysis

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### Summary

In the leaf analyzes so far, qualitative data came from manual measurement of morphological parameters, which required the great precision and patience of the person performing the work. By using digital access in addition to faster and more accurate analysis, it is possible to analyze a large number of parameters that, depending on the objectivity of the researcher, using the classical approach. The objectives of the paper are to determine whether there are statistically significant differences in quantitative leaf analyzes using the WinFOLIA Pro system compared to the classic floating scale and LI-COR system. The second goal is to compare the time period needed to measure all parameters and to use the program in processing and analyzing the parameters that were subject to the subjective assessment of the researchers. Morphological parameters of 3 samples per 30 leaves of olive were analyzed; average and individual height and width of the leaf; total, average and individual area of the leaf and leaf index. The obtained results of morphological measurements were analyzed by analysis of variance, showed according to the hypothesis that there were no statistically significant differences in any of the morphological parameters and further data processing was not needed. By comparing the time factor, WinFOLIA Pro proved to be a better and faster approach to quantitative data analysis. Using WinFOLIA Pro results obtained do not depend on subjective measurement that is subject to statistical errors caused by long-term work compared to the use of classical methods. The WinFOLIA Pro system allows the user to perform measurements within a much shorter timeframe and measuring parameters that are difficult to measure in a classical manner.

**Key words:** *WinFOLIA Pro, leaf analysis*

## Mogućnosti suzbijanja kruškine buhe

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### Sažetak

Dosadašnji trendovi u proizvodnji kruške kao neprimjerena primjena sredstava za zaštitu bilja, doveli su do povećanja populacije kruškine buhe i stvaranja rezistentnih oblika. Ciljevi ovog istraživanja su bili utvrditi optimalan broj usmjerenih zaštita obične kruškine buhe na temelju praćenja životnog ciklusa štetnika, utvrditi učinkovitost tri tretmana (1. integrirani program zaštite -diflubenzuron 0,025%, spirotetramat 0,15% abamektin 0,15%, acetamprid 0,05%, 2. kaolinska glina 3,5%, 3. kontrolni tretman), utvrditi utjecaj tretmana na korisnu entomofaunu tijekom lipnja i srpnja te utvrditi ostatke rezidua pesticida u plodovima. Istraživanje je provedeno 2017. godine u pokusnom nasadu kruške, starosti 6 godina na tri sorte (Viljamovka - BA 29 / Pastorčica, Conferance - MA, Abbate Fetel – MA) u sklopu 3,2 x 0,8 metara. Tretmani po svakoj sorti uključivali su tri repeticije po 5 stabala. Praćenje populacije štetnika izvršeno je na dva jednogodišnja izboja po stablu (30 analiziranih izbojaka po tretmanu). Tijekom 2017. godine odrađeno je ukupno sedam tretmana suzbijanja štetnika po tretmanu. Integrirani program je imao 95% učinkovitost a tretman na bazi kaolina 71% učinkovitost prema Abbottu. U oba tretmana plodovi su bili čisti i na plodovima nije bilo prisutne gljive čađavice (*Cladosporium* spp.). U oba tretmana je determinirana predatorska populacija iz porodica Coccinelidae, Anthocoridae, Chrysopidae i Anistidae ali po brojnosti u korist integriranog programa zaštite što dovodi do zaključka da kaolin ima jednako djelovanje kako na štetnu populaciju tako i na predatorsku. Kaolinski tretman je imao nižu učinkovitost s toga se preporuča uporaba kaolina u sklopu integriranog programa suzbijanja kruškine buhe. Rezultati laboratorijske analize su utvrdili da su rezidue u skladu s Uredbom (EU).

**Ključne riječi:** kruškina buha, zaštita, učinkovitost, kaolin, rezidue

## Possibility of pear psylla control

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### Summary

Past trends in the production of pears as inappropriate application of plant protection agents have led to increasing population of pear psylla and to formation of resistant forms. The aim of this study was to determine the optimum number of directed control treatments on the basis of pest monitoring and to determine the efficiency of three treatments (1. - integrated protection program (diflubenzuron 0.025%, spirotetramate 0.15% abamectin 0.15% , acetampride 0.05%), 2. kaolin clay (3.5%), 3. control treatment as well as the influence of treatments on useful fauna during June and July and to determine residues in fruits. The trial was conducted on experimental pear orchard during the 2017 season, on the three varieties Viljamovka (BA 29 /Pastorčica), Conferance (MA), Abbate Fetel (MA), at a spacing of 2 x 0.8 m. The treatments are done in three replicates of 5 trees per treatment. Monitoring of the pests population involved two marked shoots per tree (30 analyzed shoots per treatment). During 2017, there were seven pesticide controls per treatment. The integrated program had 95% efficacy and kaolin-based treatment 71% efficiency according to Abbott. In both treatments, the fruits were clean and there were no dark fungi (*Cladosporium* spp.). In both treatments, the predatory population of the Coccinelidae, Anthocoridae, Chrysopidae and Anistidae families was determined, but in little bit larger number in the integrated protection program treatment, which leads to the conclusion that kaolin has the same effect on both the harmful population and predators. The effectiveness of kaolin treatment was lower than integrated treatment, meaning that kaolin should be included in an integrated control program and thus increase its efficiency. The results of laboratory analyzes on pesticide residues in fruits were in accordance with Regulation (EU).

**Key words:** pear psylla, control, efficacy, kaolin, residue

## Vrednovanje morfološko – pomoloških svojstava sorti jabuka uzgojenih u sustavu održive voćarske proizvodnje

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### Sažetak

Održiv sustav proizvodnje karakterističan je za uzgoj komercijalnih sorti jabuka. Tradicionalne i otporne sorte jabuka su zanimljive za uzgoj zbog posebnih karakteristika ploda i smanjenje potrebe za kemijskim sredstvima. Cilj istraživanja bio je utvrditi morfološko – pomološke karakteristike tradicionalnih, otpornih i komercijalnih sorti jabuka u održivom sustavu proizvodnje. Istraživanje je provedeno u pokusnom voćnjaku Zavoda za voćarstvo, Hrvatski centar za poljoprivredu, hranu i selo u Donjoj Zelini. Analizirane su sorte jabuke: tradicionalne (Ovčji nos, Mašanka, Zlatna zimsko parmenka); otporne (Topaz®, Pinova®, Querina-Florina) i komercijalne (Gala Schnitzer Schniga®, Zlatni delišes, Idared). Mjerena su svojstva: površina poprečnog presjeka debla (trunk cross-sectional area - TCSA), površina krošnje, volumen krošnje, prirod po stablu, učinkovitost priroda (yield efficiency - YE), masa, visina i obujam ploda. Najmanja TCSA iznosila je 69,36 cm<sup>2</sup> (Zlatni delišes), a najveća 174,44 cm<sup>2</sup> (Querina-Florina). Prirod po stablu kretao se od 4,73 kg/stablo (Zlatna zimsko parmenka) do 22,63 kg/stablo (Zlatni delišes). YE je iznosila od 0,04 kg/cm<sup>2</sup> (Querina-Florina) do 0,33 kg/cm<sup>2</sup> (Zlatni delišes). Najmanju masu ploda imao je Ovčji nos (80,59 g), a najveću Topaz (203,19 g). Otporne sorte su imale značajno najveću TCSA (138,61 cm<sup>2</sup>), dok između komercijalnih (81,90 cm<sup>2</sup>) i tradicionalnih (89,69 cm<sup>2</sup>) nije bilo značajne razlike. Prirod po stablu je bio značajno najmanji kod tradicionalnih sorti (7,41 kg/stablo), a između komercijalnih (13,30 kg/stablo) i otpornih (17,43 kg/stablo) nije bilo značajne razlike. Učinkovitost priroda bila je značajno različita i iznosila je 0,09 kg/cm<sup>2</sup> za tradicionalne, 0,14 kg/cm<sup>2</sup> za otporne i 0,23 kg/cm<sup>2</sup> za komercijalne sorte.

***Ključne riječi:*** jabuka, morfološka svojstva, pomološka svojstva, održiv sustav proizvodnje

## Assessment of morphological and pomological characteristics of apples produced within the system of sustainable fruit production

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### Summary

Sustainable fruit production is representative of commercial apple production. Traditional and resistant apple cultivars are interesting for production purposes due to specific fruit characteristics and lesser usage of chemical products. The aim of this research was to determine morphological and pomological characteristics of traditional, resistant and commercial apple cultivars within the sustainable fruit production system. Research was conducted in experimental orchard of the Institute of Pomology of the Croatian Centre for Agriculture, Food and Rural Affairs in Donja Zelina. Following apple cultivars were analysed: traditional (Ovčji nos - Schafnase, Mašanka - Marschankker and Zlatna zimská parmenka - Goldparmäne); resistant (Topaz®, Pinova®, Querina-Florina) and commercial (Gala Schnitzer Schniga®, Zlatni delišes-Golden Delicious, Idared). Following characteristics were measured: trunk cross-sectional area - TCSA, tree crown area, tree volume, tree yield, yield efficiency – YE; fruit weight, height and circumference. The lowest TCSA amounted to 69.36 cm<sup>2</sup> (Golden Delicious), and highest 174.44 cm<sup>2</sup> (Querina-Florina). Tree yield ranged between 4.73 kg/tree (Zlatna zimská parmenka - Goldparmäne) to 22.63 kg/tree (Golden Delicious). YE ranged between 0.04 kg/cm<sup>2</sup> (Querina-Florina) to 0.33 kg/cm<sup>2</sup> (Golden Delicious). The lowest fruit weight was measured in Ovčji nos - Schafnase (80.59 g), and highest Topaz (203.19 g). Resistant cultivars had significantly highest TCSA (138.61 cm<sup>2</sup>), whereas commercial (81.90 cm<sup>2</sup>) and traditional cultivars (89.69 cm<sup>2</sup>) did not differ in TCSA. Tree yield was significantly lower at traditional cultivars (7.41 kg/tree), whereas no significant differences was observed between commercial (13.30 kg/tree) and resistant (17.43 kg/tree) cultivars. YE significantly differed and amounted to 0.09 kg/cm<sup>2</sup> for traditional, 0.14 kg/cm<sup>2</sup> for resistant and 0.23 kg/cm<sup>2</sup> for commercial cultivars.

**Key words:** *apple, morphological characteristics, pomological characteristics, sustainable fruit production*



ISSN 2459-5551