

**UNIVERZITET U BEOGRADU  
UNIVERSITY OF BELGRADE**

Poljoprivredni fakultet  
Faculty of Agriculture  
Institut za ratarstvo i povrtarstvo  
Institute for Crop and Vegetable Science

**VII SIMPOZIJUM  
sa međunarodnim učešćem**

**INOVACIJE  
U RATARSKOJ I POVRTARSKOJ PROIZVODNJI  
- zbornik izvoda -**

**VII SYMPOSIUM  
with international Participation  
INNOVATIONS  
in Crop and Vegetable Production**

Beograd, 11. decembar 2015.



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Poljoprivredni fakultet, Beograd - Zemun  
Faculty of Agriculture, Belgrade - Zemun

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**Innovations in Crop and Vegetable Production**

- book of abstracts -

Beograd, 11 decembar 2015.

VII SIMPOZIJUM sa međunarodnim učešćem „*Inovacije u ratarskoj i povrtarskoj proizvodnji*“  
VII SYMPOSIUM with international participation „*Innovations in Crop and Vegetable Production*“

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Program VII SIMPOZIJUMA sa međunarodnim učešćem Inovacije u ratarskoj i povrtarskoj proizvodnji PROGRAMME OF THE VII SYMPOSIUM with international participation »Innovations in Crop and Vegetable Production 2015«	
PETAK, 11. DECEMBAR 2015 / Friday, December 11, 2015	
13.00 - 14.00	Registracija i postavljanje postera / Registration and posters mounting
14.00 - 14.30	Otvaranje Simpozijuma / Symposium opening
<b>Predsedništvo / Chairpersons</b>	
Prof. dr Dušan Kovačević (Poljoprivredni fakultet, Beograd) Prof. dr Slavica Jelačić (Poljoprivredni fakultet, Beograd) Prof. dr Zora Dajić Stevanović (Poljoprivredni fakultet, Beograd) Prof. dr Martina Bavec (Faculty of Agriculture and Life Sciences, Maribor)	
<b>UVODNA PREDAVANJA / Plenary session</b>	
<b>Predsedništvo / Chairpersons</b>	
Prof. dr Nebojša Momirović (Poljoprivredni fakultet, Beograd) Prof. dr Savo Vučković (Poljoprivredni fakultet, Beograd) Prof. dr Slaven Prodanović (Poljoprivredni fakultet, Beograd) Prof. dr Vladeta Stevović (Agronomski fakultet, Čačak)	
14.30 –14.50	<b>Martina Bavec, Franci Bavec</b> „Organska ishrana“ kao primjer održive poljoprivrede i ishrane „Organic diet“ as example of sustainable agriculture and sustainable food consumption
14.50 –15.10	<b>Nikola Hristov, Novica Mladenov, Srbišlav Denčić, Radivoje Jevtić, Zoran Jerković, Mirjana Lalošević, Bojan Jocković, Vladimir Aćin, Milan Miroslavljević</b> Novi pravci u oplemenjivanju i proizvodnji pšenice New directions in wheat breeding and production
15.10 –15.30	<b>Vladeta Stevović, Dragan Đurović, Dalibor Tomić</b> Kalcizacija kiselih zemljišta kao mera za unapređenje proizvodnje kvalitetne stočne hrane Liming of acid soils as a measure of improving high quality feed production
15.30 – 16.00	<b>Kafe pauza / Coffee break</b>
<b>Predsedništvo / Chairpersons</b>	
Prof. dr Vera Rakonjac (Poljoprivredni fakultet, Beograd) Prof. dr Zoran Jovović (Biotehnički fakultet, Podgorica) Dr Milena Simić, naučni savetnik (Institut za kukuruz, Zemun Polje) Prof. dr Tomislav Živanović (Poljoprivredni fakultet, Beograd) Prof. dr Jasna Savić (Poljoprivredni fakultet, Beograd)	
16.00 - 16.20	<b>Zoran Jovović, Branko Micev, Ana Velimirović</b> Uticaj klimatskih promjena na proizvodnju krompira i mogućnosti ublažavanja štetnih posljedica Impact of climate change on potato production and options to mitigate the adverse effects
16.20 - 16.40	<b>Vesna Dragičević, Milan Brankov, Milena Simić, Bogdan Nikolić, Branka Kresović</b> Prednosti folijarne primene đubriva pri gajenju ratarskih useva Advantages of foliar fertilizing in crop growing
16.40 – 17.00	<b>Slavoljub Lekić, Ivana Draganić</b> Organsko seme – neka konceptualna razmatranja Organic seeds – some conceptual considerations
17.00 - 17.20	<b>Diskusija / Discussion</b>
17.20 - 17.35	<b>Kafe pauza / Coffee break</b>
17.35-17.50	<b>Razgledanje postera / Poster exhibition</b>
<b>Predsedništvo-moderatori / Chairpersons-moderators</b>	
Prof. dr Dubravka Savić (Poljoprivredni fakultet, Beograd) Prof. dr Aleksandar Simić (Poljoprivredni fakultet, Beograd) Doc. dr Ana Vujošević (Poljoprivredni fakultet, Beograd) Doc. dr Ljubiša Živanović (Poljoprivredni fakultet, Beograd)	
17.50-18.10	<b>Diskusija o poster sekciji / Poster discussion session</b>
18.10-18.20	<b>Dodela nagrada za najbolji poster / The best poster award</b>
18.20-18.50	<b>Diskusija i zaključci Simpozijuma / Discussion and conclusions</b>
19.00	<b>Večera / Dinner (Dom vazduhoplovstva)</b>

**POSTER PREZENTACIJA / POSTER PRESENTATIONS**

1.	<b>AMMI analiza visine prve mahune kod pasulja (<i>Phaseolus vulgaris</i> L.)</b> Aleksandra Savić, Mirjana Vasić, Jelica Gvozdanović-Varga, Miodrag Dimitrijević, Sofija Petrović, Milan Zdravković, Milka Brdar-Jokanović
2.	<b>Uticaj primene indol-3-sirćetne kiseline na kvalitet rasada letnjeg cveća</b> Ana Vujošević, Snežana Đorđević
3.	<b>Uticaj mineralne ishrane na pojavu i intenzitet crne pegavosti stabla suncokreta</b> Boško Dedić, Stevan Maširević, Igor Balalić, Siniša Jocić, Dragana Miladinović
4.	<b>Prostorno uređenje organskih farmi uvođenjem zaštitno-izolacionih pojaseva</b> Brankica Babec, Ksenija Hiel, Srđan Šeremešić, Jelena Ninić-Todorović, Ljiljana Nikolić
5.	<b>Uticaj različitih načina proizvodnje na kvalitet rasada miloduha</b> Damir Beatović, Nikol Turuš, Slavica Jelačić
6.	<b>Uticaj kalibriranja na kvalitet doradenog hibridnog semena kukuruza</b> Divna Simić, Vera Popović, Željko Dolijanović, Nada Erić, Radovan Sabovljević
7.	<b>Ispitivanje pokazatelja kvaliteta semena paprike</b> Dobrivoj Poštić, Nebojša Momirović, Rade Stanisavljević, Lana Đukanović, Ratibor Štrbanović, Željko Dolijanović, Zoran Jovović
8.	<b>Uticaj doze azotnih đubriva na prinos i komponente prinosa ozimog tritikalea</b> Dragana Lalević, Milan Biberdžić
9.	<b>Analiza proizvodnje krastavca kornišona u vertikalnom uzgoju</b> Đorđe Moravčević, Vlade Zarić, Zorica Vasiljević
10.	<b>Očekivana genetička dobit za staklavost zrna durum pšenice</b> Gordana Branković, Dejan Dodig, Vesna Kandić, Desimir Knežević, Gordana Šurlan-Momirović, Nenad Đurić
11.	<b>Očekivana genetička dobit za sadržaj albumina kod hlebne i durum pšenice</b> Gordana Branković, Vesna Dragičević, Dejan Dodig, Desimir Knežević, Gordana Šurlan-Momirović, Borislav Kobiljski
12.	<b>Porast izdanaka kao odgovor na tretiranje semena inbred linija kukuruza pesticidima</b> Gordana Tamindžić, Zorica Nikolić, Maja Ignjatov, Aleksandra Nastasić, Jasna Savić
13.	<b>Ispitivanje životne sposobnosti sjemena banjalučkih sorti pšenice (cold test)</b> Igor Đurđić, Branka Govedarica, Vesna Milić
14.	<b>Krmne smeše jarog graška i ovsu u različitim fazama iskorišćavanja</b> Ivan Krga, Aleksandar Simić, Zorica Bijelić, Violeta Mandić, Sanja Vasiljević, Nataša Veljević
15.	<b>Uticaj malčiranja zemljišta na produktivne osobine različitih sorti krompira</b> Jasmina Oljača, Zoran Bročić, Nebojša Momirović, Jelena Rudić, Danijel Pantelić, Ivana Momčilović
16.	<b>Kompenzacioni efekat remobilizacije suve materije stabala ozime pšenice u uslovima suše posle cvetanja</b> Jasna Savić, Dragana Rančić, Vesna Kandić, Dragana Ivanović, Ilinka Pećinar, Aleksandra Šešlija, Dejan Dodig
17.	<b>Uticaj zemljišnih uslova na sintezu proteina pšenice krupnik <i>Triticum spelta</i> L.</b> Jela Ikanović, Vera Popović, Snežana Janković, Ljubiša Živanović, Ljubiša Kolarić, Sveto Rakić, Gordana Dražić, Predrag Kršmanović
18.	<b>Spelta (<i>Triticum aestivum</i> ssp. <i>spelta</i>) - prirodno predodređena kultura za gajenje u organskoj proizvodnji</b> <i>Bodroža Solarov Marija, Đisalov Jovana, Brlek Tea, Krulj Jelena, Kojić Jovana, Popović Sanja</i>
19.	<b>Lokalna populacija kukuruza - izvor za povećanje sadržaja tokoferola kod inbred linija</b> Jelena Mesarović, Violeta Anđelković, Snežana Mladenović Drnić
20.	<b>Nasledivanje šećera kod kukuruza šećerca (<i>Zea mays</i> L. <i>saccharata</i>)</b> Jelena Srdić, Zorica Pajić, Marija Milašinović Šeremešić, Milica Radosavljević
21.	<b>Uticaj genotipa na prinos zrna pšenice, soje, kukuruza i suncokreta</b> Ljubiša Živanović, Jasna Savić, Ljubiša Kolarić, Jela Ikanović, Milan Novaković
22.	<b>Mogućnost primene elektromagnetnih talasa u proizvodnji soje</b> Marija Cvijanović, Vojin Đukić, Gorica Cvijanović, Gordana Dozet, Jelena Marinković
23.	<b>Karakteristike kratkog testa i keksa obogaćenih sa dve vrste rezistentnog skroba</b> Marija Milašinović-Šeremešić, Ljubica Dokić, Ivana Nikolić, Milica Radosavljević, Valentina Semenčenko
24.	<b>Prinos nekih hibrida kukuruza u zavisnosti od različitih sistema obrade zemljišta</b> Milan Biberdžić, Saša Barać, Dragana Lalević
25.	<b>Produktivnost združenog useva boranije i crnog luka u organskom sistemu zemljoradnje</b> Milan Ugrinović, Snežana Oljača, Zdenka Girek, Suzana Pavlović, Vladan Ugrešević, Jasmina Zdravković, Bogoljub Zečević

26.	<b>Ispitivanje masnog ulja plodova anisa, mirodije i kima</b> Milica Aćimović, Sanja Popović, Ljiljana Kostadinović, Olivera Đuragić, Jovanka Lević
27.	<b>Sadržaj ukupnih fenola, komponente i antioksidativni kapacitet ekstrakata uljanih pogača kumina</b> Milica Aćimović, Vele Tešević, Dimitrije Mara, Olivera Đuragić, Vladimir Filipović, Mirjana Cvetković, Jovana Stanković
28.	<b>Uticaj temperature na razvoj toksigenih vrsta gljiva</b> Milica Nikolić, Iva Savić, Slavica Stanković, Ivana Vico, Nataša Duduk
29.	<b>Uticaj azotnog đubrenja na osobine smeše lucerke sa travama</b> N. Veljević, A. Simić, S. Vučković, Z. Bijelić, V. Mandić, I. Krga
30.	<b>Prinos ZP hibrida kukuruza u proizvodnim ogledima u 2015. godini</b> Nemanja Nišavić, Jovan Pavlov, Nenad Delić, Anika Kovinčić, Olivera Đorđević
31.	<b>Odstupanje od Mendelovih zakona u nasljeđivanju <i>opaque2 (o2)</i> alela kod kukuruza</b> Olivera Đorđević, Sofija Božinović, Dragana Ignjatović - Micić, Marija Kostadinović, Dragana Mrđen, Jelena Vančetović
32.	<b>Uticaj agroekoloških uslova i setvene norme na fiziološke osobine semena žutog zvezdana (<i>Lotus corniculatus</i> L.)</b> Petar Stevanović, Savo Vučković, Jela Ikanović, Vera Popović, Gordana Dražić, Ljubiša Živanović, Predrag Krsmanović
33.	<b>Dužina života semena nekih vrsta lekovitog bilja</b> Slobodan Dražić, Slavoljub Lekić, Snežana Pavlović, Milena Dražić
34.	<b>Rezultati i perspektive oplemenjivanja lekovitog, aromatičnog i začinskog bilja u Republici Srbiji</b> Slobodan Dražić, Ljubiša Kolarić, Milena Dražić, Svetlana Turudija-Živanović
35.	<b>Prisustvo aminoheterotrofa u rizosferi lucerke gajene na neutralnom i kiselom zemljištu</b> S. Anđelković, T. Vasić, J. Radović, Z. Lugić, S. Babić, G. Jevtić, D. Stamenov
36.	<b>Fracije organskog ugljenika u zemljištu nakon tretiranja biljnih ostataka pšenice biofertilizatorima</b> Srđan Šeremešić, Maja Manojlović, Simonida Đurić, Vladimir Sikora, Dragiša Milošev, Vladimir Čirić, Tamara Martinović
37.	<b>Modeliranje prinosa i sadržaja organske materije zemljišta u višegodišnjem ogledu „Plodoredi“ korišćenjem DNDC modela</b> Srđan Šeremešić, Dragiša Milošev, Vladimir Čirić, Ivica Đalović, Boris Đurđević, Bojan Vojnov
38.	<b>Sadržaj β-glukana u zrnu nekih sorti ječma selekcionisanih u Srbiji</b> Sveto Rakić, Snežana Janković, Vera Đekić, Dušan Živković, Jela Ikanović, Radojica Rakić
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40.	<b>Uloga i značaj skupa „Otvoreni dani biodiverziteta“</b> Vladimir Filipović, Vladan Ugrenović
41.	<b>Značaj vijabilnosti semena uzoraka kukuruza iz banke gena u očuvanju genetičkog integriteta sorte</b> Vojka Babić, Aleksandar Popović, Jelena Vančetović, Violeta Anđelković, Natalija Kravić
42.	<b>Efekat razlaganja glifosata produktima <i>lr</i> gena na razvoj <i>Puccinia triticina</i></b> Zoran Jerković, Željana Prijčić, Radivoje Jevtić, Branka Orbović, Mirjana Lalošević
43.	<b>Zakorovljenost alternativnih vrsta ozime pšenice u zavisnosti od načina đubrenja</b> Željko Dolijanović, Dušan Kovačević, Snežana Oljača, Srđan Šeremešić
44.	<b><i>Arundo donax</i> L. - nov bioenergetski usev</b> Željko Dželetović, Nevena Mihailović, Gordana Andrejić



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## “ORGANSKA ISHRANA” KAO PRIMER ODRŽIVE POLJOPRIVREDNE PROIZVODNJE I ODRŽIVE POTROŠNJE HRANE

Martina Bavec, Franci Bavec

Univerzitet u Mariboru, Poljoprivredni fakultet, Katedra za organsku poljoprivredu, ratarske,  
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Konvencionalna/industrijska poljoprivreda nije postigla cilj da obezbedi dovoljno hrane, a postala je uzročnik mnogih problema u životnoj sredini uprkos mnogobrojnim istraživanjima i inovacijama u poslednjem veku. Iako je vlade i proizvođači promovišu kao “zelenu” i prijateljsku po životnu sredinu, ona nasuprot tome čini štetu životnoj sredini. Nedokazano i pogrešno oglašavanje da ova vrsta poljoprivrede donosi korist životnoj sredini može obmanuti potrošače, što označavamo kao “green washing”. Nasuprot tome organska poljoprivreda je razvijena u 160 zemalja na 40 miliona hektara. Proizvodi i koristi od organske poljoprivrede su ukusna i zdravstveno bezbedna hrana visokog kvaliteta, zaštita životne sredine (zemljišta, vode, vazduha), zaštita biodiverziteta, dobrobit životinja, kratki lanci snabdevanja, zdrava radna mesta i organska poljoprivreda je jedini stvarni održiv proizvodni sistem. Na osnovu FAO definicije održiva ishrana je ona koja ima mali uticaj na životnu sredinu, koja doprinosi bezbednosti hrane i prehrambenoj sigurnosti i zdravom životu sadašnjih i budućih generacija. Održiva ishrana štiti i poštuje diverzitet i ekosisteme, kulturološki je prihvatljiva, dostupna, ekonomski pravedna, adekvatna, sigurna i zdrava i najbolje je moguće rešenje za korišćenje ljudskih i prirodnih resursa. Može se naći nekoliko zajedničkih tačaka između ove definicije i IFOAM-ovih principa zdravlja, ekologije, pravednosti i brige.

Grupa istraživača sakupljenih u inicijativi Hrana, kvalitet i zdravlje (Food, quality and health (FQH)) smatra da organska proizvodnja hrane može da ponudi primer kombinovanja održive proizvodnje i potrošnje u jedan sistem. Kroz nekoliko aktivnosti u poslednje dve godine ova grupa je postala deo programa FAO 10 Years Food sa ciljem da učine proizvodnju i potrošnju hrane održivom. Organska proizvodnja hrane, kao živa laboratorija i ključni model za održivi sistem proizvodnje hrane, je predložen i prihvaćen kao pod-program programa Održivi sistem proizvodnje hrane (Sustainable food system programme (SFSP)). “Organska ishrana” će biti iskorišćena kao inovativni model održivog sistema proizvodnje hrane i potrošnja će biti procenjena na osnovu nekoliko kriterijuma. Razvoj novih alata, testiranje i primena organske i održive ishrane u javnim ustanovama, unapređenje lokalnog prehrambenog sistema, korišćenjem kratkih lanca snabdevanja hranom je inovativan koncept za budućnost, koji takođe vodi računa o klimatskim promenama i veliki je izazov za naučnike i potrošače.

**Ključne reči:** održiva poljoprivreda, organska hrana, životna sredina

»ORGANIC DIET« AS EXAMPLE OF SUSTAINABLE AGRICULTURE AND  
SUSTAINABLE FOOD CONSUMPTION

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Conventional/industrial agriculture failed gaining aim to supply enough food and caused several environmental problems although all achievements of research and innovation in the last century. But by governments and operators it is usually promoted as green-based and environmental friendly although it is damaging to the environment and can include misleading customers about the environmental benefits of a product through misleading advertising and unsubstantiated claims which means “green washing”. On the other side organic farming was developed in over 160 countries and 40 million ha. Outputs of organic agriculture are tasty and healthy food from the highest quality, environment protection (soil, water, air), preserving biodiversity, animal welfare, short food supply chains, healthy working places,... and organic agriculture is the only really sustainable agriculture production system.

Based on FAO definition sustainable diets are those with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources. Several common points can be found among this definition and IFOAM organic farming principles of health, ecology, fairness and care.

Group of researchers gathered in the initiative Food, quality and health (FQH) think that the organic food system may offer an example of comparing and combining both sustainable production and consumption patterns within one system and throughout of several activities in the last two years it became a part of FAO 10 Years Food Programme with goal shaping food consumption and production more sustainable. The organic food system as a living laboratory and key model for sustainable food systems was proposed and accepted as a sub programme of Sustainable food system programme (SFSP) where ”organic diet” will be used as innovative model for sustainable food production and consumption evaluated by several criteria. Developing new tools, testing and implementing organic as healthy and sustainable diets in public meals, improving local food systems using short supply chains are innovative concepts for the future respecting also climate changes and are challenges for scientists and consumers.

**Key words:** environmental, sustainable agriculture, organic food

## NOVI PRAVCI U OPELEMENJIVANJU I PROIZVODNJI PŠENICE

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Rastuća svetska populacija nameće kontinuiranu potrebu za sve većom proizvodnjom hrane. Pšenica, kao najčešće korišćeno hlebno žito, postaje sve traženiji proizvod, kako na domaćem tako i na inostranom tržištu. Status strateškog proizvoda, zadovoljenje sopstvenih potreba i ekonomska opravdanost proizvodnje, uslovljavaju nove pristupe u rešavanju nastalih problema. Kombinovana primena klasične i moderne biotehnologije, sa ciljem stvaranja novih sorti visokog prinosa i unapređenih parametara kvaliteta, pogodnih za ishranu ljudi, stoke i proizvodnju obnovljivih energenata, tolerantnih na abiotičke i biotičke faktore stresa, postaje opšte prihvatljiva u čitavom svetu. U cilju stvaranja sorti pšenice prilagođenih promenljivim agroekološkim uslovima, neophodno je intenzivirati oplemenjivanje u pravcu: povećanja fotosintetičke efikasnosti i kapaciteta klasa, smanjenja potreba za sumom efektivnih temperatura i osetljivošću na visoke temperature, povećanja ekonomičnosti iskorišćavanja azota i vode, povećanja usisne moći korenovog sistema, unošenja gena otpornosti na patogene i insekte, promena fotoperiodske reakcije i povećanja žetvenog indeksa. Pored toga, istraživanja moraju obuhvatiti i precizniju identifikaciju interakcije genotip/spoljna sredina, adaptabilnosti i stabilnosti prinosa i kvaliteta, definisanje sortne agrotehnike i namene u prerađivačkoj industriji, sa preporučenom tehnologijom gajenja u uslovima organske proizvodnje, uz poštovanje evropskih i svetskih standarda zaštite životne sredine. Iako klasično oplemenjivanje i dalje predstavlja osnovu stvaranja nove genetske varijabilnosti, savremeni trendovi u oplemenjivanju kao što su molekularni, genomski, fiziološki i drugi aspekti, zatim stvaranje hibridne pšenice, u znatnoj meri doprinose većoj efikasnosti oplemenjivačkog rada. Intenzivna tehnologija proizvodnje, koja podrazumeva upotrebu sertifikovanog semena, savremenu poljoprivrednu mehanizaciju, kvalitetniju obradu zemljišta, primenu većih količina đubriva, čije su formulacije definisane na osnovu hemijske analize zemljišta, efikasnija - ekološki prihvatljivija hemijska sredstva za zaštitu bilja i semena, poštovanje optimalnih agrotehničkih rokova i dr., u velikoj meri doprinosi boljem iskorišćavanju genetskog potencijala rodnosti a time i ekonomskoj opravdanost proizvodnje pšenice.

Ovaj rad predstavlja rezultat projekta TR31066.

**Ključne reči:** pšenica, oplemenjivanje, proizvodnja, novi pravci

**NEW DIRECTIONS IN WHEAT BREEDING AND PRODUCTION**

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Increasing world population imposes continual need for higher food production. Being the most often used bread cereal, wheat is becoming more popular in national and international markets. New approaches in dealing with these issues are conditioned by status of wheat as a strategic produce, satisfying own needs and economic viability of the production condition. Combined application of classical and modern biotechnology, aiming at the development of new high-yielding cultivars with improved quality parameters, suitable for food, feed and renewable energy sources, and tolerant to abiotic and biotic stress factors, is becoming generally accepted worldwide. In order to create wheat cultivars adapted to the changing agroecological conditions, it is necessary to intensify breeding programs focusing on the following: increased photosynthetic efficiency and spike capacity, decreased need for sum of effective temperatures and decreased sensitivity to high temperatures, increased efficiency of nitrogen and water consumption, increased absorbing power of the root system, introducing genes for resistance to pathogens and insects, changes in the photoperiod response and increased harvest index. Additionally, the research has to encompass a more precise identification of the interaction genotype x environment, adaptability and stability of yield and quality, defining cultivar management practices and applications in the processing industry, with recommended growing technology under organic production, all complying with the European and global standards regarding environmental protection. Even though the classic breeding is still the basis for creating new genetic variability, the current trends in breeding such as molecular, genomic, physiological and other aspects, as well as creation of hybrid wheat, largely contribute to higher efficiency of the breeding process. Intensive production technology that implies use of certified seed, contemporary agricultural machinery, quality tillage, applying higher quantities of fertilizer formulated according to chemical soil analyses, more efficient and environmentally acceptable chemicals for plant and seed protection, adhering to optimal dates for crop management operations, etc. greatly contribute towards better utilization of the genetic yield potential, and consequently the economic justifiability of the wheat production.

This paper presents the results of the project TR31066.

**Key words:** wheat, breeding, production, new directions

## KALCIZACIJA KISELIH ZEMLJIŠTA KAO MERA ZA UNAPREĐENJE PROIZVODNJE KVALITETNE STOČNE HRANE

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Progresivno smanjenje pH vrednosti zemljišta, kao posledica industrijskih zagađenja i agrotehničkih mera, postaje sve veći problem u mnogim delovima sveta. Lucerka (*Medicago sativa*), jedna od najznačajnijih krmnih biljaka iz grupe višegodišnjih leguminoza, poznata je kao biljka veoma osetljiva na kiselost zemljišta. pH vrednost zemljišta utiče na sve faze njenog razvoja, počev od zasnivanja, otpornosti na bolesti, prinosa i kvaliteta krme, do otpornosti na zimu i životni vek lucerišta.

Problemi u gajenju lucerke na kiselim zemljištima mogu se rešavati na nekoliko načina: selekcijom sojeva *R. meliloti* tolerantnih na kiselost, selekcijom sorti lucerke koje takođe tolerišu niske pH vrednosti zemljišta i visok sadržaj aluminijuma i hemijski- putem dodavanja kalcijuma kako bi se povećala pH vrednost zemljišta.

Predsetvena inokulacija semena lucerke sojevima *Rh. meliloti* tolerantnim na niske pH vrednosti opravdana je u zasnivanju lucerke na zemljištima koja nisu ekstremno kisela. Peletiranje semena lucerke krečnim materijalom, kao dopunski postupak pri inokulaciji, takođe može pozitivno uticati na uspostavljanje efikasne simbioze.

Selekcija sorti lucerke tolerantnih na kiselost i visok sadržaj aluminijuma je veoma složena zbog njene genetičke osnove (tetraploid), stranooplodnje, inbriding depresije i male genetičke varijabilnosti u pogledu rezistentnosti na kiselost.

Kalcizacija kiselih zemljišta pri zasnivanju lucerišta generalno ima pozitivan uticaj na rast, razvoj i trajnost lucerke, a time i prinos i kvalitet suve materije. Pozitivan efekat kalcizacije se često ne uočava u godinama nakon zasnivanja, što može biti posledica relativno niskih količina krečnih materijala i njihovog unošenja u oranični sloj. To ukazuje na potrebu normiranja količine krečnih materijala u zavisnosti od pH i tipa zemljišta, kao i s obzirom na razvijenost korena lucerke, iznalaženje ekonomski prihvatljivih načina za kalcizaciju dubljih slojeva zemljišta. Kalcizaciju bi bilo opravdano primeniti kada se raspolaže dovoljnim količinama jeftinog krečnog materijala i na zemljištima sa izrazito niskom pH vrednošću.

Kompleksnost problema u zasnivanju lucerke na kiselim zemljištima upućuje na to da bi kada god je moguće, bilo poželjno kombinovano primeniti kalcizaciju, sorte i sojeve inokulanata tolerantne na kiselost.

Kisela zemljišta su naročito izazovna za održive sisteme poljoprivredne proizvodnje u smislu njihove rekultivacije uspostavljanjem sistema simbiotske azotofiksacije. Značaj lucerke kao biljke koja bi se koristila za meliorisanje takvih zemljišta ogleda se u njenoj velikoj produkciji biomase, čijom inkorporacijom bi se značajno povećao sadržaj organske materije u zemljištu.

**Ključne reči:** lucerka, kalcizacija, prinos, kvalitet

## LIMING OF ACID SOILS AS A MEASURE OF IMPROVING HIGH QUALITY FEED PRODUCTION

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A progressive decrease in soil pH occurring due to industrial pollution and cultural practices is becoming an increasing problem in many parts of the world. Alfalfa (*Medicago sativa*), one of the most important perennial forage legumes, is well-known for its susceptibility to soil acidity. Soil pH affects all stages of its development, including stand establishment, disease resistance, forage yield and quality, winter tolerance and stand lifetime.

Problems regarding alfalfa growing on acid soils can be solved in a number of ways: by selection of *R. meliloti* strains tolerant of acidity, by selection of alfalfa cultivars tolerant of low soil pH and high aluminium levels and using chemical methods – through calcium addition for increased soil pH.

Pre-inoculation of alfalfa seed with *Rh. meliloti* strains tolerant of low pH is justified in alfalfa stand establishment on soils that are not extremely acid. Pelleting alfalfa seed with liming material, as a supplementary operation in seed inoculation, can also positively affect symbiosis.

Selection of alfalfa cultivars tolerant of soil acidity and high aluminium levels is highly complex due to the genetic basis of alfalfa (tetraploid), cross pollination, inbreeding depression and low genetic variability in terms of resistance to soil acidity.

Liming acid soils during alfalfa stand establishment generally has a positive effect on growth, development and longevity of alfalfa and, hence, dry matter yield and quality. The positive effect of liming is often unobserved in years after stand establishment, which can be attributed to relatively low amounts of liming material and their introduction into the arable soil layer. This indicates the need to define adequate rates of liming materials to be applied based on soil pH and soil type and, in view of alfalfa root development, search for economically acceptable methods of liming deeper soil layers. Liming soils with an extremely low pH can be justified only if sufficient amounts of liming material are available.

The complexity of the above problems regarding alfalfa stand establishment on acid soils indicates that the combined use of liming, cultivars and inoculant strains tolerant of acidity is advisable whenever possible.

Acid soils present a particular challenge for sustainable agricultural systems in terms of their remediation through symbiotic nitrogen fixing systems. The importance of alfalfa as a plant to be used for soil improvement lies in its high production of biomass, whose incorporation would significantly increase the organic matter content in the soil.

**Key words:** alfalfa, liming, yield, quality



## UTICAJ KLIMATSKIH PROMJENA NA PROIZVODNJU KROMPIRA I MOGUĆNOSTI UBLAŽAVANJA ŠTETNIH POSLJEDICA

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Svakodnevno nam sa svih strana svijeta stižu informacije da se klima na Zemlji intenzivno mijenja i da vrijeme nije kao što je bilo nekada. Vremenske prilike postaju sve ekstremnije, a pojava vremenskih nepogoda sve učestalija (poplave, suše, visoke temperature, olujni vjetrovi, požari). Uticaj globalne promjene klime osjeća se u skoro svim sferama ljudskog života. Zbog direktne zavisnosti od klimatskih faktora poljoprivredni sektor je jedan od najugroženijih. Brojne studije iz ove oblasti ukazuju da će uticaj klimatskih promena u budućnosti biti sve veći, a negativne posljedice po poljoprivredu sve izraženije. Ti efekti biće naročito izraženi na području Balkana, koji je prepoznat kao region sa visokom osjetljivošću.

Krompir je biljka umjerenog klimata koja se, zbog izraženog polimorfizma, dosta lako prilagođava različitim ekološkim uslovima. Zahvaljujući tome, krompir se danas gaji u skoro svim uslovima, pa i na većim nadmorskim visinama, gdje gajenje drugih ratarskih kultura nije moguće. Međutim, u posljednje vrijeme proizvodnja krompira postaje sve osjetljivija prema raznim tipovima prirodnih hazarda. Sve veća varijabilnost klime uzrokuje velike sezonske oscilacije u visini i kvalitetu prinosa. Zbog toga će se proizvodnja krompira postepeno premješati iz sve toplijih južnih prema hladnijim sjevernijim područjima, odnosno višim planinskim predjelima.

U ovom trenutku na Zemlji živi oko 7 milijardi ljudi, a predviđa se da bi taj broj do 2050. godine mogao nadmašiti 9 milijardi. Da bi se zadovoljila tolika potreba za hranom, poljoprivredna proizvodnja se do 2050. godine mora povećati za 60-70%. Međutim, to neće biti nimalo lak zadatak. U prilog tome svakako ne ide ni predviđanje Međunarodnog istraživačkog instituta za prehranbenu politiku (IFPRI) prema kojem će se površine četiri glavna izvora hrane u svijetu – pšenica, pirinač, kukuruz i krompir do 2050. godine stalno smanjivati. Prema navedenim projekcijama proizvodnja krompira će do tog perioda opasti za oko 9%. To će mnoge poljoprivrednike primorati da se različitim inovativnim pristupima prilagođavaju agroekološkim uslovima koji vladaju na njihovim poljima. Tako nešto, između ostalog, podrazumijevaće i napuštanje uzgoja pojedinih kultura i uvođenje u proizvodnju nekih novih.

**Ključne riječi:** klimatske promjene, štetene posljedice, krompir

**IMPACT OF CLIMATE CHANGE ON POTATO PRODUCTION AND OPTIONS TO MITIGATE THE ADVERSE EFFECTS**Zoran Jovović<sup>1</sup>, Branko Micev<sup>2</sup>, Ana Velimirović<sup>1</sup><sup>1</sup> Biotechnical faculty Podgorica, University of Montenegro<sup>2</sup> Institute of hydrometeorology and seismology of Montenegro

Information on Earth's intensive climate changes are coming daily from all over the world and weather is not as it used to be. The weather conditions are becoming more extreme, and the emergence of weather disasters increasingly frequent (floods, drought, high temperatures, windstorms, fires, etc.). The impacts of global climate change are felt in almost all spheres of human life. Due to the direct dependence on climatic factors, the agricultural sector is one of the most vulnerable. A number of studies in this area suggest that the impact of climate change in the future will increase, and the negative consequences for agriculture more intensive. These effects will be particularly pronounced in the Balkans, which has been recognized as a region with high sensitivity.

Potato is a plant of temperate climate which, due to strong polymorphism, quite easily adapts to different environmental conditions. As a result, potato is now grown in almost all conditions, even at high altitudes, where the cultivation of other field crops is not possible. However, in recent years potato production is becoming more sensitive to various types of natural hazards. Increasing climate variability causes large seasonal fluctuations in the amount and quality of yield. Therefore the potato production is gradually moving from warmer south to colder northern areas, and the higher mountain regions, respectively.

Currently there are about 7 billion people on Earth, and it is anticipated that this number could surpass 9 billion by 2050. In order to meet increasing demands for food, the agriculture production should increase by 60-70% until 2050. However it will not be an easy task. International Food Policy Research Institute (IFPRI) foresees that the surface of the four main sources of food in the world - wheat, rice, corn and potatoes will steadily decrease until 2050. According to these projections, potato production will by that time decrease for about 9%. This will force many farmers to adapt a variety of innovative approaches to agro-ecological conditions prevailing in their fields, including, among others, the abandonment of cultivation of certain crops and introduction in the production of new ones.

**Key words:** climate change, harmful consequences, potato



## PREDNOSTI FOLIJARNE PRIMENE ĐUBRIVA PRI GAJENJU RATARSKIH USEVA

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Nedostatak mineralnih nutritiva iz zemljišta, kao i uticaj stresa dovode do neophodnosti drugačijeg načina aplikacije đubriva. Stres povećava potrebe biljaka i istovremeno smanjuje apsorpciju minerala koje je neophodno nadohnaditi. Folijarna đubriva omogućavaju bržu i efikasniju apsorpciju i metabolisanje mineralnih elemenata, kao i drugih fiziološki aktivnih materija.

Primenom folijarnih đubriva se može umanjiti negativan efekat stresa izazvanog herbicidima, što je posebno značajno u semenaskoj proizvodnji kukuruza, gde povećana osetljivost inbred linija na pojedine herbicide može dovesti do propadanja useva. Tako je primena aminokiselinskih i fosfornih folijarnih đubriva u linijama kukuruza tretiranim različitim tipovima herbicida smanjila pojavu oštećenja i povećala prinos kukuruza. Oba tipa đubriva, a posebno aminokiselinsko, su uticala na povećanje statusa neenzimskih antioksidanata neposredno nakon primene, povećavajući fitnes biljaka, što se povoljno odrazilo na produkciju biomase i potencijal rodnosti. Značajno je istaći da su osetljive linije kukuruza u najvećem stepenu reagovala na primenu aminokiselinskog đubriva, povećavajući prinos do 30%, dok je u sušnoj godini, kada se ispoljio sinergistički nepovoljan uticaj suše i herbicida, prinos bio veći i do 50% u odnosu na usev tretiran samo sa herbicidima.

Jedan od široko rasprostranjenih načina agronomske biofortifikacije je upravo primena folijarnih đubriva. Folijarna đubriva omogućavaju bržu penetraciju i time sigurniju i efikasniju apsorpciju mineralnih i drugih nutritiva. Biljke zadovoljavaju svoje potrebe za mineralima, a kao rezultat povećava se prinos biomase i zrna. Osim mineralnih nutritiva, i druge fiziološki aktivne supstance, kao što su fitohormoni, sekundarni metaboliti, biljni ekstrakti i sl., mogu se koristiti kao folijarna đubriva, omogućavajući bolju iskoristljivost minerala, povećavajući fitnes useva i nutritivni kvalitet zrna. Primena različitih folijarnih đubriva na bazi biljnih ekstrakata, kao i fitohormonskih preparata u usevima soje i ječma je pokazala da pored povećanja prinosa, biljke bolje apsorbuju hraniva, kako iz lista, tako i iz zemljišta, povećavajući sadržaj antioksidanta, vitamina i mineralnih elemenata u zrnu, uz smanjenje nivoa antinutritiva.

**Ključne reči:** đubrenje useva, mineralna ishrana, agronomska biofortifikacija, stres herbicida, kvalitet zrna

## ADVANTAGES OF FOLIAR FERTILIZING IN CROP GROWING

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Deficiency of mineral nutrients in soli, as well as stress brings upon necessity to different way in fertilizer application. Stress increase plant requirements together with reduce in absorption of minerals, which are obligatory to be exiated. Foliar fertilizers enable faster and effective absorption and metabolisation of mineral elements and other physiologically active substances. Application of foliar fertilizers could reduce negative effects caused by herbicides, what is particularly important in maize seed production, where increased susceptibility of inbred lines to some herbicides could induce crop failure. The application of amino acid and phosphoric foliar fertilizers in maize lines treated with different herbicide types reduced damage appearances and increased grain yield. Both fertilizer types, particularly amino acid fertilizer increased level of nonenzymatic antioxidants forthright after application, boosting plant fitness, reflecting positively biomass production and yielding potential. It is important to underline that the greatest effect was expressed in susceptible lines with application of amino acid fertilizer, increasing grain yield up to 30%, while in dry year, where synergic effect of drought and herbicide was expressed, yield was 50% higher in relation to crop treated only with herbicides. One of the widespread techniques of agronomic biofortification is application of foliar fertilizers. Foliar fertilizers enable faster penetration, assured and efficient absorption of mineral and other nutrients. From this point, plats satisfy their requirements for minerals, and in result, biomass and grain yield is increasing. Beside the mineral nutrients, the other physiologically active compounds, like phytohormones, secondary metabolites, plant extracts, etc. could be used as foliar fertilizers, enabling better utilisation of minerals, increasing crop fitness and nutritive quality of grain. The application of different foliar fertilizers, based on plant extracts and phytohormone preparations in soybean and barley crop showed that beside increase in grain yield, plants had better absorption of nutrients from the leaves, as well as from the soil, increasing also content of antioxidants, vitamins and mineral elements in grain, together with reduce in the level of antinutrients.

**Key words:** crop fertilising, mineral nutrition, agronomic biofortification, herbicide stress, grain quality

## ORGANSKO SEME – NEKA KONCEPTUALNA RAZMATRANJA

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Prema stanovištu Međunarodne federacije pokreta za organsku poljoprivredu (IFOAM) organska poljoprivreda je proizvodni sistem koji održava zdravlje zemljišta, ekosistema i ljudi. On se pre zasniva na ekološkim procesima, biodiverzitetu i proizvodnim ciklusima koji su prilagođeni lokalnim uslovima, nego na upotrebi inputa s neželjenim efektima. Organska poljoprivreda kombinuje tradiciju, novine i nauku u korist zajedničke životne sredine i unapređuje pravične, odnose i valjan kvalitet života svih onih koji su uključeni u nju.

Zakonodavstvo mnogih zemalja uzima u obzir da seme i sadni materijal koji se koriste za organsku proizvodnju treba da budu proizvedeni prema prihvaćenim metodama organske poljoprivrede. Ovo se takođe odnosi i na materijale za tretiranje i oblaganje semena.

Ipak, postoji nekoliko nedoumica u vezi pojma organsko seme. Najpre, šta je organsko seme? Postoje li razlike između semena proizvedenih u organskoj proizvodnji i semena proizvedenih u konvencionalnoj proizvodnji? Ako postoje, koje su razlike između ovih useva? Danas nije sasvim jasno da li je za zasnivanje organskog useva neophodno seme iz organske proizvodnje ili ne? Osim toga, potrebno je razjasniti da li je organsko seme rezultat nove proizvodne filosofije ili dostignuća konvencionalne poljoprivrede.

Odgovori na postavljena pitanja zavise i od toga koji pravac organske poljoprivrede sledimo: naučno zasnovanu organsku poljoprivredu ili biodinamičku poljoprivredu na temelju učenja Rudolfa Štajnera. Danas je očigledno razilaženje organske poljoprivrede i GM poljoprivrede i neprihvatljivost upotrebe semena GM biljaka za zasnivanje organskih useva. Ali možda će u budućnosti doći do približavanja i stapanja organske proizvodnje i GM proizvodnje. Posebno ako se zna da u vreme Rudolfa Štajnera i Alberta Hauarda nisu upotrebljavani pesticidi i GMO.

***Ključne reči:*** organska poljoprivreda, konvencionalna poljoprivreda, GM usevi

## ORGANIC SEEDS – SOME CONCEPTUAL CONSIDERATIONS

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According to the International Federation of Organic Agriculture Movements view organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

In many countries legislation is taking into account that the seed and planting material used for organic production have to be manufactured according to the accepted methods of organic agriculture. This also applies to the materials used for seed treatment and coating.

However, there are several concerns about the concept of organic seed. First, what are organic seeds? Are there differences between the seeds produced in organic agriculture and the seeds produced in conventional production? And if there are, what are the differences between these crops? Today, it is not clear if it is necessary to use the organic certified seeds in organic production or not? In addition, it is necessary to clarify if organic seeds are the result of new production philosophy or if it is result of conventional agriculture.

Answers to these questions depends on which direction of organic agriculture we follow: the science based tradition of organic agriculture or biodynamic agriculture based on Rudolf Steiner lectures. At the moment, it is apparently divergence between organic agriculture and GM agriculture and unacceptability of use GM seeds for the establishment of organic crops. But maybe in the future convergence of organic production and GM production will be reached. Especially, if we know that in Rudolf Steiner` and Albert Howard` time there were not pesticides and GMOs.

**Key words:** organic agriculture, conventional agriculture, GM crops



**POSTER SEKCIJA**  
***POSTER SECTION***

## AMMI ANALIZA VISINE PRVE MAHUNE KOD PASULJA (*PHASEOLUS VULGARIS* L.)

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Pasulj (*Phaseolus vulgaris* L.) je po privrednom značaju među prvim leguminozama u svetu. Od velikog značaja je u ishrani ljudi usled visoke hranljive vrednosti i sadržaja dijetetskih vlakana.

Danas se pasulj uspešno gaji kao čist usev na većim površinama. Zbog uspešne mehanizovane obrade i žetve pasulja, potrebne su i određene vrednosti komponenata visine biljke, a među njima je najznačajnija visina formiranja prve mahune. Stabilnost ove osobine u različitim uslovima rasta i razvića pasulja takođe je važna.

Cilj ovog rada bio je da se ispita reakcija 14 genotipova pasulja na agroklimatske uslove gajenja tokom sedam vegetacionih sezona za osobinu formiranja visine prve mahune. Ogledi su bili postavljeni po slučajnom blok sistemu, u tri ponavljanja, na lokaciji Rimski Šančevi. Prosečna vrednost visine prve mahune za genotipove i godine iznosila je 20,32 cm. Genotip sa najniže formiranom prvom mahunom je sorta Galeb (16,09 cm), koja je ujedno imala i vrlo nizak koeficijent varijacije (12,23%). Najvišu formiranu prvu mahunu imala je sorta Sremac (23,77cm), dok je ova osobina najviše varirala kod sorte Naya Nayahit (21,06%).

Primenom AMMI modela izdvojeni su glavni efekti odgovorni za formiranje visine prve mahune pasulja. Rezultati su pokazali da je uticaj godina, genotipova i njihove interakcije na visinu prve mahune biljaka pasulja bio značajan, ali u različitom stepenu. Uticaj genotipa na formiranje prve mahune je iznosio 29,85%, znatno manji uticaj imale su godine od 23,81%. Najveći izvor varijabilnosti imala je GE interakcija od 46,36%. Izvori varijabilnosti u interakciji GE su razloženi na četiri glavne komponente, koje su statistički visoko značajne. Prvom glavnom komponentom objašnjeno je 43,22% učešća GE interakcije, odnosno 20,04% od ukupne varijabilnosti za ovu osobinu. Na osnovu grafičkog prikaza GE interakcije pomoću biplot grafikona zaključuje se da su sorte Oplenac, Sremac, i KP-80, stabilne u ispitivanim uslovima, sa većom visinom formiranja prve mahune od prosečne vrednosti. Sorta Naya Nayahit, takođe ima visoko formiranu mahunu, ali nije se pokazala stabilnom u ispitivanim godinama.

**Ključne reči:** pasulj, visina prve mahune, AMMI model

**AMMI ANALYSIS OF THE FIRST POD HEIGHT IN COMMON BEAN  
(*PHASEOLUS VULGARIS* L.)**

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Common bean (*Phaseolus vulgaris* L.), based on its economical importance, is among most valuable legumes in the world. It is important in human diet due to its high nutritional value and content of dietary fibers.

Nowadays, common bean is being cultivated in pure stand on bigger acreage. Due to mechanical processing and harvesting of common bean, it is important to have certain values of height components of bean plants. Among them, the most important is first pod height. Stability of this trait in different growing conditions is to be considered.

The aim of this work was to investigate the reaction of 14 bean genotypes to agroclimatic conditions during seven growing seasons for the first pod height forming. Trials were arranged in randomized complete block design, in three replications, on the location of Rimski Šančevi. The average value of first pod height for all genotypes was 20.32 cm. The genotype with lowest average value for this trait was variety Galeb (16.09 cm), which also had very low coefficient of variation (12.23 cm). The highest first pod on plant had variety Sremac (23.77 cm), while this trait was the most variable in variety Naya Nayahit (21.06%).

By using AMMI model the main effects responsible for bean first pod height forming were determined. The results showed that influence of environments, genotypes and their interaction on first pod height were significant, but in different levels. Influence of genotype was around 29%, while less influence had years (23.81%). The biggest source of variability came from GE interaction with 46.36%. Sources of variability in GE interactions were attributed to four statistically highly significant principal components. The first principal component explained 46.22 % of GE interaction, which presented 20.04% of total variability for this trait.

Based on biplot graphs it can be concluded that varieties Oplenac, Sremac and KP-80 population were stable in evaluated conditions. These genotypes also had average values of first pod height above overall mean. Variety Naya Nayahit also had high first pod, but it didn't express stability in tested years.

**Key words:** common bean, first pod height, AMMI model



## UTICAJ PRIMENE INDOL-3-SIRĆETNE KISELINE NA KVALITET RASADA LETNJEG CVEĆA

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U radu je ispitivan uticaj primene indol-3-sirćetne kiseline na kvalitet rasada letnjeg cveća i to: *Salvia splendens L.*, *Antirrhinum majus L.*, i *Alyssum maritima L.* Rasad cveća proizveden je u plastičnim kontejnerima i polipropilenskim saksijama. Uticaj indol-3-sirćetne kiseline praćen je kroz četiri različita tretmana i od samog početka proizvodnje rasada. Dobijeni rezultati pokazali su pozitivan efekat indol-3-sirćetne kiseline na ispitivane kvalitativne karakteristike proizvedenog rasada cveća i to: nadzemnu masu, masu korena, broj obrazovanih bočnih grana i dužinu cvasti.

**Ključne reči:** indol-3-sirćetna kiselina, cveće, rasad

## INFLUENCE OF INDOLE-3-ACETIC ACID ON THE QUALITY OF SUMMER FLOWER SEEDLINGS

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The work has examined the influence of indole-3-acetic acid on the quality of summer flowers: *Salvia splendens* L., *Antirrhinum majus* L., and *Alyssum maritima* L. Seedlings of flowers produced in polystyrene containers and polypropylene pots. Influence of indole-3-acetic acid was monitored through four different treatments from the beginning of the production of seedlings. The results show a positive effect of indole-3-acetic acid on examination the qualitative characteristics of produced seedlings and aboveground mass, root mass, number of lateral branches and length of bloom.

**Key words:** indole-3-acetic acid, flowers, seedlings

## UTICAJ MINERALNE ISHRANE NA POJAVU I INTENZITET CRNE PEGAVOSTI STABLA SUNCOKRETA

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Crna pegavost stabla (*Phoma macdonaldii*) se javlja u većini područja proizvodnje suncokreta. Simptomi se pojavljuju na svim delovima biljke u vidu crnih nekrotičnih pega. Na pojavu (procenat bolesnih biljaka) i intenzitet bolesti (procenat stabla suncokreta sa simptomima bolesti) utiče niz faktora, a jedan od njih je đubrenje. U ovom istraživanju pojava i intenzitet bolesti, u uslovima različite mineralne ishrane, pri spontanoj infekciji, su paraćeni u toku 2010., 2011. i 2013. godine. Eksperiment se sastojao od 19 varijanti mineralne ishrane i kontrolnog tretmana bez đubrenja, postavljenih prema blok sistemu u četiri ponavljanja.

Pojava i intenzitet bolesti su se značajno razlikovale u trogodišnjem periodu istraživanja. Pojava bolesti je bila najveća u 2010. (99%) a najmanja u 2011. (0,44%). Razlika u pojavi bolesti između tretmana nije bilo u 2010. kad je većina biljaka imala simptome bolesti i 2011. godine kad se bolest pojavila sporadično. U 2013. godini pojava bolesti je bila značajno veća kod tretmana gde je primenjeno azotno đubrivo (NPK 100:0:0) u odnosu na ostale tremane. U istoj godini pojava bolesti se kod ostalih tretmana nije statistički značajno razlikovala u odnosu na kontrolu. Značajne razlike u intenzitetu bolesti između varijanti đubrenja su zabeležene u 2010., a u ostalim godinama istraživanja su izostale. U 2010. najveći intenzitet bolesti je zabeležen kod tretmana gde je primenjeno samo azotno đubrivo (NPK 100:0:0) u odnosu na tretmane gde su biljke đubrene isključivo kalijumovim (NPK 0:0:100) ili fosforim đubrivom (NPK 0:100:0). Intenzitet pojave bolesti kod tretmana gde su korišćene različite doze azota, fosfora i kalijuma nije bio u korelaciji sa količinom unetih đubriva.

Rezltati istraživanja ukazuju na izraženiju pojavu i pojačan razvoj bolesti u slučaju đubrenja isključivo azotnim đubrivima (NPK 100:0:0). Mineralna ishrana sa fosforim ili kalijumovim đubrivima i mineralna ishrana u kombinaciji ovih elemenata sa azotom nije imala značajan uticaj na pojavu bolesti.

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**Ključne reči:** *Phoma macdonaldii*, mineralna ishrana, suncokret

## PLANT NUTRITION AFFECTS INCIDENCE AND SEVERITY OF PHOMA BLACK STEM

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Phoma black stem is present in almost all regions with sunflower production. Disease symptoms can appear on all plant parts in form of black necrotic areas. Disease incidence (percentage of diseased plants) and severity (percentage of stem covered in disease symptoms) is influenced by number of factors including plant nutrition. In this research disease incidence and severity were recorded in 3-year period on plants in plots with different fertilizer rates. Experiment had 19 plots differing in nutrition levels and control plot without fertilizer usage. Experimental design was completely randomized block system with four replications.

Disease incidence the highest value 2010 (99%) and the lowest in 2011 (0.44%). Disease incidence was highest in 2010 (99%) and lowest in 2011 (0,44%). Difference in disease incidence among plots was absent in 2010 when disease developed on majority of plants and in 2011 when disease was scarce. In 2013 disease incidence was significantly higher in plot where only nitrogen fertilizer (NPK 100:0:0) was applied in comparison to other treatments. Difference in disease incidence comparing other plots and control was not significant. Significant difference in disease severity was recorded only in 2010. In 2010. high mean value of disease severity had plot where only nitrogen fertilizer was applied (NPK 100:0:0), compared to control and treatments with application of potassium (NPK 0:0:100) or phosphorus (NPK 0:100:0) fertilizer. Disease severity in other plots was not correlated with levels of applied fertilizers. Research results indicate increase in disease incidence and severity when nitrogen fertilizers are solely applied (NPK 100:0:0). Application of phosphorus or potassium and their combination with nitrogen fertilizers had no influence on disease incidence.

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**Key words:** *Phoma macdonaldii*, plant nutrition, sunflower

## PROSTORNO UREĐENJE ORGANSKIH FARMI UVOĐENJEM ZAŠTITNO-IZOLACIONIH POJASEVA

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Cilj istraživanja je bio projektovanje zaštitno-izolacionih pojaseva na odabranim gazdinstvima uz pronalaženje optimalnih biljnih vrsta za podizanje istih. Zaštitni pojasevi predstavljaju jednu od tehnika ekološkog uređenja prostora koja doprinosi uvećanju staništa korisnih organizama pružajući utočište, gnezda i izvore nektara i polena, a za uzvrat oni pružaju veliku korist biljnoj proizvodnji. Biljne vrste koje se koriste za zasnivanje ovakvih pojaseva najčešće su autohtone i doprinose očuvanju lokalne flore. Formiranje izolacionog pojasa u organskoj proizvodnji predstavlja zakonsku obavezu, jer organska parcela mora biti izolovana od parcele pod konvencionalnom proizvodnjom. Istraživanja su izvedena na multifunkcionalnim gazdinstva u sistemu organske poljoprivrede - na lokalitetima Pivnice i Futog - Vlček, Aćimović i Dolovac. Analiza je podrazumevala vegetacijsko i prostorno snimanje terena. U cilju pronalaženja najadekvatnijih rešenja analizirane su zone za osnivanje i odabir biljnih vrste u skladu sa uslovima na gazdinstvu. Kao rezultat istraživanja data su nova rešenja. Takođe, utvrđen je najoptimalniji izbor vrsta za zaštitni pojas, interakcija pojasa sa gajenim usevima i okolnom vegetacijom. Definisani su postupci upravljanje biljkama u zaštitnom pojasu kako ne bi došlo do njihove nekontrolisane ekspanzije. Za parcele u blizini konvencionalne proizvodnje preporučene su biljne vrste koje imaju robusnu nadzemnu masu i visinu (npr. morač). Za izolovane delove gazdinstva preporučene su medonosne vrste i biljke koje sukcesivno cvetaju tokom godine (iz familija Asteraceae, Polygonaceae, Apiaceae). Utvrđeno je da se kroz uvođenje zaštitno-izolacionih pojaseva može postići visoki integritet organske proizvodnje što u dužem periodu obezbeđuje i njenu održivost. Masovno uvođenje eko-pojaseva na sertifikovanim parcelama predstavlja efikasnu metodu za očuvanje biodiverziteta.

**Ključne reči:** biodiverzitet, zaštitno-izolacioni pojasevi, organska proizvodnja, poljoprivredna gazdinstva

## SPATIAL PLANNING OF ORGANIC FARMS BY INTRODUCTION ISOLATION BELTS

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The aim of this research was to design the isolation belts on selected farms and selection of most suitable plant species for establishment. Isolation belts are one of the techniques of ecological spatial planning which contributes to increasing the habitat of beneficial organisms by providing refuge, nests and sources of nectar and pollen, and in return they provide great benefit to farm production. Species used for the establishment of these belts are mostly native contributing to the preservation of local flora. The formation of the isolation belt in organic production is a legal obligation because organic plots must be distanced from land under the conventional production. Research was performed on multifunctional farms in the system of organic agriculture - at the sites Pivnice and Futog - Vlček, Aćimović and Dolovac. The analysis encompasses vegetation and spatial field recording. In order to find the most appropriate design positions for the establishment and plant species were analyzed. As a result of the research new schemes are given. Recommended models offer better organization of farm spaces with intensive use of protective-isolation belts, the protection of farms and conservation of biodiversity. Also, an optimal solution of species for protection belts were presented, the interaction of belts with crops grown and existing vegetation. Procedures of managing plants in the protective zone in order to avoid their uncontrolled expansion were also researched. For those plots that are close to conventional production species that have robust aboveground mass and height (e.g., fennel) were recommended. Honeybee plant species and plants that bloom successively during the year were recommended for isolated parts of farm (family Asteraceae, Polygonaceae, Apiaceae). It was found that the introduction of protective-isolation belts can achieve high integrity of organic production which in longer period ensures its sustainability. The mass introduction of eco-belts on certified farms present an effective method for preserving biodiversity.

**Key words:** biodiversity, isolation belts, organic farming, farms

## UTICAJ RAZLIČITIH NAČINA PROIZVODNJE NA KVALITET RASADA MILODUHA

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U cilju intenziviranja proizvodnje rasada lekovitog, aromatičnog i začinskog bilja, sprovedena su istraživanja u stakleniku Poljoprivrednog fakulteta u Beogradu tokom 2015. godine.

Istraživanja su obuhvatila klasičnu proizvodnju rasada miloduha (*Hyssopus officinalis* L.) u sandučićima i kontejnersku proizvodnju rasada. U ogledu korišćeni su kontejneri sa zapreminom ćelija od 76 cm<sup>3</sup>, 30 cm<sup>3</sup> i 8 cm<sup>3</sup> (3 modela) i polipropilenske saksije (4 modela): 8,5 (260 cm<sup>3</sup>); 9 (320 cm<sup>3</sup>); 9B (360 cm<sup>3</sup>) i 11 (470 cm<sup>3</sup>).

Na osnovu rezultata istraživanja uticaja različitih načina proizvodnje na kvalitet rasada miloduha rezultati pokazuju; da je najbolji kvalitet rasada dobijen proizvodnjom u kontejneru sa najvećom zapreminom – zapreminom ćelije (76 cm<sup>3</sup>). Najslabiji kvalitet rasada dobijen je proizvodnjom u kontejneru sa najmanjom zapreminom ćelije (8 cm<sup>3</sup>).

Interesantno je, da je bolji kvalitet rasada miloduha postignut proizvodnjom u pikir sandučiću u odnosu na kontejnerski sistem za zapreminom ćelije od 8 cm<sup>3</sup>. Proizvodnjom rasada miloduha u saksijama zapremine 320 cm<sup>3</sup> dobijen je bolji kvalitet rasada u odnosu na ostale korišćene saksije.

**Ključne reči:** miloduh, načini proizvodnje, klasičan, kontejneri

## INFLUENCE OF DIFFERENT CULTIVATION TECHNOLOGY ON THE SEEDLING QUALITY OF HYSOP

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In order to boost the production of seedlings of medicinal, aromatic and spice plants, conducted research in the greenhouse of the Agricultural Faculty in Belgrade in 2015.

The research included classical production of nursery production hyssop (*Hyssopus officinalis* L.) in boxes for sowing and container production. In the experiment were used containers with a capacity of cells of 76 cm<sup>3</sup>, 30 cm<sup>3</sup> and 8 cm<sup>3</sup> (3 models) and polypropylene pots (4 models): 8,5 (260 cm<sup>3</sup>); 9 (320 cm<sup>3</sup>); 9B (360 cm<sup>3</sup>) and 11 (470 cm<sup>3</sup>).

Based on the results of research on the effect of different production methods on the quality of hyssop results show; that the best seedlings quality production obtained in a container with a maximum volume capacity of the cell (76 cm<sup>3</sup>). The worst nursery quality was obtained by producing in a container with a minimum volume of cells (8 cm<sup>3</sup>).

Interestingly, the better the quality of hyssopus seedlings reached production in box in relation to the container system for cell volume of 8 cm<sup>3</sup>. Production of hyssop seedlings in pots volume of 320 cm<sup>3</sup> was obtained better quality seedlings production compared to other used pots.

**Key words:** hyssop, cultivation technology, classical, containers



## UTICAJ KALIBRIRANJA NA KVALITET DORAĐENOG HIBRIDNOG SEMENA KUKURUZA

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Primena kalibriranja u tehnologiji dorade uvedena je od kada je počela upotreba hibridnog semena za proizvodnju kukuruza. Načini primene kalibriranja zavise od osobina i sastava proizvedenog naturalnog semenskog materijala.

U radu su prikazani rezultati istraživanja hibridnog semena jedne privatne komercijalne kombinacije FAO grupe zrenja 400. Hibridno seme F1 generacije proizvedeno je na dve lokacije (Jagodina; Padinska Skela). Ekološki uslovi u toku proizvodnje bili su različiti, ali je navodnjavanje primenjeno na oba mesta. Za oba mesta uzeto je po 20 kg semenskog materijala za laboratorijsko ispitivanje. Laboratorijska dorada (kalibriranje) izvršena je u PKB Agro seme Beograd. Osobine semena ispitane su u Institutu PKB Agroekonomik Beograd.

Semenski materijal, za svaku lokaciju posebno, podeljen je u pet setvenih frakcija. Ispitivane su sledeće osobine semena u svakoj frakciji: masa 100 semena; klijavost semena; broj semena u 1 kg; broj semena u 1 l; masa semena u 1 l. Rezultati su prikazani kao varijacioni red (X; C.V.) i kao prosti koeficijenti korelacije (r).

Utvrđene su razlike između frakcija i lokacija proizvodnje semena za sve ispitivane osobine. Dobijeni rezultati pokazuju mogućnost različitog rešenja punjenja pojedinačnih pakovanja semena prema definisanom broju semena u svakom pakovanju.

Utvrđene su nepodudarnosti mase 100 semena u istoj frakciji veličine sa dve lokacije proizvodnje. Razlike između mase semena u 1 l, između lokacija i u istoj frakciji veličine, manje su od razlika između mase 100 semena. Broj semena u 1 l manji je od broja semena u 1 kg na obe lokacije proizvodnje u svih pet frakcija veličine. Razlika u broju semena u 1 l, između lokacija proizvodnje, znatno je manja u tri frakcije dok u jednoj frakciji takva razlika nije od značaja.

**Ključne reči:** kukuruz; hibridno seme; proizvodnja; kalibriranje; osobine; varijacioni red; koeficijenti korelacije.

## INFLUENCE CALIBRATION ON QUALITY OF PROCESSED MAIZE HYBRID SEED

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Calibration application in processing technology has been introduced since use of hybrid seed in maize production. Calibration application ways depends on characteristics and composition of natural seed material.

Results that are shown in this work are research results of investigation of hybride seed of one private comercial combination FAO group 400. F1 generation hybride seed has been produced on two locations (Jagodina; Padinska Skela). Ekological conditions during seed crop production were differenta, but irrigation has been applied in both locations. 20 kg of seed material for laboratory testing has been taken from both locations. Laboratory processing (calibration) has been performed in PKB Agroseme Belgrade. Seed characteristics has been researched in Institute PKB Agroekonomik Belgrade.

Seed material has been divided into five sowing fractions separately for each location. Following characteristics have been determined in each fraction: 100 seeds mass; seed germination; number of seeds per 1 kg; number of seeds per 1 l; mass of seed per 1 l. Results are shown as variation order ( $x$ ; C.V.) and simple correlation coeficient ( $r$ ).

Different differenties between fractions and locations of seed production for all seed characteristics has been determined. Calculated results show possibility of different aproaches-solutions for filling single packages, based on number of seeds in each package.

Discrepancies were observed with a mass of 100 seeds in the same fraction of the size of the two locations. Differences between seed weight in 1 l, between sites in the same fraction size, less than the difference between the weight of 100 seeds. The number of seeds in 1 l is less than the number of seeds in 1 kg in both locations in all five fractions size. The difference in the number of seeds in 1 l, between sites of production, was significantly lower in the three fractions, while in a fraction of such difference is not significant.

**Key words:** maize; hybrid seed; production; calibration; characteristics; variation order; simple correlation coeficient.

## ISPITIVANJE POKAZATELJA KVALITETA SEMENA PAPRIKE

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Cilj rada bio je utvrđivanje dva najvažnija pokazatelja kvaliteta semena paprike, energije klijanja i ukupne klijavosti. Ispitivanje klijavosti semena je izvedeno na dve različite podloge (filter papir i pesak). Za istraživanje su korišćena dva hibrida (SK-5 F1 i Atris F1) i jedna domaća sorta (Slonovo uvo). Rezultati energije klijanja i ukupne klijavosti kod ispitivanih hibrida i sorte pokazuju značajno ( $p=0,01$ ) veće vrednosti na podlozi filter papir, u odnosu na vrednosti dobijene na podlozi pesak. Najveća energija klijanja 83% i ukupna klijavost 96%, utvrđena je kod hibrida SK-5 F1 na podlozi filter papir, dok su najmanje vrednosti 65%, odnosno 72% zabeležene kod sorte Slonovo uvo na podlozi pesak. Statistička analiza energije klijanja i ukupne klijavosti pokazala je značajne ( $p=0,01$ ) razlike pod uticajem sorte i podloge ispitivanja. Veoma je važno da seme paprike ima visoku energiju klijanja i ukupnu klijavost, jer od njih zavisi ujednačeno klijanje i nicanje semena.

**Ključne reči:** energija klijanja, ukupna klijavost, paprika

## SEED TESTING OF THE QUALITY INDICATORS OF PEPPERS

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The aim of this study was to determine the two most important indicators of the quality of seeds, germination energy and total germination. Germination testing was performed on two different substrates (filter paper and sand). For the research we have used two hybrids (SK-5 F1 and Atris F1) and one local variety (Slonovo uvo). Results of germination energy and total germination studied hybrids and cultivars show significantly ( $p=0,01$ ) higher values on the surface filter paper, compared to the values obtained in the surface sand. The highest energy germination 83% and total germination 96%, was found in the hybrid SK-5 F1 on the surface filter paper, while the minimum value of 65% and 72% recorded in the cultivar Slonovo uvo on substrates sand. Statistical analysis of germination energy and total germination showed significant ( $p=0,01$ ) differences under the influence of varieties and substrate tests. It is very important that the seeds of peppers have a high germination energy and total germination, because it depends on them uniform germination of seeds.

**Key words:** Germination energy, total germination, pepper

**UTICAJ DOZE AZOTNIH ĐUBRIVA NA PRINOS I KOMPONENTE PRINOSA  
OZIMOG TRITIKALEA***Dragana Lalević<sup>1</sup>\*, Milan Biberdžić<sup>1</sup>*<sup>1</sup> Poljoprivredni fakultet, Univerzitet u Prištini, Lešak, Republika Srbija*\*dragana.lalevic@gmail.com*

Zbog visokog genetičkog potencijala za prinos i povoljnih nutritivnih vrednosti, tritikale predstavlja perspektivnu biljnu vrstu. Za postizanje visokih i stabilnih prinosa neophodni su povoljni agroklimatski uslovi područja, sortiment i agrotehnika sa posebnim osvrtom na đubrenje. U radu je ispitan uticaj đubrenja azotom na prinos i komponente prinosa pet sorti ozimog tritikalea: Odisej, Kg-20, Trijumf, Rtanj i Tango. Trogodišnji ogled (2009-2012) koji je bio postavljen po slučajnom blok sistemu u tri ponavljanja obuhvatao je kontrolu i tri varijante đubrenja azotom (0, 60, 90, 120 kg ha<sup>-1</sup>). U svim varijantama đubrenja, osim azota, upotrebljeno je još po 80 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> i K<sub>2</sub>O. Rezultati istraživanja su pokazali da je upotreba azota imala pozitivan efekat na prinos i komponente prinosa ozimog tritikalea u svim varijantama đubrenja i kod svih sorti. Najveći prosečan prinos zrna ostvarila je sorta Tango (5,07 t ha<sup>-1</sup>), a najmanji sorta Kg-20 (3,96 t ha<sup>-1</sup>). Takođe, sorta Tango imala je i najveću vrednost mase 1000 zrna (48,6 g), dok je najveću hektolitarsku masu imala sorta Trijumf (70,73 kg). Primena mineralnih đubriva dovela je do vrlo značajno velikog povećanja prinosa u poređenju sa kontrolom. U skladu sa tim, sve ispitivane sorte su najveći prinos imale pri upotrebi najveće količine azota (120 kg ha<sup>-1</sup>).

S obzirom da je tritikale namenjen uglavnom ishrani stoke, rezultati ovih istraživanja imaju značaja, kako sa aspekta njegovog gajenja kao ratarske krmne kulture, tako i sa aspekta njegovog oplemenjivanja na kvalitet zrna i produktivnost.

**Ključne reči:** ozimi tritikale, azot, đubrenje, sorta, prinos, komponente prinosa

**EFFECTS OF NITROGEN RATES ON YIELD AND YIELD COMPONENTS OF WINTER TRITICALE***Dragana Lalević<sup>1</sup>, Milan Biberdžić<sup>1</sup>*<sup>1</sup> Faculty of Agriculture, University in Priština, Lešak, Republic of Serbia

Due to the high genetic potential for yield and favorable nutritional value, triticale is a promising plant species. For achieving high and stable yields, it's necessary to have favorable agroclimatic conditions of the locality, variety and advanced agricultural techniques, with special emphasis on fertilizing. This study examines the effect of increasing rates of nitrogen on yield and yield components of five cultivars of winter triticale: Odisej, Kg-20, Triumph, Rtanj and Tango. The three-year trial (2009-2012) which was set up in a randomized block system in three replications, which included control and three different doses of nitrogen fertilization (0, 60, 90 and 120 kg ha<sup>-1</sup>). In all variants of fertilization, 80 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were added beside the nitrogen. The obtained results showed that the use of nitrogen had a positive effect on yield and yield components in all variants and in all cultivars. The variety Tango had the highest average grain yield, while the variety Kg-20 had the lowest. Also, Tango had the highest value of the 1000 seed weight and the number of seed per spike, while Triumph had the highest value of hectoliter weight. The application of fertilizers has led to a very large and significant increase of yield compared with the control. Accordingly, all studied cultivars had the highest yield with the highest quantities of nitrogen (120 kg ha<sup>-1</sup>).

Considering that triticale is intended mainly for feeding livestock, the results of these studies would be valuable in terms of its growing as forage crop as well as in terms of its breeding for grain quality and productivity.

**Key words:** winter triticale, nitrogen, fertilization, cultivar, yield, yield components

## ANALIZA PROIZVODNJE KRSTAVCA KORNIŠONA U VERTIKALNOM UZGOJU

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U ovom radu je analizirana proizvodnja krastavca kornišona na poljoprivrednom gazdinstvu Đokić, opština Velika Plana, u dve proizvodne godine, 2013 i 2014. Krastavac sorte *dolomit F<sub>1</sub>* (Nunhems) se uzgajao u špaliru na ukupnoj površini od 2 ha (otvoreno polje). Berba se obavljala tokom tri meseca, od jula do septembra.

Ekonomska analiza je izvršena na osnovu evidencije na gazdinstvu. Podaci su sadržali troškove radne snage, repromaterijala, agrotehničkih mera, prinose i cene krastavaca.

Svi pokazatelji su preračunati na 1 ha. Cilj rada je bio obračun ekonomske opravdanosti uzgoja krastavaca u špaliru. Upotreba mašina je obračunata kao servis, dok je za zemlju uzeta prosečna cena zakupa od 300 €/ha. Stubovi i žice se amortiziraju za 10 godina, a mreža za 3 godine.

Rezultati analize pokazuju da od ukupnih troškova proizvodnje najveći udeo imaju troškovi berbe, preko 32%, a zatim agrotehničke mere đubrenja, oko 21%, dok troškovi setve i sadnje, kao i prodaje i transporta robe iznose oko 14%. Ostatak troškova čine troškovi obrade zemljišta, zaštite i navodnjavanja useva i usluga.

Ostvaren je prosečni prinos od 26.450 kg/ha, a prosečna prodajna cena ploda iznosila je 0,5 €/kg. Ukupni troškovi analizirane proizvodnje iznosili su 9.805 €, dok je ostvarena bruto marža po hektaru iznosila 3.420 €.

**Ključne reči:** krastavci kornišoni, vertikalni uzgoj, ekonomska analiza

**ANALYSIS OF GHERKIN PRODUCTION IN THE VERTICAL FARMING SYSTEM**

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In this paper it has been analyzed the production of gherkins on the Djokic farm, municipality Velika Plana, in two production years 2013 and 2014. Cucumber, variety *Dolomit F<sub>1</sub>* (Nunhems), was grown in vertical farming system on a total area of 2 ha (open field). Harvest was performed during the three months, from July to September.

The economic analysis was based on the farm records. Data included the labor costs, materials, agro-technical measures, gherkin yields and prices.

All indicators were calculated on the basis of 1ha. The aim of the paper is an economic justification for growing of gherkins in the vertical farming system. The use of machinery is calculated as a service, while for the land it has been calculated the average rental price of 300 €/ha. Pillars and wires have been depreciated in 10 years, while the net in 3 years.

The results of analysis show that the costs of harvest have the largest participation in the total production costs, over 32%, followed by the fertilization costs, about 21%, while the costs of sowing and planting, as well as the sales and transport of goods amounted to about 14%. The remaining costs are the costs of land cultivation, crop protection, irrigation and services.

It has been achieved an average yield of 26,450 kg/ha, while the average selling price of gherkin was 0.5 €/kg. The total costs of the analyzed production amounted to 9,805 €, while the achieved gross margin per hectare amounted to 3,420 €.

**Key words:** gherkins, vertical farming system, economic analysis



## OČEKIVANA GENETIČKA DOBIT ZA STAKLAVOST ZRNA DURUM PŠENICE

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Visok procenat staklavosti zrna, visok sadržaj žutog pigmenta, zadovoljavajuća test težina i sadržaj proteina, naročito glutena, predstavljaju osobine kvaliteta od primarnog interesa za korišćenje sorata durum pšenice u prehrambenoj industriji. Internacionalno klasiranje sorata durum pšenice se vrši prema stepenu staklavosti zrna i tvrdoći. Prema opštim uslovima kvaliteta durum pšenice kao sirovine za mlinsku industriju u Srbiji sadržaj potpuno staklavih zrna durum pšenice treba da je najmanje 60%, dok je u Evropskoj Uniji poželjan minimum od 80%. Cilj ovog istraživanja je bio da se prouči varijabilnost, komponente varijanse, heritabilnost u širem smislu, i očekivana genetička dobit za staklavost zrna 15 genotipova durum pšenice. Poljski ogledi su izvedeni tokom 2010-2011. i 2011-2012 vegetacione sezone na tri lokaliteta: Rimski Šančevi, Zemun Polje i Padinska Skela. Prosečne vrednosti staklavosti zrna proučavanih genotipova za svih šest sredina su bile u intervalu od 72,6% do 88,5% sa prosečnom vrednošću od 83,1%. Na osnovu združene dvofaktorijalne analize varijanse je utvrđeno da je sredina bila najznačajniji izvor variranja za staklavost zrna durum pšenice sa 89,8% objašnjene sume kvadrata (SS), potom interakcija genotip  $\times$  sredina sa 6,1% i na kraju genotip sa 4,1%. Odnos komponenti varijanse interakcije genotip  $\times$  sredina i genetičke ( $\sigma_{ge}^2/\sigma_g^2$ ) je iznosio 1,9 i ukazao je na nestabilnost proučavanih genotipova durum pšenice za staklavost zrna pšenice. Heritabilnost u širem smislu ( $h^2$ ) je bila umereno visoka sa vrednošću od 71%, dok je očekivana genetička dobit izražena u procentima od proseka (GAM) iznosila 6,8%. Uzimajući u obzir da je dobijena umereno visoka  $h^2$  i mala GAM, i da je utvrđena sezonska nestabilnost i veliki uticaj faktora sredine, ne može se očekivati veći uspeh selekcije u oplemenjivanju na povećanje staklavosti zrna durum pšenice.

**Ključne reči:** *Triticum durum*, staklavost zrna, komponente varijanse, heritabilnost, više-lokacijski ogled

## EXPECTED GENETIC ADVANCE FOR GRAIN VITREOUSNESS IN DURUM WHEAT

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High percent of grain vitreousness, high yellow pigment content, good test weight and protein content, especially of gluten, are quality traits of primary interest for using durum wheat cultivars in food processing industry. The international grading of the durum wheat varieties is determined based on degree of grain vitreousness and hardness. According to general durum wheat quality requirements as the commodity for milling industry in Serbia the content of fully vitreous grains should be minimum 60%, whereas in European Union favorable minimum is 80%. Aim of this investigation was to analyse variability, components of variance, heritability in a broad sense and expected genetic advance for grain vitreousness of 15 durum wheat genotypes. Field trials were conducted during 2010-2011. and 2011-2012 growing seasons at the three locations: Rimski Šančevi, Zemun Polje i Padinska Skela. Average values for grain vitreousness of examined genotypes across all six environments were in interval 72.6%-88.5% with the mean value of 83.1%. According to two-way combined analysis of variance environment represented the most significant source of variation with 89.8% of explained sum of squares (SS), than genotype × environment interaction with 6.1% of SS and at the end genotype with 4.1% of SS. Relation of components of variance genotype × environment interaction and genetic component ( $\sigma_{ge}^2 / \sigma_g^2$ ) was 1.9 and indicated instability of used genotypes of durum wheat for grain vitreousness. Heritability in a broad sense ( $h^2$ ) was moderately high with the value of 71%, whereas expected genetic advance as percent of mean (GAM) was 6.8%. Taking into account that moderately high  $h^2$  and small GAM were obtained, and also season instability and great environment impact, we cannot anticipate big success from selection in breeding for higher grain vitreousness content of durum wheat.

**Key words:** *Triticum durum*, grain vitreousness, components of variance, heritability, multi-environment trial

## OČEKIVANA GENETIČKA DOBIT ZA SADRŽAJ ALBUMINA KOD HLEBNE I DURUM PŠENICE

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Albumini su značajni sa nutritivnog stanovišta zbog visokog sadržaja esencijalnih aminokiselina-lizina, triptofana, metionina, a takođe imaju viši sadržaj asparagina, glutamina, arginina, prolina u odnosu na gluten. Ostvaruju ulogu konstitutivnih i metaboličkih proteina sa enzimatskom, regulatornom, sintetičkom i inhibitornom aktivnošću. U njih se ubrajaju amilaze i inhibitori različitih enzima kao što je  $\alpha$ -amilazni/tripsin inhibitor, koji kontroliše amilaznu aktivnost, reguliše metabolizam skroba, kao i osmotski pritisak, zatim serpini i purotionini. Albumini su i inhibitori insekatskih i gljivičnih patogena. Cilj ovog istraživanja je bio da se prouči varijabilnost, komponente varijanse, heritabilnost u širem smislu ( $h^2$ ), i očekivana genetička dobit u procentima od proseka (GAM) za sadržaj albumina 30 genotipova hlebne i durum pšenice. Poljski ogledi su izvedeni tokom 2010-2011. i 2011-2012 vegetacione sezone na tri lokaliteta: Rimski Šančevi, Zemun Polje i Padinska Skela. Prosečne vrednosti sadržaja albumina proučavanih genotipova za svih šest sredina su iznosile 20,23 g kg<sup>-1</sup> kod hlebne pšenice i 23,12 g kg<sup>-1</sup> kod durum pšenice. Na osnovu združene dvofaktorijalne analize varijanse je utvrđeno da je sredina bila najznačajniji izvor variranja za sadržaj albumina kod hlebne i durum pšenice sa 55,8% i 49,6% objašnjene sume kvadrata, potom interakcija genotip  $\times$  sredina sa 34,2% i 41,8%, pa genotip sa 10% i 8,6%. Odnos komponenti varijanse interakcije genotip  $\times$  sredina i genetičke komponente ( $\sigma_{ge}^2/\sigma_g^2$ ) je iznosio 13,1 kod hlebne pšenice i 241,6 kod durum pšenice, i ukazao je na veliku nestabilnost proučavanih genotipova, naročito durum pšenice.  $h^2$  je bila niska sa vrednošću od 31,3% kod hlebne pšenice i veoma niska sa 2,4% kod durum pšenice, dok je GAM iznosila 4% kod hlebne pšenice i 2,2% kod durum pšenice. Uzimajući u obzir da je dobijena niska  $h^2$  i veoma mala GAM, ne može se očekivati uspešnost selekcije za povećanje sadržaja albumina kod hlebne i durum pšenice konvencionalnim oplemenjivanjem.

**Ključne reči:** *Triticum aestivum*, *Triticum durum*, albumini, komponente varijanse, heritabilnost, više-lokacijski ogled

## EXPECTED GENETIC ADVANCE FOR ALBUMIN CONTENT IN BREAD WHEAT AND DURUM WHEAT

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Albumins are significant from the nutritional viewpoint, because they contain high content of essential amino acids such as lysine, tryptophan, methionine, and also a higher content of asparagine, glutamine, arginine, and proline compared to the gluten. They act as constitutive and metabolic proteins with enzymatic, regulatory, synthetic and inhibitory activity. Among them are amylases and inhibitors of different enzymes like alpha-amylase/trypsin inhibitor, which controls amylase activity, regulating starch metabolism, osmotic pressure, then serpins and purothionins. Albumins also inhibit insect and fungi pathogens. Aim of this investigation was to analyse variability, components of variance, heritability in a broad sense ( $h^2$ ) and expected genetic advance as percent of mean (GAM) for albumins content of 30 bread and durum wheat genotypes. Field trials were conducted during 2010-2011. and 2011-2012 growing seasons at the three locations: Rimski Šančevi, Zemun Polje i Padinska Skela. Average values for albumin content of examined genotypes across all six environments were 20.23 g kg<sup>-1</sup> in bread wheat and 23.12 g kg<sup>-1</sup> in durum wheat. According to two-way combined analysis of variance environment represented the most significant source of variation in bread and durum wheat with 55.8% and 49.6% of explained sum of squares, than genotype × environment interaction with 34.2% and 41.8%, and genotype with 10% and 8.6%. Relation of components of variance genotype × environment interaction and genetic ( $\sigma_{ge}^2 / \sigma_g^2$ ) was 13.1 in bread wheat and 241.6 in durum wheat, and indicated instability of genotypes especially durum wheat.  $h^2$  was low with the value of 31.3% in bread wheat and very low with the value 2.4% in durum wheat, whereas GAM was 4% in bread wheat and 2.2% in durum wheat. Taking into account low  $h^2$  and small GAM, we cannot predict success from selection in conventional breeding for higher albumins content in bread wheat and durum wheat.

**Key words:** *Triticum aestivum*, *Triticum durum*, albumins, components of variance, heritability, multi-environment trial

**PORAST IZDANAKA KAO ODGOVOR NA TRETIRANJE SEMENA INBRED  
LINIJA KUKURUZA PESTICIDIMA**

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Tretiranje semena je uobičajen način primene fungicidima i insekticidima u današnje vreme, s obzirom da ovaj način primene pesticida može da pruži najbolju zaštitu u neposrednoj blizini buduće biljke. Cilj ovog istraživanja je da se ispita uticaj različitih tretmana semena na klijanje semena i početni porast izdanaka različitih inbred linija kukuruza. Istraživanje je obuhvatilo testiranje tretiranja semena inbred linija kukuruza sa nekoliko kombinacija fungicida Maxim XL 035-FS i neonikotinoidnih insekticida Gaucho 600-FS i Cruiser 350-FS. Netretirano seme je uzeto za kontrolu. Rezultati istraživanja su pokazali da inbred linije 21202 x 21101 NS i 317659 NS imaju visoko vigorozno seme, na koje nisu uticali testirani preparati. Testirane kombinacije Maxim XL 035-FS+Gaucho 600-FS i Maxim XL 035-FS+Cruiser 350-FS dovele su do smanjenja klijavosti semena inbred linije 306081 NS, kao i do smanjenja dužine korena i mase suvog korena izdanaka inbred linije 21202 x 21101 NS. Svi testirani tretmani imali su pozitivan uticaj na porast izdanaka, kao i na masu svežeg i suvog nadzemnog dela i korena izdanaka inbred linija 306081 NS i 317659 NS.

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**Ključne reči:** tretiranje semena fungicidom i neonikotinoidima, inbred linije kukuruza, klijavost semena, parametri porasta izdanka

## SEEDLING GROWTH OF MAIZE INBRED LINES (*ZEAMAYS* L.) AS A RESPONSE TO SEED TREATMENT WITH PESTICIDES

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Seed treatment is a common way of fungicide and insecticide use nowadays, since this way of pesticide application can provide the best protection in the vicinity of the future plant. The aim of this research was to evaluate the effects of different seed treatments on germination and seedling growth in three different maize inbred lines. The research included seed treatment with several combinations of a fungicide Maxim XL 035-FS and neonicotinoid insecticides Gaucho 600-FS and Cruiser 350-FS, as well as untreated seed (control). The results indicated that inbred lines 21202 x 21101 NS and 317659 NS had highly vigorous seed, which were not affected by the tested seed treatments. Seed treatments with Maxim XL 035-FS+Gaucho 600-FS and Maxim XL 035-FS+Cruiser 350-FS led to a decrease in germination of maize inbred line 306081 NS as well as a decrease in root length and dry root weight of maize inbred line 21202 x 21101 NS. All seed treatments had positive effects on seedling growth, as well as on fresh and dry shoot and root weight of maize inbred lines 306081 NS and 317659 NS.

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**Key words:** seed treatment with a fungicide and neonicotinoids, maize inbred lines, germination, growth parameters

## ISPITIVANJE ŽIVOTNE SPOSOBNOSTI SJEMENA BANJALUČKIH SORTI PŠENICE (COLD TEST)

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Niske temperature i suša kao i ostali abiotički faktori, negativno utiču na kvalitet i količinu svih proizvedenih žita, a samim tim i pšenice, što bi moglo u bliskoj budućnosti da izazove velike probleme s obzirom da su žita osnova ishrane većine svjetske populacije. Niske temperature kao i drugi stresni faktori uzrokuju nastanak reaktivnih jedinjenja u biljkama što ima za posljedicu oštećenja biljnih membrana i makromolekula. Dostupnost vode kao i njeno kretanje je veoma važno u procesu klijanja sjemena, početni rast korjena i izduživanje kotiledona. Ovi procesi su pod velikim uticajem hemijskog potencijala zemljišta, teksture i kontaktnog područja sjemena i zemljišta. Dvogodišnja istraživanja (2014-2015) su obuhavila praćenje parametara klijavosti sjemena "cold" testom kod četiri sorte ozime pšenice selekcionisane u Poljoprivrednom institutu Republike Srpske (Kristina, Bosanka, Orion, Jelena). Sjeme koje je korišteno bilo je tri, odnosno četiri godine staro. Sorta Jelena je imala najveći procenat klijavosti, dok je sorta Kristina imala najduži korijen, kao i najveću masu korijena i koleoptila. Starije sjeme je imalo lošije rezultate u poređenju sa mlađim sjemenom.

**Ključne riječi:** pšenica, sorta, klijanje, stres, starost



## TESTING LIVING CAPABILITIES OF SEEDS OF WHEAT CULTIVARS FROM BANJA LUKA (COLD TEST)

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Low temperatures and drought as well as other abiotic factors, have a negative effect on a quality and amount of all grains, including wheat, which could cause great problems in near future considering that grains are foundation of nutrition in a majority of world population. Low temperatures and other stressful factors cause the forming of reactive compounds inside the plant, which lead to damaging plant membranes and macromolecules. Water availability and its movement is very important in the process of seed germination, for starting seed grow and cotyledon extension. These processes are largely affected by the lands chemical potencial, texture and contact area of seed and land. Two year research (2014-2015) included tracking parameters of seed germination with „cold“ test in four cultivars of winter wheat selected in the Agricultural institute of Republic of Srpska (Kristina, Bosanka, Orion, Jelena). The seeds that were used were three or four years old. The cultivar Jelena had the largest percent of germination, while the cultivar Kristina had the longest root, as well as the largest root and coleoptiles mass. The older seeds had worst results compared to the younger ones.

**Key words:** wheat, cultivars, germination, stress, old age



## KRMNE SMEŠE JAROG GRAŠKA I OVSA U RAZLIČITIM FAZAMA ISKORIŠĆAVANJA

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Gajenjem jednogodišnjih mahunarki za proizvodnju kabaste stočne hrane, obezbeđuje se kvalitetna krma za ishranu domaćih životinja. Spravljena na različite načine, može biti na raspolaganju u toku cele godine, a stočni grašak se pokazao kao kvalitetna vrsta za ovakvu proizvodnju.

Ogled je izveden sa ciljem da se ispita opravdanost gajenja graška u smeši sa ovsem u odnosu na pojedinačno gajene useve i ustanove njihovi interspecijski odnosi u smeši. Usev je bio prolećnog (jarog) tipa, smeše su sastavljene po principu aditivnih serija sa graškom kao glavnim i ovsem kao potpornim usevom. Ogled je obuhvatio tri smeše (A3-100% grašak: 10% ovas; A4-100% grašak: 20% ovas; A5-100% grašak: 30% ovas) i dve kontrole (A1-100% grašak; A2-100% ovas). Ispitan je prinos sirove i suve mase, broj internodija i visina biljaka, broj cvetova i mahuna u tri faze košenja (početak cvetanja, faza formiranja mahuna, faza formiranja zrna). Pored agroekološkog i ekonomskog značaja gajenja graška i ovsa u smeši, ustanovljeno je da se najbolji rezultati mogu postići u njihovom odnosu 100%:10% i 100%:20%, sa košenjem u fazi cvetanja. U prvoj fazi košenja nije došlo do značajnih razlika u prinosu sirove mase (A3- 21,1 t ha<sup>-1</sup>; A4- 21,7 t ha<sup>-1</sup>; A5; 21,2 t ha<sup>-1</sup>), ali zbog izrazite dominatnosti ovsa njegov udeo ne bi trebalo da prelazi 20%.

**Ključne reči:** faze, grašak, košenje, ovas, prinos, smeše

**FIELD PEA AND OAT MIXTURE FOR ANIMAL FEED UTILIZED IN DIFFERENT PHENOPHASE OF DEVELOPMENT**

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Cultivation of annual legumes for forage production ensures a high quality forage for animal feed. Prepared on different ways, this type of food can be available throughout the year and field pea proved to be very suitable for this kind of production.

The experiment was conducted in order to examine the justification of growing field peas in mixture with oats as compared to individually cultivated crops and to reveal the nature of their interspecies relations. The crop was sown in spring, mixtures were made on the principal of additive series with field pea as main and oat as supporting crop. The experiment included three mixtures (A3-100% field pea: 10% oats; A4-100% field pea: 20% oats; A5-100% field pea: 30% oats) and two control crops (A1-100% peas; A2-100% oats). Yield, fresh and dry matter, number of internodes, plant height, number of flowers and pods in the three stages of cutting (flowering stage, pods formation and seed formation) were tested. In addition to agro-ecological and economic importance of growing field pea and oats in their mixture, it was found that the best results can be achieved in 100%:10% and 100%:20% ratio, with mowing at the flowering stage. In the first stage of cutting, there was no significant difference in fresh matter yield (A3- 21,1 t ha<sup>-1</sup>; A4- 21,7 t ha<sup>-1</sup>; A5; 21,2 t ha<sup>-1</sup>), however, oats is highly dominant crop in mixture, thus it's share should not exceed 20%.

**Key words:** field pea, mixture, mowing, oat, utilization phase, yield

## UTICAJ MALČIRANJA ZEMLJIŠTA NA PRODUKTIVNE OSOBINE RAZLIČITIH SORTI KROMPIRA

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Malčiranjem zemljišta smanjuje se zakorovljenost, reguliše vlažnost i temperatura zemljišta u zoni korenovog sistema i time stvaraju povoljniji uslovi za rast i razvoj biljaka. U ogledu je ispitivan uticaj malčiranja zemljišta pšeničnom slamom i crnom polietilenskom folijom na broj krtola, masu krtola i ukupan prinos krompira. Ispitivane su dve sorte krompira Agria i Carrera. Eksperiment je postavljen po randomiziranom blok sistemu u četiri ponavljanja sa navodnjavanjem sistemom kap po kap na lokalitetu Zemun Polje (44°88'S, 20°35'I, 79 m n.v.) tokom 2012. i 2013. godine. U izuzetno toploj 2012. godini vrednosti analiziranih svojstava krompira bile su u proseku za 20% veće na zemljištu malčiranom slamom u poređenju sa kontrolom. U 2013. godini pozitivan uticaj malčiranja zemljišta slamom na prinos nije bio toliko izražen, što ukazuje da je u toplijoj 2012. godini slama značajnije regulisala temperaturu i vlažnost zemljišta. Najmanji prinosi, u obe ispitivane godine, dobijeni su u tretmanu sa crnom malč folijom. Rezultati dobijeni u ovom eksperimentu ukazuju na pozitivan uticaj nastiranja zemljišta slamom na prinos ispitivanih sorti krompira, posebno u ekstremnim vremenskim uslovima tj. uslovima visokih temperatura vazduha i zemljišta.

**Ključne reči:** krompir, malčiranje zemljišta, prinos

## EFFECTS OF MULCHING ON PRODUCTIVITY OF DIFFERENT POTATO CULTIVARS

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Mulching significantly reduces weed infestation and regulates soil temperature and moisture, and, consequently, creates more favorable field conditions for crop plant growth and development. The effects of wheat straw and black plastic mulching on the number of tubers per plant, tuber mass and yield were investigated in potato. Potato cultivars Agria and Carrera were the object of investigation. The experiment was conducted in the experimental field with subsurface drip irrigation in Zemun Polje, Serbia (44°88' N, 20°35' E, 79 m altitude) in years 2012 and 2013, and it was organized in complete block design with four replications. In extremely hot year 2012, two cultivars have had approximately 20% higher values of all analyzed yield parameters on straw-mulched soil compared to control. In year 2013, positive effect of straw mulching was not that prominent, indicating that straw had more significant effect on the regulation of soil temperature and moisture in hotter year 2012. The lowest yields, in both years, were determined in treatment with black plastic mulch. The results obtained in our research indicate positive effect of straw mulching on productivity of investigated potato cultivars, especially under extreme weather conditions, i.e. conditions of high air and soil temperatures.

**Key words:** potato, mulching, yield

## KOMPENZACIONI EFEKAT REMOBILIZACIJE SUVE MATERIJE STABALA OZIME PŠENICE U USLOVIMA SUŠE POSLE CVETANJA

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Rezerve ugljenih hidrata skladištene u stablu pšenice imaju značajnu ulogu u procesu nalivanja zrna pšenice, naročito u uslovima stresa izazvanog sušom. Sposobnost genotipova pšenice da akumuliraju i remobilizuju ugljene hidrate u zrno jedna je od poželjnih osobina u oplemniivačkim programima koji se izvode u regionima sa aridnom klimom. Cilj dvogodišnjih istraživanja izvedenih u sezonama 2010/11. i 2011/12. bio je da se testiraju tri grupe genotipova pšenice (standardi, F4:5 familije i njihovi roditelji, ukupno 61 genotip) ozime pšenice (*Triticum aestivum* L) na tolerantnost prema terminalnoj suši koja je simulirana ručnom defolijacijom biljaka 10 dana nakon cvetanja. Izračunati su kompenzacioni efekat remobilizacije suve materije stabla za prinos zrna po klasu (CE), zatim njegova korelaciona zavisnost u odnosu na anatomske, morfološke i agronomске osobine, kao i na indekse stresa. U sve tri grupe zabeležena je velika varijabilnost genotipova za CE, SSI - indeks osetljivosti na sušu, STI - indeks tolerantnosti na sušu i TOL- indeks tolerantnosti na sušu. Anatomske osobine kao što su debljina zida, prečnik, kao i odnos debljine i prečnika vršne internodije, zatim broj velikih provodnih snopića, ukupna površina floema na poprečnom preseku i površina fotosintetski neaktivnog parenhima bile su u pozitivnoj, a udeo lignifikovanog tkiva u negativnoj korelaciji sa CE. Za površinu neispunjenog dela stabla i hlarenhima nije utvrđena značajna korelacija sa CE. Udeo vršne internodije u stablu, specifična masa stabla, zatim broj klasića, broj zrna po klasu, kao i datum cvetanja imali su pozitivan uticaj na CE. SSI i TOL bili su pozitivnoj, a STI u negativnoj korelaciji sa CE. Iako nije ustanovljena značajna povezanost između prinosa i CE, rezultati ukazuju da je kompenzacioni efekat remobilizacije suve materije bio veći kod genotipova koji su tolerantniji na sušu, što se vidi iz pozitivne korelacije sa SSI i TOL. Značajna varijabilnost genotipova u okviru svih grupa i dve sezone za CE potvrdila je veliki uticaj spoljašnje sredine, naročito meteoroloških faktora na akumulaciju i remobilizaciju asimilativa stabla pšenice.

**Ključne reči:** ozima pšenica, remobilizacija, suva materija, suša

## COMPENSATORY EFFECT FROM STEM DRY MATTER REMOBILIZATION IN WINTER WHEAT UNDER TERMINAL DRAUGHT STRESS

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Stem reserves play an important role in the supply of carbohydrates to the wheat grains and this process is enhanced under drought stress conditions. Improved ability to store and remobilize them to grain is a desirable criterion in wheat breeding programmes targeted to regions with arid climate. Field experiments were conducted during 2010/2011 and 2011/2012 with aim to test 61 winter wheat genotypes divided in the three groups (standards, F4:5 families and their parents) to tolerance to terminal drought which was simulated by plants defoliation 10 days after anthesis. Compensatory effect (CE, compensation from stem dry matter remobilization to grain filling) and its correlation with agronomic, anatomical and morphological traits and stress indexes were calculated. Genotypes of all groups showed high variability in CE, stress susceptibility index (SSI), stress tolerance index (STI) and tolerance index (TOL). Anatomical traits such as stem wall thickness, ratio of stem wall thickness and stem diameter, number of bigger bundles, total phloem area per stem section and area of photosynthetically not active parenchyma were positively and lignified tissue share was negatively associated with CE. There was no significant correlations between CE and both, area of pith intercellular and area of chlorenchyma. Stem related traits such as peduncle share, stem specific weight, dry mass of main stem and agronomy traits such as the number of spikelets, number of grains per spike and number of grains per spike as well as date of flowering had positive effect on CE. Stress indexes SSI and TOL were positively and STI was negatively associated with CE in the both seasons. Interestingly, there was no positive correlation between CE and grain weight per spike. Results indicate that compensation from dry matter remobilization was higher in genotypes which are more tolerant to drought, as shown by SSI and TOL positive association with CE. High variation in CE among all tested groups and between two seasons confirmed large sensitivity of accumulation and remobilization of reserves to environmental conditions particularly to meteorological conditions in wheat.

**Key words:** winter wheat, remobilization, dry mater, draught

## UTICAJ ZEMLJIŠNIH USLOVA NA SINTEZU PROTEINA PŠENICE KRUPNIK *TRITICUM SPELTA* L.

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Tehnološki kvalitet pšenice definisan je fizičkim i hemijskim pokazateljima kvaliteta i pecivnim osobinama. Da bi pšenica bila predmet trgovine potrebno je da zadovoljava određene uslove koji su definisani minimalnim vrednostima pokazatelja prometnog kvaliteta. Heksaploidna pšenica krupnik (*Triticum spelta* L.) pripada grupi alternativnih žita koja ima visok sadržaj glutena, te se od njegovog brašna uspešno spravlja većina peciva. Zahvaljujući visokoj hranljivoj vrednosti brašno krupnika koristi se kao poboljšavač kvaliteta i ukusa pšeničnog hleba i drugih hlebno-pekarskih proizvoda.

Dvogodišnja istraživanja izvedena su tokom 2011. i 2012. godine u cilju ispitivanja produktivnosti sadržaja proteina na zemljištu tipa gajnjača. Ispitivane su dve sorte krupnika: mađarske sorta *Ekö 10* i srpska NS sorta *Nirvana*. Rezultati su pokazali da je NS sorta *Nirvana* imala u proseku statistički značajno veći sadržaj proteina (16,76 %) u odnosu na mađarsku sortu *Ekö 10* (15,65 %). Utvrđivanjem korelativnih odnosa ustanovljeno je da je ispitivani zemljišni lokalitet ispoljio dobre uslove za produktivnost ispitivanog parametara ovog alternativnog žita.

**Ključne reči:** krupnik, korelacije, sadržaj proteina, sorte, zemljište

**IMPACT OF SOIL CONDITIONS ON PROTEIN SYNTHESIS IN SPELT WHEAT  
(*TRITICUM SPELTA* L.)**

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Technological quality of wheat is defined by physical and chemical indicators of quality and baking properties. To make wheat a commodity, there are certain requirements that need to be met, defined by minimum values of trade quality indicators. The hexaploid spelt wheat (*Triticum spelta* L.) belongs to a group of alternative cereals with a high gluten level. Its flour is therefore used in baking most pastries. Due to its high nutritive value, spelt flour is used to enhance quality or flavour of wheat bread and other bakery products.

Two-year research was conducted during 2011 and 2012 to investigate protein production on the Eutric Cambisol type of soil. Two spelt cultivars were investigated: Hungarian cultivar *Ekö 10* and Serbian NS *Nirvana*. The results showed that NS *Nirvana* averaged a statistically significantly higher protein level (16.76%) than Hungarian cultivar *Ekö 10* (15.65%). The correlation analysis showed that soil location had good conditions for productivity of the investigated parameter of this alternative cereal.

**Key words:** spelt, correlations, protein level, cultivars, soil



**SPELTA (*TRITICUM AESTIVUM* SSP. *SPELTA*) - PRIRODNO PREDODREĐENA  
KULTURA ZA GAJENJE U ORGANSKOJ PROIZVODNJI**

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Spelta (*Triticum aestivum* spp. *spelta*) je vrsta prastare pšenice koja zauzima značajno mesto u grupi alternativnih žita zbog svojih bioloških i agronomskih karakteristika, kao i bogatih nutritivnih svojstava. Zbog prirodne predispozicije za gajenje u organskoj proizvodnji, u skorije vreme proizvodnja spelte je proširena širom Evrope: Belgija, Nemačka, Švajcarska, Austrija, Severna Italija, Slovačka, Češka i Mađarska (Tricolori, 2005; Lacko-Bartošová, 2007; Zieliński, 2008).

U Srbiji je poslednjih nekoliko godina zabeležen porast gajenja ove vrste i veliki broj istraživanja je rađen vezano za: zaštitnu ulogu plevičastog omotača zrna spelte (Bodroža et al., 2010; Vučković et al., 2012), što je zapravo čini predodređenom vrstom za organsku proizvodnju, njenu primenu u pekarstvu (Filipčev et al., 2012), za proizvodnju testenine (Filipović et al., 2013), kao i rešavanju nus proizvoda peletiranjem ljuske zrna spelte (Brlek et al., 2012). Poređenje hlebne pšenice i spelte je takođe od velikog značaja, jer pored toga što je brašno spelte skuplje smatra se organskim proizvodom (Bodroža et al., 2014).

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**Ključne reči:** spelta, ljuska, organska proizvodnja

**SPELT (*TRITICUM AESTIVUM* SSP. *SPELTA*) - NATURALLY PREDESTINED CULTURE FOR CULTIVATION IN ORGANIC AGRICULTURE**

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Spelt (*Triticum aestivum* ssp. *spelta*) as the old varieties of wheat has the status of a minor culture, but since has natural predisposition for cultivation in organic agriculture, in recent times it was noticed the area under this crop significantly increased throughout Europe: Belgium, Germany, Switzerland, Austria, Poland, Northern Italy, Slovakia, the Czech Republic and Hungary (Tricolori 2005; Lacko-Bartošová 2007; Zieliński 2008).

In the last several years, in Serbia was noticed an increase in the area under spelled followed by research based on the protective role of hull (Bodroža et al., 2010; Vučković et al., 2012) that makes spelt predefined culture for growing in organic production, used in baking (Filipčev et al., 2012), pasta production (Filipović et al., 2013), as well as in the resolving the issue of by-products through the pelleting of spelt shells (Brlek et al, 2012). Comparison of bread wheat (*Triticum aestivum*) and spelt is also of great interest since spelt's flour is more expensive and in a high percentage is certificated as organic product (Bodroža et al, 2014).

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**Keywords:** spelt, hull, organic production

**LOKALNA POPULACIJA KUKURUZA - IZVOR ZA POVEĆANJE SADRŽAJA TOKOFEROLA KOD INBRED LINIJA**

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Tokoferoli su najjači prirodni antioksidansi koji imaju ulogu u zaštiti ćelijske membrane od oštećenja nastalih delovanjem slobodnih radikala. Deluju tako što "neutrališu" slobodne radikale (imaju nespareni elektron) doniranjem elektrona ili hidridne grupe sa svoje hidroksilne grupe. Cilj ovog rada je ispitivanje lokalne populacije kukuruza crvenog zrna kao izvora za povećanje sadržaja tokoferola u komercijalnim inbred linijama kukuruza. Lokalna populacija je ukrštena sa 5 inbred linija i recipročno tokom 2015 godine. Sadržaj  $\alpha$ ,  $\gamma$  i  $\delta$  tokoferola je određen HPLC metodom. Sadržaj  $\alpha$  tokoferola je bio veći u četiri linije u odnosu na populaciju. Pozitivan heterozis u odnosu na populaciju *per se* je dobijen u svim ukrštanjima linija sa populacijom, dok je u tri ukrštanja bio pozitivan u odnosu na linije *per se*. Sadržaj  $\gamma$  tokoferola je bio viši u populaciji u odnosu na sve linije, osim linije L4. Pozitivan heterozis je dobijen i u svim ukrštanjima linija sa populacijom u odnosu na linije *per se* i u odnosu na populaciju *per se* osim sa linijom L2. U ukrštanju populacije sa linijom L5 dobijen je negativan heterozis u odnosu na liniju i populaciju *per se*. Sadržaj  $\delta$  tokoferola je veći u populaciji u odnosu na linije. Pozitivan heterozis je dobijen u svim ukrštanjima linija sa populacijom osim sa L4. Lokalna populacija može da se koristi kao donator za popravku sadržaja  $\alpha$  tokoferola kod L1, L2 i L5,  $\gamma$  tokoferola kod svih linija i  $\delta$  tokoferola kod svih linija osim L4.

**Ključne reči:** tokoferoli, kukuruz, lokalna populacija

**LOCAL MAIZE POPULATIONS - SOURCE FOR INCREASING THE CONTENT OF TOCOPHEROLS IN INBRED LINES***Jelena Mesarović<sup>1</sup>, Violeta Anđelković<sup>1</sup>, Snežana Mladenović Drinić<sup>1</sup>*<sup>1</sup>Maize Research Institute Zemun Polje, Belgrade

Tocopherols are powerful natural antioxidants which plays an essential role in protecting cell membranes from free radicals damage. They are able to “neutralize” free radicals (have unpaired electron) by donating an electron or hydride group from its hydroxyl group. The aim of this work was to investigate the red corn grain local population as a source for increasing the content of tocopherols in commercial inbred lines of maize. The local population has crossed with 5 inbred lines and reciprocally during 2015. The content of  $\alpha$ ,  $\gamma$  and  $\delta$  tocopherols was determined by HPLC. The content of  $\alpha$  tocopherol was higher in four lines compared to population. Positive heterosis comparing to the population *per se*, was obtained in all crossing lines with a population, while in three intersection were positive in relation to the line *per se*. Content of  $\gamma$  tocopherol was higher in the population compared to all lines except for the line L4. Positive heterosis was obtained in all the crosses lines with the population compared to the line *per se* and in relation to the population *per se* except for line L2. In the crossing of the line L5 with the population, negative heterosis was obtained compared to line and population *per se*. Content of  $\delta$  tocopherol was greater in population according to the lines. Positive heterosis was obtained in all crossing lines with the population except L4. Local populations can be used as a donor to repair the content of  $\alpha$  tocopherol in L1, L2 and L5,  $\gamma$  tocopherol in all lines and  $\delta$  tocopherol in all lines except L4.

**Keywords:** tocopherols, corn, local populations

## NASLEĐIVANJE ŠEĆERA KOD KUKURUZA ŠEĆERCA (*ZEA MAYS L. SACCHARATA*)

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Osnovna osobina kukuruza šećerca je povećan sadržaj šećera u njegovom zrnju u odnosu na kukuruz standardnog kvaliteta zrna. Recesivni *su* gen koji karakteriše kukuruz šećerac, odgovoran je za zaustavljanje ili usporavanje procesa konverzije šećera u složene polisaharide i škrob. Na ovaj način se u zrnju šećerca zadržava visoka koncentracija prostih šećera i saharoze, koji mu daju prepoznatljiv sladak ukus. U radu je analiziran udeo šećera saharoze kao dominantnog šećera i dva prosta šećera glukoze i fruktoze. Udeo svakog pojedinog šećera prikazan je u procentima u odnosu na sadržaja ukupnih šećera. Udeo saharoze kod svih genotipova bio je viši u odnosu na druga dva šećera. Između linija i hibrida nije bilo velikih odstupanja u pogledu sadržaja ovog šećera. Kod linija udeo saharoze kretao se između 72,70 – 76,09%, a kod hibridnih kombinacija 69,96 – 76,49%. U svim tretmanima utvrđene su statistički značajne razlike između hibridnih kombinacija, dok to nije bio slučaj za linije. Šećer glukoza bio je zastupljen u manjem procentu od saharoze. Njegov udeo bio 6 – 8 puta manji od udela saharoze. Između hibridnih kombinacija utvrđene su statistički značajne razlike u pogledu sadržaja glukoze, a između linija značajne razlike su utvrđene samo u jednom tretmanu. Najniži sadržaj ispitivanih šećera, bio je sadržaj fruktoze. Sadržaj fruktoze bio je nešto viši za hibride (2,25 – 3,38%), nego za linije (2,44 – 3,34%). Između hibridnih kombinacija utvrđene su statistički značajne razlike. Analizom varijanse kombinacionih sposobnosti nije utvrđena značajnost OKS ni PKS za saharozu i fruktozu. Za glukozu je utvrđena statistički značajna vrednost OKS. Iz ovoga se može zaključiti da aditivno delovanje gena ima presudan uticaj na ispoljavanje ove osobine.

**Ključne reči:** kukuruz šećerac, saharoza, glukoza, fruktoza

**INHERITANCE OF SUGAR IN SWEET CORN  
(*ZEA MAYS L. SACCHARATA*)**

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Sweet corn differs from field corn by the increased sugar content in the kernel. Recessive *su* gene is responsible for slowing down the process of conversion of simple sugars into complex polysaccharides and starch. This way in sweet corn high concentration of simple sugars and sucrose is maintained, which provides characteristic sweet flavor. In this paper we analyzed the content of sucrose, as the dominant sugar, and glucose and fructose. The content of sucrose is significantly higher than the other two sugars. In inbred lines sucrose amounted between 72.70 – 76.09%, while in hybrid combinations it ranged from 69.96 – 76.49%. The percentage of glucose was from 10.49% to 11.13% in inbred lines, and 10.50% to 10.84% in hybrid combinations. The content of fructose was the lowest of all sugars, 2.25 – 3.38% for hybrid combinations, and 2.44 – 3.34% for inbred lines. The analysis of variance of combining ability expressed significance only for general combining ability for glucose content. This indicated that additive gene effect has the crucial impact on the expression of glucose content in sweet corn.

**Key words:** sweet corn, sucrose, glucose, fructose

## UTICAJ GENOTIPA NA PRINOS ZRNA PŠENICE, SOJE, KUKURUZA I SUNCOKRETA

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U dvogodišnjem periodu (2013-2014) analizirani su rezultati prinosa zrna sorti pšenice i soje, odnosno hibrida kukuruza i suncokreta. Na oglednom polju PSS Instituta Tamiš u Pančevu postavljeni su makroogledi sa sortama (hibridima) iz različitih semenskih kompanija i različite dužine vegetacionog perioda. Ukupno je analizirano 10 sorti pšenice (Sirtaki, Zvezdana, Renesansa, Solehio, Balaton, Nikol, Pobjeda, Apač, MV Šuba i NS-40S), 10 sorti soje (Maksimus, Trijulf, Dukat, Galeb, Valjevka, Princeza, Galina, Biser, Angela i Balkan), 20 hibrida kukuruza (Krabas, Kalimnos, Mikado, Kermes, ZP 341, ZP 434, ZP 560, ZP 666, P 0725, P 0216, P 1114, PR 36V74, NS 6030, NS 5051, NS 4030, NS 7020, AS 63, AS 57, AS 66 i AS 72) i 10 hibrida suncokreta (Neoma, Fushia, Barolo RO, Dragon, LG 5633, Mondeo, Adagio, Durban, Kondi i Imeria). Primenjena agrotehnika na ogledima bila je standardna, kao za redovnu proizvodnju. U obe godine ispitivanja, predusev pšenici bila je soja, predusev soji bio je kukuruz, predusev kukuruzu bila je šećerna repa i predusev suncokretu bio je kukuruz.

Dobijeni rezultati su pokazali da postoje značajna variranja u pogledu adaptabilnosti i stabilnosti što ukazuje da izbor sorte/hibrida u velikoj meri može da doprinese ostvarivanju većih prinosa. U dvogodišnjem proseku, prinos zrna pšenice bio je 8.702 kg ha<sup>-1</sup>, sa variranjem između sorti do 2.705 kg ha<sup>-1</sup> (36,6%). Prosečan prinos zrna soje iznosio je 3.246 kg ha<sup>-1</sup>, sa variranjem između sorti do 560 kg ha<sup>-1</sup> (18,8%). Prosečan prinos zrna kukuruza bio je 10.004 kg ha<sup>-1</sup>, sa variranjem između hibrida do 4.036 kg ha<sup>-1</sup> (50,4%) i prosečan prinos zrna suncokreta bio je 3.546 kg ha<sup>-1</sup>, sa najvećom razlikom između hibrida od 715 kg ha<sup>-1</sup> (22,1%).

**Ključne reči:** hibrid, sorta, kukuruz, pšenica, soja, suncokret

## THE INFLUENCE OF GENOTYPE ON WHEAT, SOYBEAN, CORN AND SUNFLOWER SEED YIELD

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Grain yield of wheat and soybeans cultivars, and corn and sunflower hybrids of various seed companies were analyzed during two-year period (2013-2014). Macro-field experiment was conducted in PSS Institute Tamis in Pancevo. A total of 10 varieties of wheat (Sirtaki, Zvezdana, Solehio, Balaton, Nicol, Pobeda, Apache, MV Šuba and NS-40S), 10 varieties of soybean (Maximus, Triumph, Dukat, Galeb, Valjevka, Princeza, Galina, Biser, Angela and Balkan), 20 maize hybrids (Krabas, Kalymnos, Mikado, Kermes, ZP 341, ZP 434, ZP 560, ZP 666, P 0725, P 0216, P 1114, PR 36V74, NS 6030, NS 5051, NS 4030, NS 7020, AS 63, AS 57, AS 66 and AS 72) and 10 sunflower hybrids (Neoma, Fushia, Barolo RO, Dragon, LG 5633, Mondeo, Adagio, Durban, Kondi and Imeria). In both years preceding crop for wheat was soybean, for soybean preceding crop was corn, for corn preceding crop was sugar beet and for sunflower preceding crop was corn.

The results showed significant variations in terms of adaptability and stability, indicating that choice of varieties/hybrid might play an important role in achieving high yields. On two-year average, wheat yield was 8.702 kg ha<sup>-1</sup>, with varying between varieties up to 2.705 kg ha<sup>-1</sup> (36.6%). The average yield of soybean was 3.246 kg ha<sup>-1</sup>, with variation between varieties up to 560 kg ha<sup>-1</sup> or (18.8%). Average corn yield was 10.004 kg ha<sup>-1</sup>, with varying between hybrids up to 4.036 kg ha<sup>-1</sup> (50.4%) and an average yield of sunflower was 3.546 kg ha<sup>-1</sup>, with the greatest difference between hybrids of 715 kg ha<sup>-1</sup> (22.1%).

**Key words:** hybrid, variety, corn, wheat, soybean, sunflower



## MOGUĆNOST PRIMENE ELEKTROMAGNETNIH TALASA U PROIZVODNJI SOJE

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Soja ima veliki ekonomski, privredni i agrotehnički značaj, koji se ogleda u njenim specifičnostima. Sve složeniji zahtevi proizvodnje zdravstveno bezbedne hrane i mogućnost da se izbegnu greške koje su činjene u procesu intenzivne poljoprivredne proizvodnje, nameću nove tehnologije biljne proizvodnje. Jedna od njih je primena biofizičkih metoda, odnosno primena E-tretmana (elektromagnetni talasi (EMT) niske frekvencije). Istraživanja primene EMT u biljnoj poljoprivrednoj proizvodnji nisu do sada bila mnogo zastupljena. Dosadašnja istraživanja iz ove oblasti prvenstveno su se odnosila na tretmane semena pred setvu u cilju utvrđivanja mehanizma uticaja elektromagnetnog polja na klijavost i rast biljaka, kao i u detekciji biljnih bolesti i štetočina.

Istraživanja primene EMT u proizvodnji soje obavljena su na oglednom polju Rimski Šančevi u Novom Sadu, u period 2013-2014. godine. Ogled je postavljen po *split-plot* sistemu u četiri ponavljanja na slabo karbonatnom černozemu. Na ogledu je primenjeno osnovno đubrivo sa granuliranim živinskim stajnjakom u tri nivoa ( $\emptyset$ , 750 kg.ha<sup>-1</sup>, 1350 kg.ha<sup>-1</sup>). Setva je obavljena mašinski, semenom soje sorte Valjevka. Neposredno pred setvu obavljen je tretman semena sa aparatom specifičnog spektralnog sadržaja i elektromagnetnog polja frekvencije 15 Hz, ekspozicijom od 30 minuta. Na osnovu dobijenih rezultata u obe godine istraživanja primena EMT-a uticala je na povećanje prinosa. U 2013. godini povećanje prinosa kod primene EMT bilo je 4,26%, a u 2014. godini to povećanje iznosilo je 3,95%. Ovakvo povećanje prinosa semena soje, je uticalo i na povećanje prinosa proteina.

S obzirom da je soja veoma osetljiva na agro-meteorološke faktore (temperature i padavine) prinosi u obe godine istraživanja su bili različiti. U 2014. godini prinosi su bili znatno veći, jer su agro-meteorološki uslovi bili povoljniji.

Na osnovu dobijenih rezultata se može zaključiti da, pri jednokratnoj stimulaciji semena pred setvu elektromagnetnim talasima, postoji značajan uticaj na stabilnost i ekonomsku isplativost u proizvodnji soje.

**Ključne reči:** soja, đubrenje, elektromagnetni talasi, prinos

## POSSIBILITY OF APPLICATION OF ELECTROMAGNETIC WAVES IN THE PRODUCTION OF SOYBEAN

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Soybean has great economic, industrial and agro-technical significance, which is reflected in its specificity. Increasingly complex requirements of safe food production and the ability to avoid mistakes that were made in the process of intensive agricultural production, impose new technologies of plant production. One of them is the use of biophysical methods, ie the application of E-treatment (electromagnetic waves (EMW) low frequency). Research Application EMW in plant agriculture have not been very common. Previous studies in this area were primarily related to the treatment of seed for sowing in order to determine the mechanism of the effect of electromagnetic fields on germination and plant growth, as well as in the detection of plant diseases and pests.

Research applications of EMW in soybean production were carried out on experimental field Rismki Šančevi in Novi Sad, in the period 2013-2014. year. The experiment was set in a split-plot design with four replications at weak carbonate chernozem. On field was applied basic granular fertilizer with poultry manure at three levels (Ø, 750 kg.ha<sup>-1</sup>, 1350 kg.ha<sup>-1</sup>). Sowing was done with machines, seeds of soybean cultivar Valjevka. Just before sowing seed treatment was carried out with the appliance-specific spectral content of the electromagnetic field frequency 15 Hz, the exposure of 30 minutes. Based on the results in both years research applications EMW and resulted in higher yields. In the year 2013. increase in yield with the application EMW was 26.4%, and in the year 2014. the increase was 3.95%. Thus increasing the yield of soybean seed, was influenced by the increase in the yield of protein.

Since the soybean is very sensitive to agro-meteorological factors (temperature and rainfall) yields in both study years were different. In the year 2014. yields were much higher, because the agro-meteorological conditions were favorable.

Based on these results we can conclude that, for a single stimulation of seeds before sowing elektromagnetnim waves, there is a significant impact on the stability and economic viability in soybean production.

**Key words:** soybean, fertilization, electromagnetic waves, yield

## KARAKTERISTIKE KRATKOG TESTA I KEKSA OBOGAĆENIH SA DVE VRSTE REZISTENTNOG SKROBA

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Rezistentan skrob (RS) je obuhvaćen definicijom prehrambenih vlakana i pokazuje slične fiziološke prednosti kao i konvencionalna vlakna. Primena RS-a u formulacijama za kratka testa i kekse može uticati na poboljšanje nutritivnog kvaliteta gotovog proizvoda povećanjem sadržaja vlakana i smanjenjem energetske vrednosti istog. Ispitivan je uticaj dve vrste RS-a, tipa 3 (RS3) i tipa 4 (RS4), na reološka i teksturalna svojstva testa, kao i kvalitet gotovog proizvoda. RS3 ili RS4 su dodati u testo kao zamena brašnu u različitim koncentracijama (0, 5, 10 i 15%). U svim uzorcima testa, upotreba RS-a je dovela do povećanja elastičnih i viskoznih modula i smanjenja vrednosti parametra  $\tan \delta$ , što ukazuje na povećanje elastičnih osobina sistema sa dodatkom RS-a (zbog sposobnosti RS-a da veže vodu). Uzorci testa sa RS3 i RS4 su imali manje destruktivnu strukturu i veću mogućnost za oporavak. Kontrolni uzorak je imao znatno manju rastegljivost i otpornost pri istezanju u odnosu na sve ostale uzorake koji sadrže RS. Veći udeo oba tipa RS-a u formulacijama za kratka testa doprineo je povećanju mekoće testa.

Istraživanje je obuhvatilo i probno pečenje testa, kao važnog kriterijuma za ocenu kvaliteta brašna i RS-a. Keksi koji su sadržali RS3 i RS4 imali su svetliju boju. RS3 tip izazvao je veće promene u teksturi u odnosu na RS4 tip. Primena RS-a u formulacijama za kratka testa rezultirala je proizvodima poboljšanog senzornog i nutritivnog kvaliteta. Dodavanjem RS-a, tipa 3, dobijeni su bolji rezultati u smislu opšteg senzornog kvaliteta.

Dobijeni rezultati su pokazali da oba tipa RS-a imaju dobar potencijal za razvoj novih proizvoda tj. kekse i njemu sličnih proizvoda obogaćenih prehrambenim vlaknima.

**Ključne reči:** rezistentan skrob, testo, kekse, reologija, tekstura, senzorne osobine

## PROPERTIES OF SHORT DOUGH AND COOKIES ENRICHED WITH TWO TYPES OF RESISTANT STARCH

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Resistant starch (RS) is included in the definition of dietary fiber and demonstrates similar physiological benefits as dietary fiber. The application of RS in cookie formulations can improve nutritional quality of cookies by increasing the fiber content and reducing the energy value. The influence of two types of resistant starch, type 3 (RS3) and type 4 (RS4), on the rheological and textural properties of short dough and the quality of cookies was studied. RS3 or RS4 were added in dough as a replacement of flour in different concentrations (0, 5, 10 and 15%). In all dough samples, the use of RS resulted in the increase of elastic and viscous moduli and the lowering of loss tangent, which indicates that it is characteristically more elastic (because of the ability of RS to bind water). Samples with the RS3 and RS4 addition had a less destructive structure and a greater ability for recovery. Control sample had significantly lower extensibility and resistance to extension than all samples containing the RSs. The increasing proportion of both RS ingredients in the formulation produced softer doughs.

The study involved baking test, as an important criterion for evaluating the quality of flour and RS. Cookies containing the RS3 and RS4 developed a lighter colour. The RS3 type starch caused bigger changes in the texture parameters than the RS4 type.

The application of RS in the formulation of short dough resulted in the products of improved sensory and nutritional quality. Addition of the starch, type 3, showed better results in terms of overall sensory quality.

The present results demonstrated that both RS ingredients have good potential for developing fiber-rich cookies and similar products.

**Key words:** resistant starch, dough, cookies, rheology, texture, sensory properties

## PRINOS NEKIH HIBRIDA KUKURUZA U ZAVISNOSTI OD RAZLIČITIH SISTEMA OBRADJE ZEMLJIŠTA

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Obrada je vrlo bitna agrotehnička mera koja osigurava odgovarajuće uslove za klijanje nicanje i rast biljaka i ima velikoga značaja na produktivnost gajenih biljaka. Zemljišta koja imaju teški mehanički sastav zahtevaju sistem obrade koji sprečava degradacione procese u zemljištu i koji će očuvati prirodnu plodnost zemljišta.

U radu su prikazani rezultati nekih morfoloških i produktivnih osobina kukuruza u zavisnosti od sistema obrade zemljišta. Ogled je izveden u okolini Požege, u toku 2014 i 2015. godine, na zemljištu tipa smonice. U ogledu su bila uključena 4 sistema obrade zemljišta (CT- konvencionalna obrada-Conventional Tillage: jesenje oranje+tanjiranje+setvospremač; RT- redukovana obrada-Reduced Tillage: tanjiranje+setvospremač; RT1- tanjiranje; NT- direktna setva-No Tillage) i 3 hibrida kukuruza (ZP 427, ZP 555 i AS 603). Hibridi su sejani u optimalnim gustinama (70 x 20, 70 x 25 i 70 x 30 cm). Ogled je bio postavljen po blok sistemu u 3 ponavljanja. Praćeni su sledeći parametri: broj poniklih biljaka, visina biljaka, broj biljaka u berbi, apsolutna masa zrna i prinos zrna sa 14 % vlage. Rezultati istraživanja pokazuju da su broj biljaka u berbi i prinos značajno varirali u zavisnosti od sistema obrade zemljišta, dok su broj poniklih biljaka, visina biljaka i apsolutna masa zrna pokazali znatno manja variranja. Najvći prosečni prinos (8.87 t ha<sup>-1</sup>) ostvaren je kod konvencionalnog sistema obrade zemljišta, a najmanji (5.41 t ha<sup>-1</sup>) kod direktne setve. Hibridi ZP 555 i AS 603 su u svim sistemima obrade zemljišta imali značajno veći prinos u odnosu na hibrid ZP 427, dok između njih nisu postojale statistički značajne razlike u prinosu zrna.

**Ključne reči:** konvencionalna obrada, redukovana obrada, direktna setva, kukuruz, prinos

## THE YIELD OF SOME MAIZE HYBRIDS DEPENDING ON THE DIFFERENT TILLAGE SYSTEMS

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Tillage is a very important agricultural measure that ensures the appropriate conditions for germination, emergence and growth of plants and it has great significance in the productivity of cultivated plants. The soils which have a heavy mechanical composition, demand a cultivation system that prevents the degradation processes in the soil and that will preserve the natural fertility of soils.

The paper presents the results of some morphological and productive traits of maize depending on the tillage system. The experiment was carried out in the vicinity of Požega during 2014 and 2015 on the smonitza soil type. The experiment included four tillage systems (CT – Conventional Tillage: autumn plowing + disking + seedbed conditioner); RT – Reduced Tillage: disking + seedbed conditioner); RT 1 – disking ; NT- Direct seeding – No tillage) and three maize hybrids (ZP 427; ZP 555 and AS 603). Hybrids were sown in optimal densities (70 x 20; 70 x 25; 70 x 30 cm). The experiment was set up in a randomized block system with three replications. The following parameters were monitored: the number of arisen plants, plant height, the number of plants at harvest, the absolute grain mass and grain yield with 14% humidity. Research results show that the number of plants at harvest and yield significantly varied depending on the tillage system, while the number of arisen plants, plant height and the absolute grain mass showed significantly less variation. The highest average yield (8.87 t ha<sup>-1</sup>) was achieved with conventional tillage, and the lowest (5.41 t ha<sup>-1</sup>) with direct seeding (no tillage). Hybrids ZP 555 and AS 603 had statistically significant differences in grain yield in all tillage systems.

**Key words:** conventional tillage, reduced tillage, direct seeding, maize, yield

## PRODUKTIVNOST ZDRUŽENOG USEVA BORANIJE I CRNOG LUKA U ORGANSKOM SISTEMU ZEMLJORADNJE

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U nekoliko proteklih decenija porasla je tražnja za svežim povrćem. Istovremeno, da bi se podmirile narasle potrebe, prinosi povrća su povećavani intenzivnom upotrebom fosilnih goriva, mineralnih hraniva i pesticide. Savremena istraživanja i porast svesti o značaju očuvanja zdravlja ljudi i životne sredine nametnuli su interesovanje za održive sisteme zemljoradnje i organsku proizvodnju. Združivanje useva je dobro poznata i lako primenljiva tehnika. Može biti veoma korisno rešenje proizvođačima zainteresovanim za organsku proizvodnju. Ipak, zbog nedostatka savremenih istraživanja agronomi nisu u mogućnosti da proizvođačima daju korisne preporuke u vezi s združivanjem useva.

Cilj ovog istraživanja bio je da se utvrdi produktivnost združenog useva boranije i crnog luka u organskom sistemu zemljoradnje.

Dvogodišnje istraživanje obavljeno je na Ogladnom polju, Instituta za povrtarstvo, Smederevska Palanka, kako bi se utvrdila produktivnost novog načina združivanja boranije i crnog luka pri različitim rokovima setve i primeni različitih đubriva. Boranija (*Phaseolus vulgaris* L.) je združena sa crnim lukom (*Allium cepa* L.) po metodu zamenjujućih serija a obe vrste su gajene i kao čisti usevi. U dva roka setve (prolećni i letnji) ispitana su četiri načina đubrenja: kontrolno (bez đubrenja), mikrobiološkim đubrivom, mineralnim đubrivom i stajnjakom.

Na osnovu rezultata istraživanja utvrđeno je da su ispitivana đubriva uticala na prinose boranije i crnog luka u oba roka setve. Ostvarene vrednosti LER veće od 1 ukazale sun a veću produktivnost združenog useva u poređenju s čistim usevima. Relativni prinos boranije nije značajno odstupao od očekivanih vrednosti (0,5) dok je kod crnog luka relativni prinos bio veći zahvaljujući inovativnom načinu združivanja.

**Ključne reči:** Organska proizvodnja, održivost, povrće, LER indeks



## INCREASED VEGETABLE PRODUCTIVITY VIA INNOVATIVE ONION/GREEN BEAN INTERCROPPING (IN ORGANIC FARMING SYSTEM)

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Demands for fresh vegetable was increased during the last few decades. At the same time, thanks to high fossil fuels, mineral fertilizers and pesticides inputs, average crop yields were significantly enhanced with goal to satisfy market requirements. Recently, some negative effects of such production practices and research results promoted awareness for human health, environmental issues, interests for sustainable crop practices and organic production. Intercropping is widely used and affordable growing technique. It can be helpful tool for farmers interested for sustainable vegetable production, but there is a lack of scientific data related to productivity of vegetable intercrops and agricultural experts are not capable to make useful recommendations for farmers. Research goal of this trial was to evaluate productivity of green bean/onion intercropping in organic farming system.

A two years trial was conducted at the experimental field of Institute for vegetable crops, Smederevska Palanka, in order to investigate the performance of an innovative green bean/onion intercrop within different sowing dates and fertilizing treatments. Green bean (*Phaseolus vulgaris* L.) was intercropped with onion (*Allium cepa* L.) according to the method of replacement series and both species were also grown as a sole crops. In two sowing periods (spring and summer), four fertilization treatments were tested: control treatment, microbiological fertilizer, mineral fertilizer and farm yard manure.

Green bean and onion yields were affected by tested fertilizers in both growing periods. LER values were higher than 1 and that suggests better performance of green bean/onion intercrop, comparing to related sole crops. Relative yields of green bean were not significantly affected by intercropping with onion but relative yields of onion were significantly higher than 0,5 thanks to innovative intercrop system.

**Key words:** Organic production, sustainability, vegetable, LER index



## ISPITIVANJE MASNOG ULJA PLODOVA ANISA, MIROĐIJE I KIMA

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Anis (*Pimpinella anisum* L.), mirođija (*Anethum graveolens* L.) i kim (*Carum carvi* L.) su poznate kao biljke bogate etarskim uljima koje im daje karakterističan miris i aromu zbog čega se i koriste kao začini, ali i u lekovite svrhe. Pored etarskog ulja, plodovi ovih biljaka sadrže i masno ulje, proteine, celulozna vlakna i ugljene hidrate. Cilj ovog rada je bio da se utvrdi količina i ispita masnokiselinski sastav navedenih biljaka gajenih tokom 2014. godine na oglednom polju u Mošorinu. Masno ulje iz samlevenih plodova je izdvojeno Soxhlet ekstrakcijom, a masnokiselinski sastav je determinisan nakon esterifikacije GC analizom. Ustanovljeno je da plod anisa (*Anisi fructus*) sadrži 6,31% masnog ulja u kome dominira C14:0 sa 75,52%, a potom slede nezasićene kiseline sa 18 ugljenikovih atoma (C18:1 sa 13,29% i C18:2 sa 6,56%). Plod mirođije (*Anethi fructus*) sadrži 1,89% masnog ulja u kome dominiraju C18:1 (46,29%), C13:0 (16,40%) i C15:1 (15,26%). U plodu kima (*Carvi fructus*) je bilo 6,94% masnog ulja bogatog nezasićenim masnim kiselinama sa 18 ugljenikovih atoma (C18:1 sa 57,78% i C18:2 sa 32,26%), dok je C16:0 bila zastupljena sa 5,47%. Utvrđivanje količine i sastava masnog ulja ovih biljaka je značajno zbog toga što se anis, mirođija i kim koriste kao funkcionalna hrana, ali i kao pomoćna lekovita sredstva u brojnim galenskim preparatima. Pored toga, plod ovih biljaka je u isto vreme i seme, a rezerve masti u njemu obezbeđuju klijanje i početni rast biljaka.

**Ključne reči:** *Pimpinella anisum*, *Anethum graveolens*, *Carum carvi*, masne kiseline

## INVESTIGATION OF ANISE, DILL AND CARAWAY FRUIT FATTY OILS

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Anise (*Pimpinella anisum* L.), dill (*Anethum graveolens* L.) and caraway (*Carum carvi* L.) are well known for being rich in essential oil, which gives to them the characteristic odor and aroma. Because of this, they are used as spices as well as for medicinal purposes. Apart from the essential oil, fruit of these plants contains fatty oil, proteins, cellulose fibers and carbohydrates. The aim of this investigation was to determine the fatty oil content and fatty acid composition of the above mentioned plants grown during 2014 at the experimental field in Mošorin. Fatty oil content was determined by Soxhlet extraction, while fatty acid composition was determined by esterification and GC analysis. It was established that anise fruit (*Anisi fructus*) contains 6.31% of fatty oil with C14:0 as the dominant fatty acid with 75.52%, followed by unsaturated fatty acids with 18 carbon atoms (C18:1 with 13.29% and C18:2 with 6.56%, respectively). Dill fruit (*Anethi fructus*) contains 1.89% of fatty oil with C18:1 (46.29%), C13:0 (16.40%) and C15:1 (15.26%) as the dominant fatty acids. In caraway fruit (*Carvi fructus*) there was 6.94% of fatty oil rich in unsaturated fatty acids with 18 carbon atoms (C18:1 with 57.78% and C18:2 with 32.26%, respectively), while C16:0 was present with 5.47%. Determining the quantity and composition of fatty oil from these plants is important because anise, dill and caraway are used as functional food, as well as dietary supplements in numerous galenic preparations. Apart from this, the fruit of these plants is also the seed, and the reserves of fatty oil in it ensure the emergence and early growth of plants.

**Ključne reči:** *Pimpinella anisum*, *Anethum graveolens*, *Carum carvi*, fatty acids

## SADRŽAJ UKUPNIH FENOLA, KOMPONENTE I ANTIOKSIDATIVNI KAPACITET EKSTRAKATA ULJANIH POGAČA KUMINA

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Kumin (*Cuminum cyminum* L.) jednogodišnja biljka iz familije Apiaceae poreklom sa Istočnog Mediterana. Najviše se gaji u Indiji ali i u Siriji, Iranu i Turskoj. Kumin je karakterističan začim orijentalne kuhinje i jedan od glavnih sastojaka kari mešavine. Ova biljka se od davnina koristi u tradicionalnoj medicini, a savremenim naučnim metodama je potvrđeno da etarsko ulje kumina poseduje antimikrobne i antioksidativne osobine, te da se može koristiti za prevenciju i lečenje mnogih bolesti. Nakon destilacije etarskog ulja zaostaju uljane pogače koje su bogate mastima i proteinima, te se mogu koristiti za ishranu stoke, i to posebno preživara zbog velikog sadržaja nesvarljivih vlakana. Cilj našeg istraživanja bio je da se ispita sadržaj ukupnih fenola i antioksidativni kapacitet uljanih pogača zaostalih nakon destilacije etarskog ulja na aparaturi po Klevendžeru. Iz ekstrakata četiri uzorka kumina dostupni na tržištu Srbije, određen je sadržaj ukupnih polifenola korišćenjem Folin-Ciocalteu-ovog reagensa pomoću galne kiseline (GAE) kao standarda i izražen u mg/g suvog ekstrakta. Za identifikaciju jedinjenja prisutnih u ekstraktu korišćena je LC-DAD-ESI-ToF MS analiza. Kapacitet neutralisanja slobodnih radikala ispitivanih uzoraka određen je merenjem njihove sposobnosti da neutrališu DPPH radikale, a rezultati su izraženi kao ekvivalenti mg troloksa (TE). Dobijeni rezultati ukazuju da je sadržaj ukupnih polifenola od 30,1-47,5 mg/g, i da je antioksidativni kapacitet slab (0,02-0,04 TE). U ekstraktu kumina identifikovano je nekoliko grupa jedinjenja: hidroksibenzojeve i hidroksicimne kiseline, kao i glikozidi flavonona i flavonola.

**Ključne reči:** *Cuminum cyminum*, DPPH, polifenoli, vodeni ekstrakt

## TOTAL PHENOLS CONTENT, PHYTOCHEMICAL CONSTITUENTS AND ANTIOXIDATIVE CAPACITY OF CUMIN POSTDISTILLATION WASTE MATERIAL

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Cumin (*Cuminum cyminum* L.) is a herbaceous plant from Apiaceae family originating from the Eastern Mediterranean. It is mainly grown in India, Syria, Iran and Turkey. Cumin is a characteristic spice of the oriental cuisine and one of the main ingredients of curry powder. This plant has been used in traditional medicine since the ancient times. Modern scientific methods acknowledge that cumin essential oil possesses antimicrobial and antioxidative properties, so it can be used for prevention and treatment of many disorders. After the essential oil distillation, seed oil cakes rich in fatty oil and proteins remain and can be used for animal nutrition, especially ruminant, because of the high content of indigestible fibers. The aim of our investigation was to determine the total phenols content and antioxidative capacity of seed oil cake remains after Clevenger oil distillation. From four samples of cumin available on the Serbian market, the total phenols content in the extract was determined by using *Folin-Ciocalteu* reagent, and expressed in mg/g gallic acid (GAE). In order to identify compounds present in the extract LC-DAD-ESI-ToF MS analysis was used. Capacity of samples to neutralize free radicals was determined by DPPH method, and results are expressed in equivalent mg trolox (TE). The findings indicate that the content of total polyphenols varied between 30.1-47.5 mg/g, and that the antioxidative capacity was poor (0.02-0.04 TE). In the cumin extract several groups of compounds were identified such as: hydroxybenzoic and hydroxycinnamic acids, as well as glycosides of flavonones and flavonoles.

**Key words:** *Cuminum cyminum*, DPPH, polyphenols, aqueous extract

## UTICAJ TEMPERATURE NA RAZVOJ TOKSIGENIH VRSTA GLJIVA

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U ovom radu je prikazan efekat temperature, kao jedan od faktora koji mogu uticati na intenzitet pojave različitih vrsta toksigenih gljiva. Naime, poslednjih godina je utvrđeno da je usled klimatskih promena došlo do izmena u okviru mikopopulacija na kukuruzu. Visoka temperatura i dugotrajna suša pogoduju povećanoj učestalosti *Aspergillus* vrsta, dok umerene temperature više odgovaraju *Fusarium* vrstama.

Efekta temperature na razvoj *Aspergillus flavus* Link, *A. parasiticus* Speare, *Fusarium verticillioides* (Sacc.) Nirenberg i *F. graminearum* Schwabe je proučavan na krompir dekstroznoj podlozi (KDA). Nakon 7 dana inkubacije u tami na temperaturama od 25°C i 34°C, izmeren je porast pomenutih vrsta gljiva. *Aspergillus* i *Fusarium* vrste su na temperaturi od 25°C pokazale ujednačen porast. Na temperaturi od 34°C utvrđena je potpuna dominacija *Aspergillus* vrsta u odnosu na *F. verticillioides*, dok kod *F. graminearum* nije zabeležen porast.

Klimatske promene pogodovale su neuobičajeno visokom intenzitetu pojave *Aspergillus* vrsta u našim agroekološkim uslovima u toku vegetacije kukuruza. Rezultati istraživanja donekle potvrđuju ovu pojavu, jer su ukazali da visoke temperature pogoduju razvoju *Aspergillus* vrsta, u odnosu na *Fusarium* vrste. Pojava i zastupljenost toksigenih gljiva na kukuruzu predstavlja značajan problem, kako u proizvodnji kukuruza, tako i po ljudsko zdravlje, što ukazuje na neophodnost daljih istraživanja ove grupe biljnih patogena kroz detaljnu identifikaciju, karakterizaciju i ispitivanja mogućih interakcija mikopopulacija na kukuruzu.

**Ključne reči:** *Aspergillus*, *Fusarium*, kukuruz

## IMPACTS OF TEMPERATURES ON THE DEVELOPMENT OF TOXIGENIC FUNGI

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This paper presents impacts of temperatures, as one of factors that can affect the intensity of incidence of different types of toxigenic fungi. In fact, in recent years it has been determined that due to climate changes mycopopulations in maize have been changing. High temperatures and prolonged drought favour increased frequency of *Aspergillus* species, while temperatures that are more moderate are more favourable for *Fusarium* species.

The temperature impact on the development of *Aspergillus flavus* Link, *A. parasiticus* Speare, *Fusarium verticillioides* (Sacc.) Nirenberg and *F. graminearum* Schwabe was observed on potato dextrose agar (PDA). After the 7-day incubation in the dark at the temperatures of 25°C and 34°C, the growth of the stated fungi was measured. *Aspergillus* and *Fusarium* species had uniform growth at the temperature of 25°C. On the other hand, at the temperature of 34°C, an absolute domination of *Aspergillus* species over *F. verticillioides* was established, while the growth of *F. graminearum* was not recorded.

Climate changes have favoured uncommonly a high incidence intensity of *Aspergillus* species during the growing season of maize under Serbian agroecological conditions. The obtained results confirm this phenomenon to a certain extent, because they indicate that high temperatures favour more the development of *Aspergillus* species than the development of *Fusarium* species. The incidence and distribution of toxigenic fungi in maize is a significant problem both in the production of maize and human health, which suggests a need for further studies of this group of plant pathogens including detailed identification, characterisation and testing of possible interactions of mycopopulations in maize.

**Key words:** *Aspergillus*; *Fusarium*; maize

## UTICAJ AZOTNOG ĐUBRENJA NA OSOBINE SMEŠE LUCERKE SA TRAVAMA

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Cilj ovog istraživanja je bio da se utvrdi efekat različitih doza azota iz mineralnih đubriva na proizvodne i kvalitativne karakteristike lucerkinih smeša sa travama. Količina azota, dobijena procesom azotofiksacije u smeši lucerke sa travama, nije dovoljna da zadovolji potrebe biljaka za azotom, te je neophodno ovaj nedostatak azota nadoknaditi primenom azota iz mineralnih đubriva. Istraživanja su obuhvatila čist usev lucerke (A1) i njene smeša sa travama u različitim kombinacijama (A2: lucerka 50%; ježevica 50%, A3: lucerka 50%; ježevica 25%; livadski vijuk 25%, A4: lucerka 25%; ježevica 50%; livadski vijuk 25%, A5: lucerka 40%; ježevica 20%; livadski vijuk 20%; engleski ljulj 20%). Jesenja setva je obavljena na razmak između redova 12 cm. Dopunska mineralna ishrana izvršena je u proleće, sa azotnim mineralnim hranivom KAN (27% N), u dva tretmana: 50 kg ha<sup>-1</sup> (B2) i 100 kg ha<sup>-1</sup> (B3) i kontrolom bez primene azota (B1).

Na osnovu prinosa zelene mase u smeši A5 (22,8 t ha<sup>-1</sup>) i pri varijanti đubrenja B3 (18,76 t ha<sup>-1</sup>) u odnosu na varijantu B2 (17,56 t ha<sup>-1</sup>) može se zaključiti da, na variranja ispitivanih osobina veći uticaj ima tip smeše, a nivo azotnog đubrenja je imao uticaj na prinos suve mase (4,19 t ha<sup>-1</sup>), sirovih proteina (169,7 t ha<sup>-1</sup>) i na udeo trava (79%) u smešama, koji su najbitniji pokazatelji kvalitetne kabaste stočne hrane, dok su se ostali parametri smanjivali ili ostali nepromenjeni. Najveći prinos su imale varijante sa 100 kg N ha<sup>-1</sup>, ali upotreba prekomernih količina azota poskupljuje proces proizvodnje, dovodi do zagađenja zemljišta, površinskih i podzemnih voda nitratima, kao i do nagomilavanja nitrata u biljkama.

**Ključne reči:** azot, kvalitet, lucerka, produktivnost, smeša



## THE EFFECT OF NITROGEN FERTILIZATION ON MIXTURE PROPERTIES OF ALFALFA WITH GRASSES

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The aim of this study was to determine the effect of different rates of nitrogen from mineral fertilizers on production and qualitative characteristics of alfalfa mixtures with grasses. The amount of nitrogen, the resulting process of nitrogen fixation in alfalfa mixture with grasses, is not sufficient to meet the needs of plants for nitrogen, and it is necessary to compensate that lack of nitrogen application using nitrogen mineral fertilizers. The research included pure alfalfa (A1) and its mixtures with grasses in different combinations (A2: alfalfa 50%, orchard grass 50%; A3: alfalfa 50%; orchard grass 25%, meadow fescue 25%; A4: alfalfa 25%; orchard grass 50%, meadow fescue 25%; A5: alfalfa 40%; orchard grass 20%, meadow fescue 20%, perennial ryegrass 20%). Autumn sowing was done with inter row spacing of 12 cm. Additional mineral nutrition was conducted in the spring, with the nitrogen mineral fertilizer KAN (27% N), in two treatments: 50 kg ha<sup>-1</sup> (B2) and 100 kg ha<sup>-1</sup> (B3) and control without nitrogen (B1).

The based on the yield of green matter in the mixture A5 (22.8 t ha<sup>-1</sup>) and at fertilization treatment B3 (18.76 t ha<sup>-1</sup>) compared to treatment B2 (17.56 t ha<sup>-1</sup>) may be concluded that, on variation of the traits investigated was effected by the type of mixture, and the level of nitrogen fertilization had significant effect on dry matter yield (4.19 t ha<sup>-1</sup>), crude protein (169.7 t ha<sup>-1</sup>) and the proportion of grass (79%) in mixtures, which are the most important indicators of animal feed, while the other parameters decreased or remained unchanged. The highest yield was obtained by treatment 100 kg N ha<sup>-1</sup>, but the use of excessive amounts of nitrogen increases the price of the production, leading to pollution of soil, surface and groundwater with nitrates and nitrate accumulation in plants.

**Key words:** alfalfa, mixture, nitrogen, productivity, quality



**PRINOS ZP HIBRIDA KUKURUZA U PROIZVODNIM OGLEDIMA U 2015. GODINI**

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Tokom 2015. godine deset ZP hibrida kukuruza FAO grupe zrenja 300-600 ispitivano je na 42 lokaliteta u različitim proizvodnim rejonima u Srbiji. Svake godine Institut za kukuruz ispituje svoje hibride kukuruza na velikom broju lokaliteta sa ciljem da se ispita njihov proizvodni potencijal, adaptabilnost i stabilnost prinosa. Na osnovu rezultata dobijenih u ogledima selekcioneri kukuruza vrše odabir novih, perspektivnih hibrida kukuruza koji će biti uključeni u proizvodnju semena. Protekla proizvodna sezona odlikovala se veoma visokim temperaturama i nedostatkom padavina tokom letnjeg perioda, pa su i ostvareni prinosi bili niži od očekivanih. Na dvadeset lokaliteta u Vojvodini prosečni prinosi hibrida varirali su u rasponu od 8040 kg/ha (ZP 555) do 8484 kg/ha (ZP 366), sa prosečnom vrednošću od 8247 kg/ha, dok su u Centralnoj Srbiji prosečni prinosi bili u rasponu od 5616 kg/ha (ZP 341) do 6782 kg/ha (ZP 606), sa srednjom vrednošću 6232 kg/ha. Kada se uzmu u obzir prinosi ostvareni na 42 lokaliteta u Vojvodini i Centralnoj Srbiji, ostvaren je prosečan prinos od 7191 kg/ha, a varirao je u rasponu od 6818 kg/ha (ZP 341) do 7518 kg/ha (ZP 606). Iako su postignuti rezultati bili znatno niži u odnosu na genetički potencijal rodnosti hibrida, možemo zaključiti da su bili viši u odnosu na prosečne prinose ostvarene u Republici Srbiji.

**Ključne reči:** prinos zrna, hibridi kukuruza

## GRAIN YIELDS OF ZP MAIZE HYBRIDS IN PRODUCTION TRIALS IN 2015

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In 2015. ten ZP maize hybrids belonging from FAO 300-600 maturity group were tested at 42 locations in different growing areas in Serbia. Each season Maize Research Institute Zemun polje test maize hybrids at a large number of locations in order to test its production potential, as well as adaptability and yield stability. Based on the results obtained in demo trials breeders make choice of new, promising hybrids which will be included in seed production. Last growing season was characterized by very high temperatures, followed with the deficit in precipitations during the summer period, so obtained grain yields were lower than expected. At twenty locations in Vojvodina average grain yields were in range from 8040 kg/ha (ZP 555) to 8484 kg/ha (ZP 366), with an average value of 8247 kg/ha, while in Central Serbia average grain yields at twenty two locations varied from 5616 kg/ha (ZP 341) to 6782 kg/ha (ZP 606), with the average value of 6232 kg/ha. When grain yields at 42 locations including Vojvodina and Central Serbia are taken in consideration, average grain yield obtained in demo trials were 7191 kg/ha, and it was in range from 6818 kg/ha (ZP 341) to 7518 kg/ha (ZP 606). Even though obtained grain yields were considerably lower than hybrids' genetic potential, it can be concluded that they were higher compared to the average grain yields in the Republic of Serbia.

**Key words:** grain yields, maize hybrids

## ODSTUPANJE OD MENDELOVIH ZAKONA U NASLEĐIVANJU *OPAQUE2* (*O2*) ALELA KOD KUKURUZA

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Različiti istraživači utvrdili su da se pri nasleđivanju recesivnog *opaque2* (*o2*) alela u segregirajućim potomstavima kukuruza javlja značajno manji procenat recesivno homozigotnih (*o2o2*) biljaka od očekivanog (prema Mendelovim zakonima nasleđivanja). Ovo je objašnjeno malom veličinom ispitivanog uzorka, slučajnim odabirom biljaka iz populacije, slabijom klijavošću polenovih zrna kukuruza sa recesivnim *o2* alelom u odnosu na ona koja nose dominantni *O2* alel i eventualnom inkompatibilnošću uzrokovanom za sada nepoznatim genetičkim faktorima. Kako bi dalje pojasnili ovu pojavu, 2014. godine izveli smo četiri tipa ukrštanja: 1) B-73*o2o2* × B-73*o2O2* (recesivni alel u ocu je poreklom iz majke) i recipročno 2) B-73*o2O2* × B-73*o2o2*, kao i 3) B-73*o2o2* × B-73*O2o2* (recesivni alel u ocu je poreklom iz oca) i recipročno 4) B-73*O2o2* × B-73*o2o2*. U potomstvima ukrštanja praćen je odnos razdvajanja heterozigotnih normalnih (N) i *o2o2* zrna. Ni u jednom ukrštanju nije dobijen očekivani odnos razdvajanja 1:1. Dobijene vrednosti bile su: 1) 55,7%N: 44,3%*o2o2* ( $\chi^2=18,9^{**}$ ); 2) 46,2%N: 53,8%*o2o2* ( $\chi^2=12,5^{**}$ ); 3) 66,2%N: 33,8%*o2o2* ( $\chi^2=53,8^{**}$ ); 4) 31,9%N : 68,1%*o2o2* ( $\chi^2=202,8^{**}$ ). Ukoliko je otac heterozigotan (ukrštanja 1 i 3) dobija se značajno veći procenat N zrna, što je u skladu sa dosadašnjim saznanjima. U obrnutom slučaju (ukrštanja 2 i 4), dobija se značajno veći procenat *o2o2* zrna. Ovo se može objasniti ili preferencijalnim spajanjem homozigotnih gameta, ili eventualno selekcijom pre formiranja gameta, odnosno odnosom svila koje nose *O2* i *o2* gamete različitim od 1:1. Takođe se uočava i velika razlika u segregaciji između ukrštanja 1 i 3, odnosno 2 i 4. U ukrštanju 1 odnosno 2 je daleko niži procenat *o2o2* zrna u odnosu na ukrštanje 3 odnosno 4. Ova pojava je poznata kao *genetic imprinting*, odnosno posledica porekla određenog alela dotičnog genotipa iz majke ili oca.

**Ključne reči:** kukuruz, *opaque2*, poremećaj segregacije

## MENDELIAN LAW DEVIATION IN *OPAQUE2* (*O2*) ALLELE INHERITANCE IN MAIZE

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Various researchers determined that in inheritance of recessive *opaque2* (*o2*) allele there is significantly lower percentage of homozygous (*o2o2*) plants in segregating offspring than expected (according to Mendelian laws of inheritance). This was explained by small sample size, randomly selected plants from the field, lower germination of maize pollen grains carrying recessive *o2* allele compared to those carrying *O2* dominant allele and possible incompatibility caused by still unknown genetically factors. To further explain this phenomenon, four types of crosses were made in 2014: 1) B-73*o2o2* × B-73*o2O2* (recessive allele in the father originates from mother) and reciprocally 2) B-73*o2O2* × B-73*o2o2*, and 3) B-73*o2o2* × B-73*O2o2* (recessive allele in father originates from its father) and reciprocally 4) B-73*O2o2* × B-73*o2o2*. Normal (N) and *o2o2* kernel segregation ratio was observed in the crosses' offspring. Expected segregation ratio 1:1 has not been obtained in any cross. The given values were: 1) 55,7%N : 44,3%*o2o2* ( $\chi^2=18,9^{**}$ ); 2) 46,2%N : 53,8%*o2o2* ( $\chi^2=12,5^{**}$ ); 3) 66,2%N : 33,8%*o2o2* ( $\chi^2=53,8^{**}$ ); 4) 31,9%N : 68,1%*o2o2* ( $\chi^2=202,8^{**}$ ). In case when male parent was heterozygous (crosses 1 and 3) significantly higher N kernel percentage was obtained, which is in accordance to the previous findings. In the opposite case (crosses 2 and 4), significantly higher *o2o2* kernel percentage was obtained. This can be explained by preferential conjugation of homozygous gametes or by possible selection before gamete formation, meaning that ratio of the silks carrying *O2* and *o2* gametes was not initially 1:1. The big difference in the segregation ratios between crosses 1 and 3, i.e. 2 and 4 has been observed. In cross 1 i.e. 2 there is much lower percentage of *o2o2* kernels comparing to cross 3 i.e. 4. This phenomenon is known as *genetic imprinting* - the effect of origin of specific allele in the genotype (maternal or paternal).

**Key words:** maize, *opaque2*, segregation distortion

## UTICAJ AGROEKOLOŠKIH USLOVA I SETVENE NORME NA FIZIOLOŠKE OSOBINE SEMENA ŽUTOG ZVEZDANA (*LOTUS CORNICULATUS L.*)

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Žuti zvezdan (*Lotus corniculatus L.*) je višegodišnja mahunarka koja se odlikuje dobrom hranljivom vrednošću krme. Za zasnivanje travno - leguminoznih smeša i pašnjaka žuti zvezdan je jedna od najvažnijih vrsta iz grupe leguminoza. Predmet ove studije je uticaj setvenih normi (5 kg/ha, 10 kg/ha i 20 kg/ha) na varijabilnost fizioloških osobina semena: energiju klijanja, klijavost i udeo tvrdih semena žutog zvezdana - *Lotus corniculatus L.* Ogledi su izvedeni u trogodišnjem periodu od 2013. do 2015. godine, na međurednom rastojanju od 60 cm. Istraživanje fizioloških osobina: energije klijanja, klijavosti semena i udela tvrdih semena su komercijalno značajne osobine semena. U laboratorijskim uslovima, izvršena su ispitivanja osobina semena: energije klijanja, klijavosti semena i procentualnog udela tvrdih semena.

Godina i interakcija setvena norma x godina imala je statistički visoko značajan uticaj na energiju klijanja, klijavost semena i udeo tvrdih semena. Najveća klijavost i energija klijanja ostvarena je u 2015. godini (69,7% i 59,0%), i to visoko statistički značajno viša u odnosu na 2014. godinu (10,6%). Statistički visoko značajno viši udeo tvrdih semena ostvaren je u 2014. godini u odnosu na 2013. i 2015. godinu.

Najveća klijavost i energija klijanja u proseku ostvarena je u varijanti sa setvenom normom, od 10 kg/ha. Uticaj setvenih normi bio je upravo proporcionalan primenjenim količinama semena na udeo tvrdih semena. U proseku za ispitivani period najveći prosečan udeo tvrdih semena (43,43 %) ostvaren je u varijanti sa primenom najveće količine semena, 20 kg/ha, zatim u varijanti sa primenom 10 kg/ha (39,77%) dok je najmanji udeo od 37,53% bio u varijanti s najmanjom normom semena, od 5 kg/ha. Varijanta s najvišom setvenom normom, od 20 kg/ha imala je statistički značajno veći udeo tvrdih semena u odnosu na varijantu sa najmanjom setvenom normom. Rezultati su pokazali da je varijabilnost fizioloških osobina semena zavisila od vremenskih uslova-godine i od setvene norme.

**Ključne reči:** *Lotus corniculatus L.*, ekološki uslovi, setvene norme, fiziološke osobine semena

**EFFECT OF ENVIRONMENTAL CONDITIONS AND SEEDLING RATES ON  
PHYSIOLOGICAL CHARACTERISTICS OF BIRDSFOOT TREFOIL SEED (*LOTUS  
CORNICULATUS L.*)**

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Birdsfoot trefoil (*Lotus corniculatus L.*) is a perennial legume that has a good nutritional value of feed. For the establishment of grass - leguminous pastures trefoil is one of the most important species from legumes. The objective of this study was the influence of seedling rates (5 kg/ha, 10 kg/ha and 20 kg/ha) on the variability of physiological characteristics of seeds: germination energy, germination and share of hard seeds. The experiments were performed in a three-year period 2013 to 2015, on the inter-row spacing of 60 cm. The study of physiological traits: germination energy, germination and share of hard seeds are commercially important seed characteristics. In laboratory conditions, were examined seed traits: germination, seed germination and percentage share of hard seeds.

Year and interactions sowing rate x years had a statistically significant effect on germination energy, seed germination and share of hard seeds. The highest germination and vigor was achieved in 2015 (69.7% and 59.0%), and a highly statistically significantly higher than in 2014 (10.6%). Highly statistically significantly higher proportion of hard seeds was realized in 2014 compared to 2013 and 2015.

The highest germination and vigor in the average realized in variants with sowing density of 10 kg/ha. The effect of sowing norms was exactly proportional to the applied quantity of seed on the share of hard seeds. On average for the test period the largest average share of hard seeds (43.43%) was recorded in the variant with the largest quantities of seeds, 20 kg/ha, then the variant with 10 kg/ha (39.77%) and the lowest share of 37.53% was embodiment with the lowest norm of the seed, from 5 kg/ha. The variant with the highest sowing density of 20 kg/ha had a significantly higher share of hard seeds compared to the variant with the lowest sowing density. The results showed that the variability of the physiological characteristics of seed depended on the environmental conditions - year and seeding rate.

**Key words:** *Lotus corniculatus*, environmental conditions, sowing rates, physiological properties of seed

**DUŽINA ŽIVOTA SEMENA NEKIH VRSTA LEKOVITOG BILJA***Slobodan Dražić<sup>1</sup>, Slavoljub Lekić<sup>3</sup>, Snežana Pavlović<sup>2</sup> i Milena Dražić<sup>3</sup>*<sup>1</sup>Društvo selekcionera i semenara Republike Srbije, Beograd<sup>2</sup>Institut za proučavanje lekovitog bilja “dr J.Pančić”, Beograd, Srbija<sup>3</sup>Poljoprivredni fakultet, Univerzitet u Beogradu, Srbija

Dužina života semena je osobina, važna za proizvođače, trgovce a takođe i za čuvanje u bankama semena. Ovo je nasledna osobina na koju utiču različiti faktori (biotički i abiotički). Cilj ovog ispitivanja bio je da se u laboratorijskim uslovima utvrdi klijavost semena tokom pet godina čuvanja. Ispitivano je pet višegodišnjih vrsta lekovitog bilja familije Lamiaceae: lavanda (*Lavandula vera* DC), matičnjak (*Melissa officinalis* L.), miloduh (*Hyssopus officinalis* L.), timijan (*Thymus vulgaris* L.) i žalfija (*Salvia officinalis* L.). Seme je čuvano na temperaturi od 6°C. Klijavost je ispitivana svakih 12 meseci prema pravilima ISTA-e (International Seed Testing Association, 2009.) Klijavost semena ispitivanih vrsta posle žetve bila je različita: matičnjak 96%, timijan 88%, žalfija 83%, lavanda 69%, miloduh 34%. Posle tri godine klijavost je bila sledeća: žalfija 62%, matičnjak 54%, timijan 14%, lavanda 12% i miloduh 3%. Posle pet godina čuvanja matičnjak je imao klijavost od 20% dok su ostale vrste izgubile klijavost.

**Ključne reči:** klijavost, lavanda, matičnjak, miloduh, timijan, žalfija



**SEEDS LONGEVITY OF SOME MEDICINAL PLANT SPECIES**

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Longevity of seeds is an important property for productions, tradesmen as also for preserving in banks for seeds . This is hereditary property influenced by various factors (biotic and abiotic). The aim of the research was to establish in laboratory conditions germination of seeds over the five years period of storage. Five perennial species of medicinal herbs of *Lamiaceae* family were tested: lavender (*Lavandula vera* DC), balm (*Melissa officinalis* L.), hyssop (*Hyssopus officinalis* L.), common thyme (*Thymus vulgaris* L.) and sage (*Salvia officinalis* L.). The seeds were stored at 6°C. Germination was tested every 12 months according to ISTA (International Seed Testing Association, 2009). Germination of seeds tested after the harvest was different: balm 96%, common thyme 88%, sage 83%, lavender 69%, hyssop 34%. After three years period of storage sprouting was the following: sage 62%, balm 54%, common thyme 14%, lavender 12% and hyssop 3%. After five years of storage balm germination was 20% whereas the other species have lost germination.

**Key words:** germination, lavender, balm, hyssop, common thyme, sage



**REZULTATI I PERSPEKTIVE OPLEMENJIVANJA LEKOVITOG,  
AROMATIČNOG I ZAČINSKOG BILJA U REPUBLICI SRBIJI**

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Aktuelni sortiment naše zemlje, predstavljaju domaće i introdukovane populacije i sorte, poboljšane sorte, kao i novostvorene sorte. Domaće populacije još uvek preovladavaju u proizvodnji, što je zahtevalo poboljšanje sortimenta. Na listama sorti Ministarstva poljoprivrede (1989-2006.) nalazile su se 44 vrste što predstavlja oko 10% od ukupnog broja biljnih vrsta sa lekovitim sastojcima u flori Srbije. One su bile predstavljene sa 83-85 sorata. U zadnjoj deceniji selekcionisano je nekoliko sorti, koje su privučene kao tehnička rešenja. Zakonom o semenu ("Sl.glasnik RS" br.45/2005. i 30/2010.) ove biljne vrste su isključene iz postupka priznavanja sorti, pa se neće upisivati u Registar sorti poljoprivrednog bilja. Umesto sortnog, proizvođačima se nudi »nesortno«, odnosno »proizvodno« seme. Ovakva odredba nije stimulatívna za dalji razvoj ove privredne delatnosti.

**Ključne reči:** lekovito bilje, oplemenjivanje, perspektive, rezultati, sorta.

## RESULTS AND PERSPECTIVES OF BREEDING MEDICINAL, AROMATIC AND SPICE PLANTS IN THE REPUBLIC OF SERBIA

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Sortiment of our country consists of domestic and introduced populations and varieties, as well as improved and newly created varieties. However, sortiment improvement was needed since domestic populations still prevail in production. In period 1989-2006. official list of varieties in Ministry of Agriculture contained 44 species, that represent around 10% of the total number of plant species with medicinal traits in Serbian flora. These species were represented with 83-85 varieties. In the last decade several varieties have been selected and accepted as technical solutions. National Law on Seed ("Sl.glasnik RS" numbers 45/2005. and 30/2010.) excluded these plant species from the procedure for release of varieties, so they will not be inscribed in the Register of released cultivars. Instead of certified seeds, manufacturers are being offered "uncertified", respectively "productive" seeds. Such regulation is not stimulative for further development of this agricultural activity.

**Key words:** medicinal plants, breeding, perspectives, results, variety.

## PRISUSTVO AMINOHETEROTROFA U RIZOSFERI LUCERKE GAJENE NA NEUTRALNOM I KISELOM ZEMLJIŠTU

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Mikroorganizmi imaju značajan uticaj u poljoprivrednoj proizvodnji time što učestvuju u stvaranju i održavanju zemljišta i njegove plodnosti. Aminoheterotrofi učestvuju u procesima amonifikacije, odnosno razgradnje i transformacije proteina u mineralne i nove organske forme. U cilju poboljšanja produktivnih svojstava zemljišta i proizvodnog potencijala biljaka sve više se primenjuje mikrobna inokulacija. U ovim istraživanjima ispitivan je efekat inokulacije rizobumom, azotobakterom i aktinomicetama, posebno i u kombinacijama na brojnost aminoheterotrofa u rizosferi lucerke gajene na zemljištima različitih pH vrednosti – neutralne reakcije (KCl – 6,57) i povišene kiselosti (KCl – 4,7). Seme lucerke je inokulisano sledećim inokulantima: rizobium (*Sinorhizobium meliloti*), azotobakter (*Azotobacter chroococcum*) i aktinomicete (*Streptomyces* spp.). Navedeni mikroorganizmi su korišteni kao pojedinačne i združene kulture (kombinacije dve, odnosno sve tri vrste mikroorganizama). Kontrolna varijanta je bez inokulacije. Nakon inokulacije seme je iz svake varijante posejano u sudove ispunjene zemljom (polukontrolisani uslovi). Posle prvog otkosa lucerke određen je broj aminoheterotrofa u rizosferi lucerke svakog tretmana.

Rezultati Fisher-ovog testa pokazuju da je najveća brojnost aminoheterotrofa bila na tretmanu aplikacije monovalentnim inokulumom *Azotobacter chroococcum* na zemljištu neutralne pH reakcije. Zabeležena je statistički značajna razlika između kontrole i svih primenjenih varijanti inokulacije na kiselom zemljištu. Na neutralnom zemljištu, u odnosu na kontrolni tretman zabeleženo je prisustvo statistički značajne razlike, osim na varijanti inokulacije združenim kulturama *Azotobacter chroococcum* + *Streptomyces* spp. Na ovom zemljištu brojnost aminoheterotrofa se nije statistički značajno razlikovala između varijanti aplikacije monovalentnog inokuluma *Streptomyces* spp. i inokulacije združenim kulturama *Sinorhizobium meliloti* + *Streptomyces* spp. Odsustvo statistički značajne razlike zabeleženo je i na zemljištu kisele pH reakcije na varijanti inokulacije *A. chroococcum* i *A. chroococcum* + *S. meliloti* na zemljištu neutralne reakcije.

**Ključne reči:** aminoheterotrofi, lucerka, inokulacija

## THE PRESENCE OF AMINOHETEROTROPHS IN THE RHIZOSPHERE OF ALFALFA GROWN ON THE NEUTRAL AND ACIDIC soil

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Microorganisms have a significant impact in agricultural production by taking part in the creation and maintenance of the soil and its fertility. Aminoheterotrophs participate in the processes of ammonification or decomposition and transformation of proteins into mineral and new organic forms. In order to improve productive traits of soil and production potential of plants, microbial inoculation is increasingly being applied. In these studies, the effect of inoculation with rhizobium, azotobacter and actinomycetes, individually and in combinations, on the abundance of aminoheterotrophs in the rhizosphere of alfalfa grown on soils of different pH values neutral (KCl - 6.57) and acidic (KCl - 4.7) was examined. Alfalfa seed was inoculated with the following inoculants: rhizobium (*Sinohizobium meliloti*), azotobacter (*Azotobacter chroococcum*) and actinomycetes (*Streptomyces* spp.). These microorganisms are useful as individual and combined cultures (a combination of two or all three types of microorganisms). The control variant was without inoculation. After inoculation, the seeds were sown in each variant in pots filled with soil (semi-controlled conditions). After the first cutting of alfalfa, the number of aminoheterotrophs was determined in the rhizosphere of alfalfa in each treatment.

The results of Fisher test show that the highest number of aminoheterotrophs was in the treatment with monovalent *Azotobacter chroococcum* inoculum in the soil with neutral pH reaction. There was statistically significant difference between the control and all tested inoculation variants applied on acidic soil. In the neutral soil, in relation to the control treatment, significant difference was noted, except for the variant with inoculation with the combined cultures of *Azotobacter chroococcum* and *Streptomyces* spp. In this soil, the abundance of aminoheterotrophs was not significantly different between variants with monovalent inoculum of *Streptomyces* spp. and inoculation with the combined cultures of *Sinohizobium meliloti* + *Streptomyces* spp. The lack of statistically significant difference was also noted in the soil with acidic pH in the variant with inoculation with *A. chroococcum* and, also, in variant with *A. chroococcum* + *S. meliloti* on the soil of neutral reaction.

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**Key words:** aminoheterotrophs, alfalfa, inoculation

## FRAKCIJE ORGANSKOG UGLJENIKA U ZEMLJIŠTU NAKON TRETIRANJA BILJNIH OSTATAKA PŠENICE BIOFERTILIZATORIMA

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Jedan od glavnih ciljeva u organskoj poljoprivredi jeste povećanje plodnosti zemljišta i podsticanje kruženja hranljivih materija u okviru agroekosistema. Shodno tome agrotehničke mere se planiraju da se racionalno koristi i pravilno upravlja sa resursima na farmi. Posebna pažnja je posvećena korišćenju biljnih ostataka, zelenišnog đubriva, stajnjaka ali i mikrobioloških đubriva i mikro-organizama aktivatora zemljišta. Cilj ovog rada je da se utvrdi uticaj tretiranja biljnih ostataka komercijalnim mikrobiološkim đubrivima na promene u organskoj materiji zemljišta. Racionalno korišćenje biljnih ostataka je od velikog značaja, jer predstavlja značajan izvor organske materije koja se nakon mikrobiološke transformacije može stabilizovati u obliku humusa. Istraživanja su sprovedena na sertifikovanim organskim površinama Instituta za ratarstvo i povrtarstvo u Bačkom Petrovcu. Za procenu promena organskog ugljenika u zemljištu analizirane su sledeće frakcije: ukupan ugljenik u zemljištu (SOC), ugljenik rastvorljiv u toploj vodi (HWOC), čestični organski ugljenik (POC-C), mineralno udruženi ugljenik (MOC-C) i mikrobiološka svojstva. Nakon žetve pšenice u julu, zemljište je tretirano sa preparatom Naturmikro i Ekovital u koncentracijama od 0,5ml, 2,5ml i 5 ml po litru. Utvrđeno je da Ekovital povećava sadržaj ukupnog ugljenika u zemljištu kao i vrednosti POC-C i HWOC. Preparat Naturmikro ima značajan uticaj na povećanje ukupnog broja mikroorganizama. Dobijeni rezultati ukazuju da pravilna primena mikrobioloških đubriva može pomoći u iskorišćavanju biljnih ostataka čime se povećava plodnost zemljišta i sadržaj organske materije. Istovremeno pravilno upravljanje biljnim ostacima je ključno za uspostavljanje održive biljne proizvodnje u sistemima organske poljoprivrede.

**Ključne reči:** organska materija, biljni ostaci, bio-fertilizatori, ozima pšenica

## WINTER WHEAT RESIDUE TREATMENTS AFFECT SOIL CARBON FRACTIONS IN ORGANIC FARMING

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One of the main objectives in the organic agriculture is to develop the soil fertility in which nutrients are expected to circle within the agro-eco system. Therefore, the main focus is to exploit and rationally utilize and manage the on farm resources. A special attention is given to the use of plant residues, green fertilizers and manure, but also micro-biological fertilizers used as bio-fertilizers or micro-organism activators. The aim of this study is to assess the soil organic carbon change after residue treatment with commercial microbiological fertilizers. Residue utilization is of great importance because a significant amount of organic materials that can be incorporated and decomposed by the micro-organisms. The study was conducted on certified organic field of the Institute of Field and Vegetable Crops Novi Sad in Bački Petrovac. To assess change in soil organic carbon the following fractions were analyzed: total soil carbon (SOC), carbon soluble in hot water (HWOC), the particulate organic carbon (POC-C), mineral-associated carbon (MOC-C) and soil microbiology. Following the wheat harvest in July, soil was treated with the Naturmikro and Ekovital preparations in concentrations of 0,5ml, 2,5ml and 5ml per liter. Ekovital was found to increase the content of total soil carbon, and treated soil has the highest values of POM-C, and HWOC. Preparation Naturmikro has a significant impact on increasing the total number of microorganisms. Our result showed that when properly used application of the microbiological fertilizers could help in straw decomposition that could help in a gradual development of the soil fertility. Likewise, proper management of crop residue is key for sustainable field crop production.

**Key words:** organic matter, plant residue, bio-fertilizer, winter wheat

## MODELIRANJE PRINOSA I SADRŽAJA ORGANSKE MATERIJE ZEMLJIŠTA U VIŠEGODIŠNJEM OGLEDU „ PLODOREDI“ KORIŠĆENJEM DNDC MODELA

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Poznavanje dinamike porasta biljaka i inetrakcija sistema obrade sa faktorima spoljašnje sredine su glavni preduslovi postizanja visokih i stabilnih prinosa dobrog kvaliteta. Istovremeno, praćenje promena u zemljištu kao rezultat gajenja poljoprivrednih useva mora biti sastavni deo planiranja određene proizvodnje. Cilj ovih istraživanja je bio ustanoviti mogućnosti korišćenja DNDC (denitrifikacija – dekompozicija) modela u umerenim agroekološkim uslovima poređenjem izmerenih podataka za visinu prinosa i sadržaja organske materije iz višegodišnjih oglada „Plodoredi“ i rezultata dobijenih modeliranjem pomoću DNDC. Analizirano je četiri sistema ratarenja koji su bazirani na kukuruza i pšenici. Izmerene vrednosti u uzorcima deponovanog C su približne modeliranim vrednostima na dvopoljnom i tropoljnom plodoredu dok kod monokultura kukuruza i pšenice nisu utvrđene zavisnosti izračunatih i modeliranih vrednosti pomoću DNDC modela. Kada je u pitanju prinos, dobijena je statistički značajna zavisnost između izmerenih prinosa pšenice i kukuruza na monokulturi, dvopolju i tropolju i modeliranih vrednosti korišćenjem DNDC modela. Analiza gasova staklene bašte pomoću DNDC modela je pokazala veću emisiju CO<sub>2</sub> i NH<sub>3</sub> na parcelama sa kukuruzom u poređenju sa zemljištem nakon gajenja pšenice. Rezultati ispitivanja DNDC modela govore u prilog njegovom korišćenju u našim agroekološkim uslovima u funkciji praćenja dinamike organske materije i regulaciji gasova staklene bašte, dok je njena primena ograničena u proceni prinosa. **Ključne reči:** DNDC, plodoredi, organski ugljenik u zemljištu, prinos



**SIMULATION OF YIELD AND CONTENT OF SOIL ORGANIC CARBON FROM A LONG-TERM EXPERIMENT “CROP ROTATION” USING DNDC MODEL**

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Knowing the dynamics of plant growth and interaction of cropping systems with the environmental factors are the main preconditions for achieving high and stable yields. At the same time, measuring changes in the soil as a result of the cultivation of crops must be an integral part of planning a specific production. The aim of this study was to determine the possibilities of using DNDC (denitrification - decomposition) model in temperate ecological conditions and comparing the measured data for yield and organic matter from long-term experiments “crop rotation” with results obtained by DNDC modeling. The research encompasses four cropping systems that are based on maize and winter wheat. The measured values of deposited soil organic carbon are approximate to those values modeled on two year and three year crop rotation while the monoculture of maize and wheat not correspond with values from DNDC model. When it comes to yield it showed a statistically significant correlation between the measured yields of wheat and maize in monoculture, two- and three year crop rotation and modeled values using DNDC model. Analysis of greenhouse gases by DNDC models showed higher CO<sub>2</sub> and NH<sub>3</sub> on plots with maize in comparison to gasses emission after winter wheat. Our study favor using DNDC model in our agroecological conditions for monitoring the dynamics of organic matter and in the regulation of greenhouse gases. However yield anticipation is more difficult to predict.

**Key words:** DNDC, crop rotation, soil organic carbon, yield



**SADRŽAJ  $\beta$ -GLUKANA U ZRNU NEKIH SORTI JEČMA  
SELEKCIONISANIH U SRBIJI**

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Ovom studijom su obuhvaćeni uzorci zrna tri sorte ozimog ječma (Rekord, Zlatnik i Nonius) koje su selekcionisane u Srbiji. Uzorci su dobijeni sa oglednih polja Centra za strna žita u Kragujevcu. Sadržaj ukupnog  $\beta$ -glukana određivan je spektroskopskom metodom 32–23.01 (AACC, 2003) koristeći Megazyme  $\beta$ -glukan kit (Megazyme International Ireland Ltd., Wicklow, Ireland).  $\beta$ -Glukan je glavni sastojak zrnenog vlakna, koji se nalazi u zrnu ječma i ovsa. Sastoji se od molekula glukoze koji su međusobno vezani  $\beta$ -(1→4) i  $\beta$ -(1→3) vezama. Prednost  $\beta$ -glukana je ta što pozitivno deluje na ljudsko zdravlje uključujući regulaciju holesterola i metabolizma glukoze. Efekat vlakana i  $\beta$ -glukana na osećaj sitosti predmet je više prethodnih studija, ali konsenzus o tome nije postignut. Cilj ovih istraživanja je da se utvrdi sadržaj  $\beta$ -glucana u zrnu ječma na osnovu čega bi se mogli izvesti zaključci i preporuke o količinama koje bi se aplikovale kao poboljšivači različitim komponentama hrane. Sadržaj  $\beta$ -glukana u zrnu ječma sorte Rekord se kretao u granicama od 3,135% do 4,165%, Zlatnika od 3,991% do 4,572% i Nonius od 3,891% do 4,527%. Variranje u sadržaju  $\beta$ -glukana zavisilo je od godine žetve.

**Ključne reči:**  $\beta$ -glukan, sadržaj, ječam

**β-GLUCAN CONCENTRATION IN KERNELS OF BARLEY CULTIVARS  
SELECTED IN SERBIA**

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This study investigated samples of kernels of three winter barley cultivars (*Rekord*, *Zlatnik* and *Nonius*) selected in Serbia. The samples were taken from experimental fields of the Small Grains Research Centre in Kragujevac. The total concentration of β-glucan was analysed by the spectroscopic method 32–23.01 (AACC, 2003) using Megazyme β-glucan mixed linkage assay kit (Megazyme International Ireland Ltd., Wicklow, Ireland). β-glucan is a major constituent of grain fibres, abundant especially in barley and oats. It consists of glucose molecules bound to each other with β-(1→4) and β-(1→3) linkages. The benefits of β-glucan on health, including improvement of cholesterol and glucose metabolism, are well known. Effects of fibre and β-glucan on satiety have been reported in many studies, but no consensus has been reached. The goal of this study was to determine the concentration of β-glucan in barley kernels, to draw some conclusions and make recommendations on rates to be applied for enhancing different components of foodstuffs. The concentration of β-glucan in kernels of the cultivar *Rekord* ranged from 3.135% to 4.165%, in the cultivar *Zlatnik* from 3.991% to 4.572% and in the cultivar *Nonius* from 3.891% to 4.527%. Variations in the β-glucan concentrations depended upon the year of harvest.

**Key words:** β- glucan, concentration, barley

## MOGUĆNOSTI PROIZVODNJE SILAŽE KORIŠĆENJEM ŽETVENIH OSTATAKA OČINSKIH KOMPONENATA HIBRIDA KUKURUZA

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Cilj ovog istraživanja bio je da se ispituju mogućnosti proizvodnje silaže od biljaka bez klipa očinskih komponenata hibrida kukuruza koje inače ostaju neiskorišćene nakon oplodnje i predstavljaju agrozidue. Iskorišćenje ovih žetvenih ostataka u obliku kabaste hrane za ishranu različitih kategorija preživara može biti veoma korisno. Postavljen je ogled sa dve očinske linije hibrida kukuruza i hibridom ZP 544 kao kontrolnim, u dva ponavljanja po principu slučajnog blok sistema i gustom od 50.000 biljaka ha<sup>-1</sup>. Silaža je pripremana od sveže isečenih biljaka bez klipa dve očinske komponente nakon oprašivanja, prema tri različite recepture i smeštena u plastične silose.

Određivani su sadržaj suve materije, prinos zelene mase i prinos suve materije. Pored toga, određivani su sadržaj lignoceluloznih vlakana, svarljivost suve materije, sadržaj amonijačnog azota, sadržaj isparljivih masnih kiselina i pH vrednost silaže.

Dobijeni rezultati su pokazali da se sadržaj NDF-a ispitivanih silaža kretao od 39.81% (ZP 544) do 49.81% (L1+PR+KVS). Sadržaj NDF-a u linijama očeva bio je viši (60,79% u L1 i 58,20% u L2) nego u uzorcima silaže, za razliku od svarljivosti suve materije koja je bila niža (56,74 i 55,96%, respektivno). Sadržaj amonijačnog azota, mlečne kiseline, sirćetne kiseline i pH vrednost varirali su sledećim redom: od 0,018% do 0,035%; 2,57% do 3,96%; 0,53% do 0,68 % i od 3,68 do 3,92. Sve dobijene silaže od očinskih komponenata imale su višu svarljivost suve materije u poređenju sa silažom kontrolnog hibrida ZP 544. Utvrđen je visok procentualni udeo (79,08 do 88,00%) mlečne kiseline u ukupnom sadržaju isparljivih kiselina u silaži, te su ove silaže dobile najveće ocene prema Fligovoj metodi. Na osnovu dobijenih rezultata može se zaključiti da se korišćenjem ostataka očinskih komponenata hibrida kukuruza može dobiti kvalitetna silaža za ishranu preživara.

**Ključne reči:** očinske komponenta hibrida kukuruza, zeleni biljni ostaci, kvalitet silaže, lignocelulozna vlakna, svarljivost suve materije

## POSSIBILITIES OF PRODUCING SILAGE USING PLANT RESIDUES OF MALE COMPONENTS OF MAIZE HYBRIDS

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The aim of this study was to determine the possibilities of silage production from male components of maize hybrids that are generally considered as agricultural residues. Utilization of these postharvest remains as feedstuff for different categories of ruminants can be very beneficial. The two-replicate trial with two male components of maize hybrids and hybrid ZP 544 as a control was set up according to the randomized complete block design and crop density of 50.000 plants ha<sup>-1</sup>. Silage was prepared from fresh cut corn stover after pollination, using three different recipes, and placed in plastic silos.

Dry matter content, fresh biomass yield and dry matter yield were estimated. The content of lignocellulose fibers, dry matter digestibility, contents of ammonium nitrogen, volatile fatty acids and pH values of silage were determined.

Obtained results showed that the NDF content of the observed ZP maize silages varied from 39.81% (ZP 544) to 49.81% (L1+PR+KVS). The content of NDF in male components of maize hybrids was higher (60.79% in L1 and 58.20% in L2) than in the obtained silages, as opposed to the dry matter digestibility which was lower (56.74 and 55.96%, respectively). The content of ammonium nitrogen, lactic acid, acetic acid and pH values ranged from 0.018% to 0.035%; 2.57% to 3.96%; 0.53% to 0.68 % and from 3.68 to 3.92, respectively. All processed silages had higher dry matter digestibility in comparison to silage of the control hybrid ZP 544. A high percentage (79.08 to 88.00%) of lactic acid in the total content of acids in silages of the processed maize residues was determined; hence these silages had the highest scores according to the Flieg method. Based on obtained results, the high quality feedstuff can be produced by the use of the processed residues of male components of maize hybrids.

**Key words:** male components of maize hybrids, plant residues, silage quality, lignocellulose fibers, dry matter digestibility

## ULOGA I ZNAČAJ SKUPA „OTVORENI DANI BIODIVERZITETA“

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Zbog sve veće potrebe da se ukaže na činjenicu da je našu biološku raznolikost, nužno održati i unaprediti, početkom 2011. godine krenulo se sa idejom da se organizuje manifestacija koja će, kroz različite aspekte delovanja, skretati pažnju javnosti na značaj očuvanja pre svega biljnih ali i ostalih prirodnih resursa.

Tako je nastao naučno-stručni skup „Otvoreni dani biodiverziteta“ u okviru koga se prezentuju aktuelne teme iz oblasti organske proizvodnje i biodiverziteta. Skup prati i niz različitih aktivnosti koje se odvijaju putem predavanja, radionica, televizijskih nastupa, objavljivanjem tekstova i priloga u štampanim i elektronskim medijima i sl. Region u kome se dosad održavao skup je Južni Banat (Vojvodina, Srbija). To je region tipičan za intenzivnu, pre svega ratarsku proizvodnju, koji je nebrigom poljoprivrednih proizvođača u značajnom delu biljne flore promenjen. Na skupu, od organizatora, preko predavača i prezentera, do domaćina i gostiju, sve spaja isti cilj, a to je da kroz svoj angažman pokušaju da daju jasnu poruku da se „sačuva biološka raznovrsnost kako bi se očuvala i zaštitila i životna sredina“. Ovu poruku šalju poljoprivredni proizvođači, ekolozi, članovi različitih vrsti udruženja, istraživači, naučnici i svi ostali ljudi dobre volje.

U dosadašnjih pet skupova, svojim učešćem u programskom delu, skup su upriličili stručnjaci iz različitih oblasti. Pomenimo samo neke od oblasti: ekologija, poljoprivreda, zaštita životne sredine, biologija i druge. Kako je poljoprivreda, jedan (prema autorima ovog teksta) od naših najvećih remetilaca postojećeg biodiverziteta, tako su na prethodnim skupovima teme iz ove oblasti bile najčešće obrađivane. Predstavljanje tema učesnicima skupa dešavalo se kroz prezentacije i predavanja u salama i na otvorenom, a ostalim zainteresovanim putem elektronskog i štampanog zbornika referata pod nazivom „Organska proizvodnja i biodiverzitet“, kojih je do sad izašlo ukupno četiri.

**Ključne reči:** naučno-stručni skup, organska proizvodnja, biodiverzitet, predavanja, zbornik referata

## THE ROLE AND IMPORTANCE OF THE MEETING OF „OPEN DAYS BIODIVERSITY“

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Due to the increasing need to emphasize the fact that our biodiversity, it is necessary to maintain and improve, at the beginning of 2011 we started with the idea to organize an event that will explore different aspects of operation to divert public attention to the importance of preserving primarily plant as well as other natural resources.

That is how the scientific expert meeting “Open Days of Biodiversity”, presenting current topics in the field of organic production and biodiversity. This meeting also monitors a variety of activities that take place through lectures, workshops, television appearances, the publications of texts and articles in print and electronic media and the like. The region where the meeting was previously held was South Banat (Vojvodina, Serbia). It is a region typical for intensive, primarily crop production, which has had a significant part of its plant life changed due to the farmers’ neglect. At the meeting, from the organisers through the lecturers and presenters to the host and the guests, all are connected by to the same goal, and the goal is to attempt to convey a clear message through their engagement that biological diversity “should be preserved in order to preserve and protect the environment”. This message is sent by farmers, environmentalists, the members of a variety of associations, researchers, scientists and all other people of goodwill. The past five meetings were marked by the participation of experts in various fields as part of the academic programme. The following are just some of the areas: ecology, agriculture, environmental protection, biology and others. Since agriculture (according to the authors of this text) stands as one of our biggest disturbing factors in the existing biodiversity, an thus, at the previous meetings, the topics from this field were most often discussed. The topics were presented to the participants through presentations and lectures in halls and outdoors, whereas other stakeholders were acquainted with them through the electronic and printed thematic proceedings titled “Organic Production and Biodiversity”, four of which have so far been published.

**Key words:** scientific-expert meeting, organic production, biodiversity, lectures, thematic proceedings

## ZNAČAJ VIJABILNOSTI SEMENA UZORAKA KUKURUZA IZ BANKE GENA U OČUVANJU GENETIČKOG INTEGRITETA SORTE

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U procesu regeneracija uzoraka koji se čuvaju u bankama biljnih gena izuzetno je važno pravilno proceniti momenat regeneracije, iz više razloga. S obzirom da je to skup proces, a nosi i rizike narušavanja početne varijabilnosti uzorka, treba ga raditi što redje. Takodje, potrebno je voditi računa i o gubitku vijabilnosti tokom perioda dugog čuvanja. Deo gubitka diverziteta je prouzrokovan hipotetički, starenjem semena koje je rezultiralo u mrtvo seme. Sa ciljem da se, na osnovu morfoloških parametara po CIMMYT/IBPGR deskriptoru, utvrdi gubitak diverziteta u procesu čuvanja semena i regeneracije, odabrane su tri populacije kukuruza (ID86, ID768 i ID2026) koje su se razlikovale po tipu zrna (tvrđunac, poluzuban i zuban) i procentu klijavosti semena pre regeneracije (63, 59, 72%, respektivno). Utvrđena laboratorijska klijavost za sve tri sorte je bila ispod nivoa standarda koji se primanjuju u bankama gena. Pored laboratorijskog određivanja klijavosti, procenjena je i klijavost u polju. Na osnovu t testa, upoređivani su parovi morfoloških osobina biljaka iz starog i novog semena iste populacije. Kod populacije ID768, od posmatranih 16 osobina, 11 je ispoljilo statistički značajne razlike. Najmanji broj osobina (tri), sa ispoljenim statistički značajnim razlikama utvrđen je kod populacije ID2026. Ovi rezultati su u skladu sa rezultatima ispitivanja vijabilnosti, odnosno klijavosti pre regeneracije. Zaključeno je da je kod populacija ID86 i ID768, usled regeneracije nakon znatnog smanjenja klijavosti u period čuvanja, došlo do genetičkog drifta, a time i do narušavanja genetičkog integriteta sorti.

**Ključne reči:** genetički drift, dugoročno čuvanje semena, *Zea mays* L.



## THE IMPORTANCE OF SEED VIABILITY OF GENE BANK MAIZE ACCESSIONS FOR GENETIC INTEGRITY PRESERVATION

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In the process of regeneration of samples stored in plant gene bank, the accurate estimation of regeneration timing is of great importance, for several reasons. Since this is money consuming process, bearing the risks of the initial samples variability distortion, it should be conducted as rare as possible. In addition, it is necessary to consider the loss of viability during a long-term storage. A part of the loss variability hypothetically caused by ageing, results in seed death. The level of diversity loss in process of seed storage and regeneration was determined by morphological parameters according to CIMMYT/IBPGR descriptors, in three maize landraces (ID86, ID768 i ID2026). Those landraces differed in kernel type (flint, semident and dent) and germination rate prior to regeneration (63, 59, 72%, respectively). The estimated germination rate under laboratory conditions was below the standards for gene bank management. In addition, the seed testing was done in field conditions. Morphological parameters of plants obtained from the same landraces originated prior and after the regeneration were compared using *t* Test. In ID768 landrace, 11 out of 16 observed parameters exhibited statistically significant differences, whereas in ID2026, only three parameters were statistically significant. The results obtained indicated high correlation between seed viability loss and genetic integrity distortion. It could be concluded that in landraces ID86 and ID768, seed viability decrease as the consequence of long-term storage, resulted in genetic drift and their genetic integrity distortion.

**Key words:** genetic drift, long-term storage, *Zea mays* L.



**EFEKAT RAZLAGANJA GLIFOSATA PRODUKTIMA LR GENA NA  
RAZVOJ PUCCINIA TRITICINA**

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Jedanaest izogenih linija pšenice različitih po genima za otpornost prema prouzročivaču lisne rđe gajene su u staklari a glifosat u propisanoj dozi primenjen dva puta u danu kada su izbili drugi listovi. Nakon deset dana izogene linije su podeljene u četiri grupe na osnovu razlike redukcija sabranih dužina nadzemnih delova glifosatom izraženih u procentima između ponavljanja prirodno i permanentno veštački osvetljenih: -6-10% (Lr 1, Lr 15, Lr 21), -12-15% (Lr 16, Lr 19, Lr 21, Lr 29) i -29%, Lr 24. Navedeni rasno specifični Lr geni su izazvali ubranu degradaciju za razliku od Lr 2a, Lr 9 i nespecifičnog Lr 22b na osnovu obrnutih rezultata (6-9%). U sledećem ogledu prvi listovi su inokulisani izolatom *Puccinia triticina* dok je polovina biljaka jednom tretirana glifosatom u propisanoj dozi dva dana pre inkubacije u vlažnoj komori. Gajene su pri temperaturi vazduha oko 20°C sedam dana tokom marta a posle tri dana izložene podnevnom svetlosnom i temperaturnom stresu i preko 30°C. Tako, primećeno je relativno pojačano žućenje izogenih linija iz prve tri grupe ukazujući da su produkti Lr gena bili aktivni ne samo oko mesta infekcije. Produžen latentni period (vreme između infekcije i fruktifikacije, LP) za oko jedan dan je bio na kontrolnim Lr 1, Lr 2a, Lr 9, Lr 16, Lr 19 i Lr 29 linijama. Preko glifosata njihov LP je bio produžen za oko jedan, drugih sposobnih da ubrzano razgrađuju herbicid za pola dana a kod ostalih nije bilo značajnih razlika. Dakle, totalni herbicid je ispoljio ograničeno dejstvo na miceliju *Puccinia triticina* kao što je primećeno ranije za *Pyrenophora tritici repentis* ali slabog uticaja na fruktifikaciju a očekivano na travnim korovima takođe. Šira primena na sortama s Lr genima koje ga ubrzano razlažu je rizična usled zavisnosti efekta od vremenskih prilika a može biti izbegnuta početkom maja s obzirom na karakteristike nekih.

**Ključne reči:** glyphosat tolerantnost, *Puccinia triticina*, Lr geni

## EFFECT OF GLYPHOSATE DEGRADATION BY LR GENES ON *Puccinia triticina* DEVELOPMENT

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Eleven wheat isogenic lines different by leaf rust reducing genes (Lr NILs) were grown in glasshouse and glyphosate as labeled foliar applied two times at day when second leaves started to appear. Ten days later, NILs were divided in four groups according to the difference in growth reduction of assumed underground plant part lengths presented in percents between replications grown under natural and permanent artificial light: -6-10% (Lr 1, Lr 15, Lr 21), -12-15% (Lr 16, Lr 19, Lr 21, Lr 29) and -29% of Lr 24. Such those race specific Lr genes were able to accelerate degrade herbicide for the difference of Lr 2a and Lr 9 and nonspecific Lr 22b by opposite results (6-9%). In another trial, first leaves were infected with *Puccinia triticina* isolate while half of the plants were once treated by glyphosate in labeled dose two days before incubation in humid chamber. Grown were at air temperature around 20°C for seven days in March and after three days stressed by intensive light and heat over 30°C at noon. Increased was relative yellowing at NILs from first three groups meaning that products of Lr genes were active not only around infection sites. At controls, the prolonged latency period (time between infection and fructification, LP) for one day was recognized at Lr 1, Lr 2a, Lr 9, Lr 16, Lr 19 and Lr 29 NILs. By the glyphosate their LP was prolonged for one more, of others able to accelerate degrade herbicide half of day while at rest there was no significant changes. Herbicide had limited influence on mycelia of *Puccinia triticina* as was to *Pyrenophora tritici repentis* but without significant effect on fructification, all expected on weed grasses also. Wide application on wheat varieties is risky while in May focusing some of Lr genes characters possible.

***Key words:*** glyphosate tolerance, *Puccinia triticina*, Lr genes **UTICAJ SPOLJNE**

## ZAKOROVLJENOST ALTERNATIVNIH VRSTA OZIME PŠENICE U ZAVISNOSTI OD NAČINA ĐUBRENJA

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Alternativne ratarske biljke u svetu i kod nas gaje se na malim površinama, ali imaju veliki značaj u ishrani ljudi, domaćih i gajenih životinja, kao i u raznim granama industrije. Većina ovih vrsta sadrži materije koje se koriste u farmaceutskoj industriji ili u narodnoj medicini za proizvodnju pomoćnih lekovitih sredstava. U okviru sistema organske proizvodnje, među alternativnim vrstama biljaka, najzastupljenija su žita.

Jedan od najznačajnijih problema u organskim sistemima gajenja jesu korovi i njihov uticaj na kvalitet i kvantitet prinosa po jedinici površine. Cilj ovog rada jeste da se ispita zakorovljenost različitih alternativnih vrsta ozime pšenice (bambi-*Triticum aestivum* L. ssp. *compactum*, krupnik Nirvana-*Triticum aestivum* L. ssp. *spelta*, durum pšenica Durumko-*Triticum durum* L. i jedna sorta namenjena intenzivnijim sistemima gajenja NS 40S-*Triticum aestivum* L. ssp. *vulgare*) u zavisnosti od načina đubrenja. Ispitivanja su obavljena na eksperimentalnom oglednom dobru Poljoprivrednog fakulteta "Radmilovac". Usevi su gajeni u prirodnom vodnom režimu, na zemljištu tipa izluženi černoze.

Pored kontrolne varijante ispitivane su još dve varijante đubrenja: organsko đubrivo u jesen zajedno sa predsetvenom pripremom zemljišta i mikrobiološko đubrivo u prihranjivanju i druga varijanta samo mikrobiološko đubrivo u proleće. Primena organskih đubriva u kombinaciji sa mikrobiološkim, u odnosu na samu primenu mikrobiološkog đubriva, dovela je do povećanja zakorovljenosti svih alternativnih vrsta, ali ne i intenzivne sorte NS 40s. Najveća zakorovljenost svih ispitivanih vrsta ustanovljena je na kontrolnoj varijanti, bez primene đubriva.

**Ključne reči:** alternativna žita, ozima pšenica, đubriva, zakorovljenost

## WEED INFESTATION OF ALTERNATIVE TYPES OF WINTER WHEAT DEPENDING ON METHODS OF FERTILIZATION

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Alternative crop plants in the world and in our country are grown in small areas, but are of great importance in the diet of humans, domestic and cultivated animals, as well as in various industries. Most of these species contain substances that are used in the pharmaceutical industry or in alternative medicine for the production of medicinal resources. In organic production systems, most are grown alternative types of grain.

The major problems in organic growing systems are weeds and their impact on the quality and quantity of yield per unit area. Three of them were chosen for specific usage in food technology compact wheat Bambi - *Triticum aestivum* L. ssp. *compactum*, spelt Nirvana (*Triticum aestivum* L. ssp. *spelta*), durum wheat Durumko- (*Triticum durum* L.), and one which leads as a genotype for intensive conventional common wheat production in Serbia - NS 40S (*Triticum aestivum* L. ssp. *vulgare*) in dependent on method of fertilization. The investigations were carried out on Experimental field of Faculty of Agriculture "Radmilovac". Crops are grown in non-irrigation regime, on leached chernozem.

Besides the control variant were examined two variants of fertilization: organic fertilizer in the fall together with soil preparation and microbiological fertilizer in top dressing and second variant only microbiological fertilizer in the spring. Combination with organic and microbiological fertilizer have lower effect on the weed infestation of different species alternative small grains compared with only organic fertilizers, but no by high input genotype NS40s. The highest weed infestation of all investigation species was found in the control treatment, without fertilizers.

**Key words:** fertilizers, alternative small grains, weed infestation, winter wheat

**ARUNDO DONAX L. - NOV BIOENERGETSKI USEV**Željko Dželetović<sup>1</sup>, Nevena Mihailović<sup>1</sup>, Gordana Andrejić<sup>1</sup><sup>1</sup>INEP - Institut za primenu nuklearne energije, Univerzitet u Beogradu, Srbija

Meditranska trska (*Arundo donax* L.) je višegodišnja visoko produktivna C<sub>3</sub>-trava iz fam. *Poaceae*, koja potiče iz šireg područja Mediterana. Ubraja se u grupu tzv. "bioenergetskih useva" druge generacije. Mediteranska trska predstavlja biljnu vrstu podesnu za intenzivno gajenje, koja svojom biomasom može omogućiti uspešnu supstituciju postojećih energetskih izvora sa novim, obnovljivim izvorima, s ciljem smanjenja emisija gasova staklene bašte.

Rizomi ili mikro-propagirane biljčice se sade u proleće. Intenzivan rast useva se odvija tokom leta, obrazujući veliku nadzemnu biomasu i snažan i dubok korenov sistem. Krajem jeseni ili tokom zime, kosi se celokupan nadzemni deo, koji može da se: balira, briketira, peletira, koristi za direktno sagorevanje u kotlovima ili kao silaža za biogasna postrojenja.

Ponovni rast useva (nicanje stabala) počinje sledećeg proleća, kada temperature zemljišta dostignu >7°C. Jednom zasnovana kultura mediteranske trske opstaje 12-15 godina, proizvodeći prosečno >20 tona suve materije ha<sup>-1</sup> godišnje.

Meditranska trska nije zahtevna u pogledu zemljišnih uslova, tako da se uspešno može gajiti i na tzv. "marginalnim zemljišnim površinama" (IV-VIII bonitetne klase). Dugogodišnjim gajenjem na istoj površini biljke korenovima pozitivno utiču na kvalitet zemljišta, obogaćujući ga organskom materijom. Zahvaljujući snažnom korenovom sistemu, ovaj usev dobro podnosi kratkotrajnu sušu.

Usev mediteranske trske se može koristiti i za fitostabilizaciju oštećenih i teškim metalima zagađenih zemljišnih površina (kao što su npr. rudnička zemljišta). Ova biljka usvaja teške metale, ali ih iz korena praktično ne sprovodi u stable i listove.

Zbog relativno jednostavne agrotehnike i osrednjih potreba u hranivima, ovaj bioenergetski usev može biti veoma interesantan za gajanje u nizijskom i brdskom području Srbije.

**Ključne reči:** mediteranska trska, bioenergetski usev, biomasa

**ARUNDO DONAX L. - NOVEL BIOENERGY CROP**Željko Dželetović<sup>1</sup>, Nevena Mihailović<sup>1</sup>, Gordana Andrejić<sup>1</sup><sup>1</sup>INEP - Institute for the Application of Nuclear Energy, University of Belgrade, Serbia

Giant reed (*Arundo donax* L., *Poaceae*) is a perennial, highly productive C<sub>3</sub>-grass, originating from wider Mediterranean region. It belongs to the group of so-called second generation “bioenergy crops”. Giant reed represents a plant species convenient for intensive culture, which by its biomass may enable a successful substitution of actual energy sources by new, renewable sources, a plant which will decrease the emission of the “greenhouse gas”.

The rhizomes or micro-propagated plantlets are planted in the spring. Intensive growth of the crop takes place during the summer, forming a large aboveground biomass and strong and deep root system. During late autumn or winter, the entire aboveground part is mowed and subsequently baled, briquetted or pelleted, used for direct combustion in boilers or as silage for biogas plants.

Regrowth of crops (stem sprouting) starts in the following spring when soil temperatures reach >7°C. Once established giant reed crop persists 12 to 15 years, producing an average of >20 t of dry matter ha<sup>-1</sup> per year.

Giant reed is not demanding in the terms of soil conditions, it may be grown successfully on so-called “marginal lands” (land capability classes IV-VIII). After many years of cultivation on the same land, plant roots have a positive impact on the quality of the soil, enriching it with organic matter. Thanks to the strong root system, this crop tolerates short-term drought well. Giant reed can be used for phytostabilization of damaged and heavy metal contaminated land areas (such as, for example, minesoils). This plant accumulates heavy metals, but keeps them mainly in roots, without transporting them to the leaves and stem.

Due to the comparatively simple agricultural technology and moderate needs in nutrients, this bioenergy crop can be very interesting for the cultivation of lowland and upland areas of Serbia.

**Key words:** giant reed, bioenergy crop, biomass

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